

Project
Manual

Contract 1-2009

**Phase 1
Improvements—
Sewage Treatment
Plant No. 2**

City of
Washington, IL

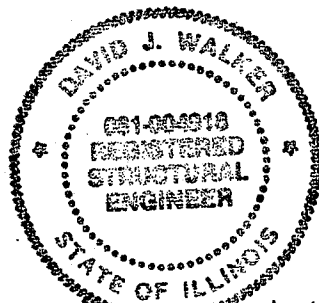
June 2009

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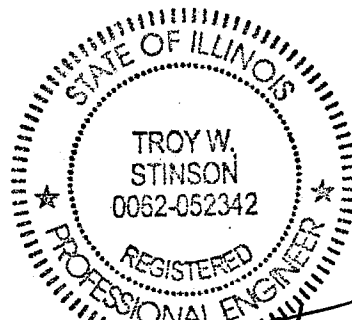
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PROJECT MANUAL

PHASE 1 IMPROVEMENTS-
SEWAGE TREATMENT PLANT NO. 2
CONTRACT 1-2009
CITY OF WASHINGTON, ILLINOIS



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Exp. 11/30/2010



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June 2009



SECTION 00010

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CITY OF WASHINGTON, ILLINOIS

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BIDDING AND CONTRACTING REQUIREMENTS

SECTION 00100

ADVERTISEMENT TO BID

PHASE 1 IMPROVEMENTS–
SEWAGE TREATMENT PLANT NO. 2
CONTRACT 1-2009
CITY OF WASHINGTON, ILLINOIS

The City of Washington, Illinois will receive sealed Bids for improvements to Sewage Treatment Plant No. 2 until 2 P.M., local time, August 5, 2009, at City Hall, 115 West Jefferson Street, Washington, IL 61571, at which time the Bids will be publicly opened and read aloud.

The Work includes the construction of additional influent pumps, screening building, oxidation ditch, final clarifiers, chlorine contact tank, biosolids pumping building, aerobic digestion modifications, and additional sludge dewatering beds. The project also includes associated structural, mechanical, electrical, SCADA, and other related work.

Bids are to be addressed to the City of Washington, 115 West Jefferson Street, Washington, IL 61571, and shall be marked "Sealed Bid–Phase 1 Improvements–Sewage Treatment Plant No. 2–Contract 1-2009."

Bidding Documents may be obtained from the Issuing Office which is Illinois Blueprint Corporation, 800 Southwest Jefferson Avenue, Peoria, IL 61605-3943. A nonrefundable fee of \$80 will be required for each paper copy of Bidding Documents. Overnight mailing of Bidding Documents will not be provided.

Bidding Documents may be examined at the offices of the City of Washington, Illinois, and are on file at the following locations:

Greater Peoria Contractors and Suppliers Association, Inc. Plan Room Services, 1811 Altorter Drive, Peoria, IL 61615 (309) 692-5710

Bidders who submit a Bid must be a Plan Holder of record at the Issuing Office. Bids from Bidders who are not on the Plan Holders List may be returned as not being responsive.

Plan Holders are requested to provide an e-mail address if they wish to receive addenda and other information electronically from the Issuing Office. Plan Holders are requested to designate whether they are a prime contractor, subcontractor, or supplier if they want this information posted on the project Plan Holders List.

No Bid will be received unless accompanied by a cashier's, certified or bank check, or a Bid Bond equal to at least 10 percent of the maximum Bid payable to the OWNER as a guarantee that after a Bid is accepted, Bidder will execute and file the Agreement and 100% Performance and Payment Bonds within 15 days after the Notice of Award.

Any contract or contracts awarded under this Advertisement to Bid are expected to be funded in part by a loan from the Illinois Environmental Protection Agency (Illinois EPA). Neither the State of Illinois nor any of its departments, agencies, or employees is or will be a party to this Advertisement to Bid or any resulting contract. The procurement will be subject to regulations contained in the Procedures for Providing Financial Assistance from the Water Pollution Control Loan Program under the American Recovery and Reinvestment Act of 2009 (ARRA), the Davis-Bacon Act (40 USC 276a through 276a-5) as defined by the United States Department of Labor, and the Employment of Illinois Workers on Public Works Act (30 ILCS 570). This procurement is

also subject to the loan recipient's policy regarding the increased use of disadvantaged business enterprises. The loan recipient's policy requires all bidders to undertake specified affirmative efforts at least sixteen (16) days prior to bid opening. Bidders are also required to comply with the President's Executive Order No. 11246, as amended. The requirements for bidders and contractors under this order are explained in 41 CFR 60-4." And finally, bidders are required to comply with Section 1605 of the ARRA, which specifies that all iron, steel and manufactured goods used in the project are produced in the United States.

The City of Washington, Illinois reserves the right to reject any or all Bids, to waive any technicality, and to accept any Bid which it deems advantageous. All Bids shall remain subject to acceptance for 85 days after the time set for receiving Bids.

Notwithstanding any other provisions to the contrary, all bids are subject to Section 5/8-9-1 of the Illinois Municipal Code (65 ILCS 5/8-9-1), including the right, in the sound discretion of the Corporate Authorities of the City, to award the contract to the lowest responsible bidder, who might be other than the lowest bidder. In order to determine the lowest responsible bidder, the City may require the lowest bidder to submit additional information as to the lowest bidder's qualifications and also participate in interviews with City staff and committees.

A prebid conference will be held at 1 P.M., local time, on July 15, 2009, at Sewage Treatment Plant No. 2, 955 Ernest Street, Washington, IL 61571.

Representatives of OWNER and ENGINEER will be present to discuss the project. Bidders are encouraged to attend and participate in the conference. The Issuing Office will transmit to all prospective Bidders of record such Addenda as ENGINEER considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

The Strand Associates project manager is Troy W. Stinson, P.E., and can be contacted at Strand Associates, Inc., 910 West Wingra Drive, Madison, WI 53715, (608) 251-4843 regarding the project.

Published by the authority of the City of Washington, Illinois
Patricia S. Brown, City Clerk

Dated at the City of Washington, Illinois
June 17, 2009 and June 24, 2009

END OF SECTION

SECTION 00200

INSTRUCTIONS TO BIDDERS

- A. These Instructions to Bidders establish requirements for Bidding and Award of Contract.
- B. These articles are not necessarily numbered consecutively.
- C. Table of Contents
 - 1. Defined Terms
 - 2. Copies of Bidding Documents
 - 3. Qualifications of Bidders
 - 4. Examination of Bidding Documents, Other Related Data and Site
 - 5. Prebid Conference
 - 6. Site and Other Areas
 - 7. Interpretations and Addenda
 - 8. Bid Security
 - 9. Contract Times
 - 10. Liquidated Damages
 - 11. Substitute or "Or Equal" Items
 - 12. Subcontractors, Suppliers, and Others
 - 13. Bid
 - 14. Basis of Bid; Evaluation of Bids
 - 15. Submission of Bids
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 - 20. Contract Security and Insurance
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 - 26. Certification Regarding Compliance with Criminal Code
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 - 28. Non-Collusion and Certification Statement
 - 29. Certification of Non-Segregated Facilities
 - 30. Utilization of Disadvantaged Business Enterprise
 - 31. Affirmative Action Ensure Equal Opportunity Employment
 - 32. American Recovery and Reinvestment Act

ARTICLE 1-DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and the Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below which are applicable to both the singular and plural thereof:

- A. Issuing Office—The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

ARTICLE 2—COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Advertisement or Invitation to Bid may be obtained from the Issuing Office.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither OWNER nor ENGINEER assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 OWNER and ENGINEER in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder's qualifications to perform the Work, within five days of OWNER's request, Bidder shall submit written evidence such as financial data, previous experience, present commitments and other such data as may be called for below.

3.02 Bidder must be prepared to submit evidence of Bidder's qualifications to do business in the state where the Project is located prior to award of the Contract.

3.03 Bidders shall submit the documentation listed in Paragraph 7.01 of the Bid Form (Section 00400).

ARTICLE 4—EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA AND SITE

4.01 Subsurface and Physical Conditions

A. The Supplementary Conditions identify, if any,:

1. Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that ENGINEER has used in preparing the Bidding Documents.

2. Those drawings of physical conditions in or relating to existing surface and subsurface structures at or contiguous to the Site (except Underground Facilities) that ENGINEER has used in preparing the Bidding Documents.

B. Copies of reports and drawings referenced in Paragraph 4.01.A, which are not included with the Bidding Documents, will be made available by OWNER to any Bidder on request. Reports and drawings, whether included in the Bidding Documents or not, are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.02 of the General Conditions has been identified and established in Paragraph 4.02 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.02 Underground Facilities

A. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are based upon information and data furnished to OWNER and ENGINEER by owners of such Underground Facilities, including OWNER, or others.

4.03 Hazardous Environmental Condition

A. The Supplementary Conditions identify, if any, those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, that ENGINEER has used in preparing the Bidding Documents.

B. Copies of reports and drawings referenced in Paragraph 4.03.A will be made available by OWNER to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.06 of the General Conditions has been identified and established in Paragraph 4.06 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.04 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work appear in Paragraph 4.06 of the General Conditions.

4.05 On request, OWNER will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.

4.06 Reference is made to Article 7 of the Supplementary Conditions for the identification of the general nature of other work that is to be performed at the Site by OWNER or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, OWNER will provide to each Bidder for examination access to or copies of Contract Documents (other than portions thereof related to price) for such other work.

4.07 It is the responsibility of each Bidder before submitting a Bid to:

A. examine and carefully study the Bidding Documents, including any Addenda and the other related data identified in the Bidding Documents and any Addenda;

B. visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

C. become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work;

D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions, and (2) reports and drawings of Hazardous Environmental Conditions at the Site which have been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions;

E. obtain and carefully study (or accept consequences of not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods,

techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto (Bidder may want to engage the services of a specialist or specialists to help Bidder evaluate these physical conditions and their impact on the work enumerated above);

F. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents;

G. become aware of the general nature of the work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Bidding Documents;

H. correlate the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents;

I. promptly give ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by ENGINEER is acceptable to Bidder; and

J. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

4.08 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolution thereof by ENGINEER is acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the work.

ARTICLE 5—PREBID CONFERENCE

5.01 A prebid conference will be held at 1 P.M., local time on July 15, 2009, at Sewage Treatment Plant No. 2, 955 Ernest Street, Washington, IL 61571.

Representatives of OWNER and ENGINEER will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. ENGINEER will transmit to all prospective Bidders of record such Addenda as ENGINEER considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 6—SITE AND OTHER AREAS

6.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by OWNER unless otherwise provided in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment are to be obtained and paid for by CONTRACTOR.

ARTICLE 7-INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to ENGINEER in writing. Interpretations or clarifications considered necessary by ENGINEER in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Issuing Office as having received the Bidding Documents.

7.02 All requests for interpretation must be received at least seven days prior to the day set for receiving Bids. Addenda will be mailed not later than five days prior to the day set for receiving Bids. Failure of any Bidder to receive any such Addendum or interpretation shall not relieve such Bidder from any obligations under the Bid as submitted. All Addenda so issued shall become part of the Contract Documents.

7.03 Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.04 Addenda may also be issued to clarify, correct, or change the Bidding Documents as deemed advisable by OWNER or ENGINEER.

7.05 Receipt of all addenda must be acknowledged in space provided in the Bid.

ARTICLE 8-BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to OWNER in an amount of 10 percent of the Bidder's maximum Bid price and in the form of a cashier's, certified, or bank check or a Bid Bond (on form attached) issued by a surety meeting the requirements of Paragraphs 5.01 and 5.02 of the General Conditions.

8.02 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, OWNER may annul the Notice of Award and the Bid security of the Bidder will be forfeited.

8.03 Bid security of Bidders will be retained unless requested to be returned and will not be returned until after Contract has been awarded or until the Bid hold period expires.

ARTICLE 9-CONTRACT TIMES

9.01 The numbers of days within which, or the dates by which, milestones, if any, are to be achieved and the Work is to be substantially completed and ready for final payment are set forth in the Agreement (or incorporated therein by reference to the attached Bid Form).

ARTICLE 10-LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 11-SUBSTITUTE OR "OR EQUAL" ITEMS

11.01 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of Equipment Alternatives listed in the Lump Sum Base Bid or without consideration of possible substitute or "or equal" items. Whenever it is specified or described in the Bidding Documents that an Equipment Alternative listed in the Lump Sum Base Bid or that a substitute or "or equal" item of material or equipment may be furnished or used by CONTRACTOR if acceptable to ENGINEER, application for such acceptance will not be considered by ENGINEER until after the Effective Date of the Agreement.

11.02 As an exception to the above, there will be no substitutions or "or equal" items considered for Base Bid or Alternative Bid designated items that are included in the Contract award.

ARTICLE 12—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

12.01 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to OWNER in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to OWNER a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entities if requested by OWNER. If OWNER or ENGINEER, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity may, before the Notice of Award is given, request the apparent successful Bidder to submit an acceptable substitute without an increase in the Bid.

12.02 If apparent Successful Bidder declines to make any such substitution, OWNER may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for the forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity listed and against which OWNER or ENGINEER makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to OWNER and ENGINEER subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06.B of the General Conditions.

12.03 CONTRACTOR shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom CONTRACTOR has reasonable objection.

12.04 In contracts where the Contract Price is on the basis of cost-of-the-work plus a fee, the apparent successful Bidder, prior to the Notice of Award, shall identify in writing to OWNER those portions of the work that such Bidder proposes to subcontract and after the Notice of Award may only subcontract other portions of the work with OWNER's written consent.

ARTICLE 13—BID

13.01 The Bid Form is included with the Bidding Documents.

13.02 All blanks on the Bid Form must be completed by printing in ink or by typewriter and the Bid signed in ink. A Bid price shall be indicated for each section, Bid item, alternative, adjustment unit price item or unit price item listed therein, or the words "No Bid," "No Change," or "Not Applicable" entered. Erasures or alterations shall be initialed in ink by the person signing the Bid Form.

13.03 A Bid by a corporation shall be executed in the corporate name by the president or vice president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

13.04 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown below the signature.

13.05 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown below the signature.

13.06 A Bid by an individual shall show the Bidder's name and official address.

13.07 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid form. The official address of the joint venture shall be shown below the signature.

13.08 All names shall be printed in ink below the signatures.

13.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid form.

13.10 The address and telephone number for communications regarding the Bid shall be shown.

13.11 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of the Contract. Bidder's state contractor license number for the state of the Project, if any, shall also be shown on the Bid Form.

13.12 All Bids shall be signed in the presence of and be notarized by a Notary Public or other Officer authorized to administer oaths.

ARTICLE 14—BASIS OF BID; EVALUATION OF BIDS

14.01 Lump Sum Base Bid with Bid Alternatives and Equipment Alternatives

A. Bidders shall submit a Bid on a lump sum base bid basis. The price for all base bid items shall be included in the lump sum base bid. Bidder shall include a separate bid price for each bid alternative described in the Bidding Documents and as provided for in the Bid Form. The price for each bid alternative will be the amount to be added to or deducted from the price of the base bid if OWNER selects the bid alternative.

B. Bidder shall include a separate price for each equipment alternative item listed in the Bid. Bidder may bid other equipment alternatives by writing in the alternative's name and the amount to be added to or deducted from the price of the base bid equipment item.

C. Failure to provide a separate price for each bid alternative and for each base bid equipment item may result in OWNER declaring Bid non-responsive. Consideration of bid alternatives will be made prior to the Notice of Award. Consideration of equipment alternatives will be made by OWNER within 60 days after the Effective Date of the Agreement.

D. Bid alternative and equipment alternative prices shall include the entire cost of the bid alternatives and equipment alternatives, including cost for engineering changes to accommodate the bid alternatives and equipment alternatives, and additional work to be performed which is not shown on the Drawings but which is required as a result of selection of the bid alternative and/or equipment alternative.

14.02 Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.

14.03 The Bid price shall include such amounts as the Bidder deems proper for overhead and profit on account of cash allowances, if any, named in the Contract Documents as provided for in Paragraph 11.02 of the General Conditions. The final Contract Price will be adjusted to reflect actual costs on account of cash allowances. No allowances for temporary services are provided. Bidder shall include costs for temporary services in Contract Price.

14.04 The following cash allowances shall be included in the Bid for the Contract(s).

Unsuitable Foundation Material for Structures and Roads	Section 02222–Excavation, Fill, Backfill and Grading

Unsuitable Foundation Material for Utility Trenches	Section 02222–Excavation, Fill, Backfill and Grading

Service Entrance Utility Charges	Section 16420–Electrical Service System

Computer Hardware and Software	Section 16940–Controls and Instrumentation

14.05 Bids prices will be compared after adjusting for differences in the time designated by Bidders for Substantial Completion. The adjusting amount will be determined at the rate set forth in the Contract Documents for liquidated damages for failing to achieve Substantial Completion for each day before or after the desired date appearing in Paragraph 9.01.

ARTICLE 15–SUBMISSION OF BIDS

15.01 Bids will be received for all divisions of the Specifications and all other provisions of the Bidding Documents.

15.02 Bidder is furnished one copy of the Bidding Documents with one separate unbound copy of the Bid Forms and the Bid Bond. The Bidding Documents may be retained by Bidder. The unbound copy of the Bid Forms is to be completed and submitted with the Bid security along with any data required by the Bidding Documents to be attached to and made a condition of the Bid. Additional copies may be obtained from the Issuing Office.

15.03 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Advertisement or Invitation to Bid and shall be enclosed in an opaque sealed envelope, plainly marked with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If the Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate envelope plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to place indicated in the Advertisement or Invitation to Bid. No relief will be provided for a mailed Bid not being received by the prescribed time. No Bid will be considered which is received after the time set for receiving Bids.

ARTICLE 16–MODIFICATION AND WITHDRAWAL OF BIDS

16.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time set for receiving Bids.

ARTICLE 17--OPENING OF BIDS

17.01 Bids will be opened at the time and place set for receiving Bids indicated in the Advertisement or Invitation to Bid and, unless obviously nonresponsive, read aloud publicly. An abstract of the amounts of the base bids and major alternatives and components, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18--BIDS TO REMAIN SUBJECT TO ACCEPTANCE

18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but OWNER may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19--AWARD OF CONTRACT

19.01 OWNER reserves without limitation the right to reject any or all Bids, to waive any and all informalities not involving price, time or changes in the work and to negotiate Contract terms with the Successful Bidder; and the right to accept or reject all incomplete, nonconforming, nonresponsive, unbalanced, obscure, or conditional Bids, or Bids which contain additions not called for, erasures, alterations, or irregularities of any kind, or which do not comply with the Instructions to Bidders. OWNER reserves the right to reject the Bid of any Bidder if OWNER believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by OWNER. OWNER further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to be nonresponsive.

19.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.03 In evaluating Bids, OWNER will consider whether or not the Bids comply with the prescribed requirements, and such alternatives, unit prices, and other data as may be requested in the Bid Form or prior to the Notice of Award.

19.04 In evaluating Bids, OWNER will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions. OWNER also may consider the operating costs, maintenance requirements, performance data, and guarantees of major items of materials and equipment proposed for incorporation in the work when such data is required to be submitted prior to the Notice of Award.

19.05.1 OWNER may conduct such investigations as OWNER deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals or entities to perform the Work in accordance with the Contract Documents to OWNER's satisfaction within the prescribed time. Bidder shall furnish to OWNER all such information and data for this purpose as OWNER may request. OWNER reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy OWNER that such Bidder is properly qualified to carry out the obligations of the Contract Documents and to complete the work contemplated therein.

19.05.2 OWNER shall be satisfied that Bidder involved (1) maintains a permanent place of business, (2) has adequate plant and equipment to do the work properly and expeditiously, (3) has a suitable financial status to meet obligations incident to the work, (4) has appropriate technical experience, and (5) can submit a satisfactory performance record.

19.06.1 Notwithstanding any other provisions to the contrary, all bids are subject to Section 5/8-9-1 of the Illinois Municipal Code (65 ILCS 5/8-9-1), including the right, in the sound discretion of the Corporate Authorities of the City, to award the contract to the lowest responsible bidder, who might be other than the lowest bidder. In order to determine the lowest responsible bidder, the City may require the lowest bidder to submit additional information as to the lowest bidder's qualifications and also participate in interviews with City staff and committees.

19.06.2 OWNER reserves the right to accept or reject any bid alternatives or equipment alternatives to the lump sum base bid. Should OWNER wish to consider bid alternatives listed, Bidder may be required to provide additional information as listed in Article 6.05 of the General Conditions prior to the Notice of Award. If a bid alternative is selected by OWNER, the Contract will be awarded and a Change Order incorporating the cost of the bid alternative will be prepared concurrently with Contract award and signed along with the Contract Documents. Consideration of equipment alternatives of the selected Bidder will be made by OWNER within 60 days after the Effective Date of the Agreement.

19.07 If a Contract is to be awarded, OWNER will give the successful Bidder a Notice of Award within 60 days after the time set for opening Bids.

ARTICLE 20—CONTRACT SECURITY AND INSURANCE

20.01 Article 5 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth OWNER's requirements as to performance and payment bonds and insurances. When the Successful Bidder delivers the executed Agreement to OWNER, it must be accompanied by the required performance and payment bonds and insurances.

ARTICLE 21—SIGNING OF AGREEMENT

21.01 When OWNER gives a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement with all other Contract Documents which are identified in the Agreement as attached thereto. Within 15 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to ENGINEER with the required Bonds and insurances. Within 10 days after receipt of properly executed documents and Bonds and insurance which meet all requirements of the Contract Documents, ENGINEER will deliver one fully signed counterpart to Successful Bidder with a complete set of the Drawings with appropriate identification.

ARTICLE 22—RETAINAGE

22.01 Provisions concerning retainage are set forth in the Agreement.

ARTICLE 23—WAGE RATE DETERMINATION

23.01 All applicable laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the PROJECT shall apply to the contract throughout including the Employment of Illinois Workers on Public Works Act (30 ILCS 570) and the Davis-Bacon Wage Act (40 USC 276a through 276a-5) as defined by the United States Department of Labor. Wage rates are available on the U.S. Government Printing Office web site at www.gpo.gov/davisbacon. Bidder shall inspect the wage rate determination and shall incorporate its requirement into their Bid. See General Requirements for additional requirements.

ARTICLE 24–TAXES

24.01 The Bid shall include all taxes in effect at the time the Bid is submitted. No charge will be allowed for taxes from which OWNER is exempt. Bidders who are uncertain as to what items are subject to tax, or who require further explanation or clarification, are requested to contact the Illinois Department of Revenue. Refer to the Supplementary Conditions SC-6.10 for additional information.

ARTICLE 25–LAWS, ORDINANCES, AND REGULATIONS

25.01 Bidder must familiarize itself with all laws, ordinances, and regulations by federal, state, city, or other governmental agency, which by reason of being neglected or violated may affect the Work contemplated and must secure and pay the fee required for any permits which may be necessary unless such fees are otherwise indicated to be paid in the Bidding Documents.

ARTICLE 26–CERTIFICATION REGARDING COMPLIANCE WITH CRIMINAL CODE

26.01 Bidder shall complete the form inserted as part of the Bidding Documents entitled “Bidder Certification in Compliance with Article 33E to the “Criminal Code of 1961” and submit it with the Bid.

ARTICLE 27–CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS

27.01 Bidders shall read the instructions and complete the form inserted as part of the Bidding Documents entitled “Certification Regarding Debarment, Suspension, and Other Responsibility Matters.” The completed form shall be submitted with the Bid.

ARTICLE 28–NON-COLLUSION AND CERTIFICATION STATEMENT

28.01 Bidder shall complete the form inserted as part of the Bidding Documents entitled “Non-Collusion and Certification Statement” and submit it with the Bid.

ARTICLE 29–CERTIFICATION OF NON-SEGREGATED FACILITIES

29.01 Bidders shall complete the form inserted as part of the Bidding Documents entitled “U.S. Environmental Protection Agency Certification of Nonsegregated Facilities” and submit it with the Bid.

ARTICLE 30–UTILIZATION OF DISADVANTAGED BUSINESS ENTERPRISE

30.01 Bidder shall review the specifications inserted with the Bidding Documents entitled “City of Washington Specifications for Disadvantaged Business Enterprise Participation” and complete the required forms. The required forms, certifications, and other information shall be completed and submitted with the Bid as specified.

ARTICLE 31–AFFIRMATIVE ACTION TO ENSURE EQUAL OPPORTUNITY EMPLOYMENT

31.01 Bidders shall comply with the President's Executive Order No. 11246, as amended. The requirements for Bidders and Contractors under this order are explained in 41 CFR 60-4 included in the Bidding Documents. Bidder shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. Contractor shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

ARTICLE 32-AMERICAN RECOVERY AND REINVESTMENT ACT

32.01 Bidder shall comply with Section 1605 of the American Recovery and Reinvestment Act of 2009 (ARRA), which specifies that all iron, steel, and manufactured goods used in the project are produced in the United States. Bidder shall complete the form inserted as part of the Bidding Documents entitled "Buy American Certification" and submit it with the Bid.

END OF SECTION

SECTION 00400

BID

PHASE 1 IMPROVEMENTS–
SEWAGE TREATMENT PLANT NO. 2
CONTRACT 1-2009
CITY OF WASHINGTON, ILLINOIS

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ARTICLE 1–BID RECIPIENT

1.01 Bids to be received until 2 P.M., local time, August 5, 2009.

1.02 This Bid is submitted to: City of Washington
City Hall
115 West Jefferson Street
Washington, IL 61571

1.03 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2–BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 85 days after the Bid opening or for such longer period of time that Bidder may agree to in writing upon request of OWNER.

2.02 Bidder will sign and deliver the required number of counterparts of the Agreement with the bonds, insurance certificates and other documents required by the Bidding Requirements within 15 days after the date of OWNER's Notice of Award.

ARTICLE 3–BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, and the following Addenda (list addenda by addendum number and date), receipt of all which is hereby acknowledged:

Date:

Addendum Number:

B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in GC-4.02, and (2) reports and drawings of Hazardous Environmental Conditions, if any, that have been identified in SC-4.06.

E. Bidder has obtained and carefully studied (or accepts the consequences of not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.

F. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder is aware of the general nature of work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Bidding Documents.

H. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.

I. Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by ENGINEER is acceptable to Bidder.

J. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance of the Work for which this Bid is submitted.

K. Bidder will submit written evidence of its authority to do business in the state where the Project is located not later than the date of its execution of the Agreement.

ARTICLE 4—FURTHER REPRESENTATIONS

4.01 Bidder further represents that:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation;

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and,

D. Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.

ARTICLE 5—BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

The following abbreviations may be used in this Bid:

CIP	-	Complete in Place	LF	-	Linear Foot
CY	-	Cubic Yard	LS	-	Lump Sum
DI	-	Ductile Iron	LT	-	Left
DIA	-	Diameter	MBF	-	Thousand Board Feet
EA	-	Each	MH	-	Manhole
EST	-	Estimate(d)	RCP	-	Reinforced Concrete Pipe
EXCL	-	Excluding	RT	-	Right
FT	-	Feet	SF	-	Square Foot
GAL	-	Gallon	STA	-	Station
HERCP	-	Horizontal Elliptical RCP	SY	-	Square Yard
HRS	-	Hours	T	-	Ton
IN	-	Inch	VLF	-	Vertical Linear Foot
INCL	-	Including	W/	-	With
LBS	-	Pounds	W/O	-	Without

BIDDERS SHOULD NOT ADD ANY CONDITIONS OR QUALIFYING STATEMENTS TO THIS BID OR THE BID MAY BE DECLARED IRREGULAR AS NOT BEING RESPONSIVE TO THE INSTRUCTIONS TO BIDDERS.

BID

PHASE 1 IMPROVEMENTS–
SEWAGE TREATMENT PLANT NO. 2
CONTRACT 1-2009
CITY OF WASHINGTON, ILLINOIS

LUMP SUM BASE BID:

_____ Dollars \$ _____
(Words) (Numbers)

See Section 01019–Contract Considerations for discussion of cash allowances to include in the Bid.

Contract award will be made based on the lump sum base bid or lump sum base bid with any combination of bid alternatives selected. The price for all base bid equipment items shall be included in the lump sum base bid. Bid alternatives will be added or deducted from the lump sum base bid, if they are accepted, prior to Notice of Award being made.

OWNER reserves the right to accept or reject any bid alternatives or equipment alternatives to the lump sum base bid. Should OWNER wish to consider bid alternatives listed, Bidder may be required to provide additional information as listed in Article 6.05 of the General Conditions prior to Notice of Award. Consideration of equipment alternatives of the selected Bidder will be made by OWNER within 60 days after the Effective Date of the Agreement.

If a bid alternative is selected by OWNER, the Contract will be awarded and a Change Order incorporating the cost of the bid alternative will be prepared concurrently with Contract award and signed along with the Contract Documents.

BID ALTERNATIVES

BID ALTERNATIVE NO. 1:

CONTRACTOR shall include in the cost of the bid alternative ALL work associated with providing the scope listed below.

The price of \$_____ shall be added to the contract lump sum base bid if OWNER elects to have CONTRACTOR provide 2,080 square yards of asphaltic concrete paving overlay (excludes base course) on entrance drive as specified in Section 02510–Asphaltic Concrete Paving.

EQUIPMENT ALTERNATIVES

The name of the base bid equipment item which Bidder shall include in the lump sum base bid is listed for each equipment item. Where an equipment alternative is listed, Bidder shall include an add or deduct to the base bid equipment. Where spaces are provided, Bidder may also bid other equipment alternatives by writing in the alternative's name. Equipment alternative bid prices shall include the entire cost of the alternative, including cost for engineering changes to accommodate the alternative, and additional work to be performed which is not shown on the Drawings, but which is required as a result of selection of the alternative.

Whether or not an equipment alternative is offered to one or more of the base bid items provided for in the bid, Bidder shall, in the "name" column on the Bid Form and immediately above the name of each of the base bid items A. through J., write (in numbers) the price for providing the base bid item, as included in the lump sum base bid.

When more than one base bid manufacturer name is listed for a base bid item, CONTRACTOR shall circle the name of the equipment selected for the lump sum base bid and write in the price for the selected equipment.

Item	Name	Add to Base Bid	Deduct From Base Bid
A. Slide and Weir Gates (Section 05502)	\$ _____		
Base Bid Includes: (Circle One)	Rodney Hunt OR Whipps, Inc. OR Fontaine	(Not Applicable) (Not Applicable) (Not Applicable)	(Not Applicable) (Not Applicable) (Not Applicable)
Alternative	_____	(+)_____	(-)_____
B. Centrifugal Vertical Non Clog Pumps (Section 11300)	\$ _____		
Base Bid Includes: (Circle One)	Aurora OR Fairbanks Morse	(Not Applicable) (Not Applicable)	(Not Applicable) (Not Applicable)
Alternative	_____	(+)_____	(-)_____
C. Centrifugal Sludge Pumps (Section 11310)	\$ _____		
Base Bid Includes: (Circle One)	Wemco OR Hayward Gordon	(Not Applicable) (Not Applicable)	(Not Applicable) (Not Applicable)
Alternative	_____	(+)_____	(-)_____

Item	Name	Add to Base Bid	Deduct From Base Bid
D. Progressive Cavity Pumps (Section 11314)	\$ _____		
Base Bid Includes: (Circle One)	Robbins & Myers OR Netzsch, Inc.	(Not Applicable) (Not Applicable)	(Not Applicable) (Not Applicable)
Alternative	_____	(+)_____	(-)_____
E. Screening Equipment (Section 11331)	\$ _____		
Base Bid Includes: (Circle One)	Huber OR Vulcan OR Parkson	(Not Applicable) (Not Applicable) (Not Applicable)	(Not Applicable) (Not Applicable) (Not Applicable)
Alternative	_____	(+)_____	(-)_____
F. Chemical Phosphorous Removal Equipment (Section 11349)	\$ _____		
Base Bid Includes: (Circle One)	LMI OR Prominent	(Not Applicable) (Not Applicable)	(Not Applicable) (Not Applicable)
Alternative	_____	(+)_____	(-)_____
G. Final Clarifiers (Section 11337)	\$ _____		
Base Bid Includes: (Circle One)	Eimco OR U.S. Filter/Envirex OR Westech OR Walker Process	(Not Applicable) (Not Applicable) (Not Applicable) (Not Applicable)	(Not Applicable) (Not Applicable) (Not Applicable) (Not Applicable)
Alternative	_____	(+)_____	(-)_____
H. Oxidation Ditch Aeration (Section 11376)	\$ _____		
Base Bid Includes:	Eimco	(Not Applicable)	(Not Applicable)
Alternative	_____	(+)_____	(-)_____
Alternative	_____	(+)_____	(-)_____

Item	Name	Add to Base Bid	Deduct From Base Bid
I. Variable Frequency Drives (Section 16480)	\$ _____		
Base Bid Includes: (Circle One)	Toshiba	(Not Applicable)	(Not Applicable)
Alternative	Allen Bradley	(+) _____	(-) _____
Alternative	ABB	(+) _____	(-) _____
Alternative	_____	(+) _____	(-) _____
J. System Supplier (Section 16940)	\$ _____		
Base Bid Includes: (Circle One)	CIC Engineering	(Not Applicable)	(Not Applicable)
	OR		
	Instrument Control Systems	(Not Applicable)	(Not Applicable)
	OR		
	Wunderlich-Malec	(Not Applicable)	(Not Applicable)

BID

PHASE 1 IMPROVEMENTS—
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SUPPLEMENTAL UNIT PRICES

The following supplemental unit prices will apply in the event that additions to or deductions from the Work required in the Contract Documents are ordered. A single price shall be bid for each item. OWNER reserves the right to accept or reject these prices for item(s) 1, 4, 5, and 6 by inclusion in or omission from the Contract Documents to be executed after the award of the Contract. If Work involving omitted supplemental unit prices does occur, such Work shall be compensated for using other methods as provided in the Contract Documents. Item(s) 2 and 3 shall become part of the Contract Documents to be used for additions to or deductions from the estimated quantities given in the Specifications.

Item No.	Description	Unit	Unit Cost
1.	Earth Excavation Section 02222	CY	\$ _____
2.	Remove and Replace Unsuitable Foundation Material for Structures and Roads Section 02222	CY	\$ _____
3.	Remove and Replace Unsuitable Foundation Material for Utility Trenches Section 02222	CY	\$ _____
4.	Hot Mix Asphalt Paving (Overlay) Section 02510	SY	\$ _____
5.	Hot Mix Asphalt Paving (Including Base Course) Section 02510	SY	\$ _____
6.	Concrete Sidewalk-in-Place Section 02521	SF	\$ _____
7.	Concrete-in-Place Section 03300	CY	\$ _____

ARTICLE 6--TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete on or before September 30, 2010 and will be completed and ready for final payment in accordance with Paragraph 14.07.B of the General Conditions on or before October 31, 2010.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the Contract Times.

ARTICLE 7--ATTACHMENTS TO THIS BID

7.01 The following documents are attached to and made a condition of this Bid:

- A. Required Bid security in the form of _____ in the
(Bond or Certified Check)
amount of _____ Dollars
(\$_____) as required by the Instructions to Bidders.
- B. Bidder Certification in Compliance with Article 33E to the "Criminal Code of 1961."
- C. USEPA Certification Regarding Debarment, Suspension, and other Responsibility Matters.
- D. Non-Collusion and Certification Statement.
- E. USEPA Certification of Nonsegregated Facilities.
- F. City of Washington Specification for Disadvantaged Business Enterprise Participation.
- G. Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246).
- H. Notice to Labor Unions or Other Organizations for Workers-Nondiscrimination in Employment.
- I. Buy American Certification.

ARTICLE 8--DEFINED TERMS

8.01 The terms used in this Bid with initial or all capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9-COMMUNICATIONS

9.01 Communications concerning this Bid shall be addressed to the address of Bidder indicated below:

Name: _____

Street: _____

City, State, Zip Code: _____

Phone No.: _____ Fax No.: _____

E-mail: _____

ARTICLE 10-BID SUBMITTAL

Submitted on _____

State Contractor License No. _____ (if applicable).

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____
(Individual's signature)

Doing business as: _____

Business address: _____

Phone No.: _____ Fax No.: _____

A Partnership

Partnership Name: _____(SEAL)

By: _____
(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Business address: _____

Phone No.: _____ Fax No.: _____

A Corporation

Corporation Name: _____(SEAL)

State of Incorporation: _____

Type (General Business, Professional, Service, Limited Liability): _____

By: _____
(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____(CORPORATE SEAL)

Attest _____
(Signature of Corporate Secretary)

Business address: _____

Phone No.: _____ Fax No.: _____

Date of Qualification to do business is _____

Sworn and subscribed to before me this _____ day of _____, _____

Notary Public or Other Officer
Authorized to Administer Oaths.
My Commission expires: _____

A Joint Venture

Joint Venturer Name: _____(SEAL)

By: _____
(Signature of joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ Fax No.: _____

Joint Venturer Name: _____(SEAL)

By: _____
(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ Fax No.: _____

Phone No., Fax No., and address for receipt of official communications:

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

Bidder is currently certified as a MBE or WBE under EPA's DBE Program? _____ Yes
_____ No
(Check One)

Sworn and subscribed to before me this
_____ day of _____, _____

Notary Public or Other Officer
Authorized to Administer Oaths.
My Commission expires: _____

END OF SECTION

SECTION 00430

10% BID BOND

BIDDER (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address):

BID:

BID DUE DATE: _____

PROJECT (Brief Description Including Location):

BOND:

BOND NUMBER: _____

DATE: (Not later than Bid Due Date): _____

PENAL SUM: _____

Surety and Bidder, intending to be legally bound hereby, subject to the terms hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

SURETY

Surety's Name and Corporate Seal (Seal)

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title

BIDDER

Bidder's Name and Corporate Seal (Seal)

By: _____
Signature and Title

Attest: _____
Signature and Title

Above addresses are to be used for giving required notice.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to pay to OWNER upon default of Bidder the penal sum set forth on the face of this Bond. Payment of penal sum is the extent of Surety's liability.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 OWNER accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by OWNER, or
 - 3.3 OWNER fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default by Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from OWNER, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by OWNER and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in paragraph 4 above is received by Bidder and Surety, and in no case later than one year after Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notice required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage prepaid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of the Bond conflicts with any applicable provision of any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

12. Important: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

END OF SECTION

Bidder Certification
In Compliance with Article 33E to the
"Criminal Code of 1961"

I _____, do hereby certify that:

1. I am _____ of the _____
Name Position Firm
and have authority to execute this certification on behalf of the firm

2. This firm is not barred from bidding on this contract as a result of a violation of either Section 33E-3, Bid-rigging, or Section 33E-4, Bid Rotating, as set forth in Article 33E to the "Criminal Code of 1961."

Name of Firm _____

Signature _____

Title _____

Date _____

Corporate Seal (where appropriate)

On this _____ day of _____, 20____, before me appeared (Name)

_____ to me personally known,
who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly
authorized by (Name of Firm) _____ to execute the
affidavit and did so as his or her free act and deed.

Notary Public _____ Commission Expires _____

Notary Seal

EPA Project Control #: _____

United States Environmental Protection Agency
Washington, DC 20460

Certification Regarding Debarment, Suspension and Other Responsibility Matters

The prospective participant to the best of its knowledge and belief that it and its principles:

- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- (b) Have not within a three year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.
- (c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1) (b) of this certification; and
- (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in fine of up to \$10,000 or imprisonment for up to 5 years, or both.

(Typed Name & Title of Authorized Representative)

(Signature of Authorized Representative)

(Date)

☐ I am unable to certify the above statements. My explanation is attached.

EPA FORM 5700-49 (11-88)

Instructions

Under Executive Order 12549 an individual or organization debarred or excluded from participation in Federal assistance or benefit programs may not receive any assistance award under a Federal program, or a sub-agreement thereunder for \$25,000 or more.

Accordingly, each prospective recipient of an EPA grant, loan, or cooperative agreement and any contract or sub-agreement participant thereunder must complete the attached certification or provide an explanation why they cannot. For further details, see 40 CFR 32.510, Participants' responsibilities, in the attached regulation.

Where to Submit

The prospective EPA grant, loan, or cooperative agreement recipient must return the signed certification or explanation with its application to the appropriate EPA Headquarters or Regional office, as required in the application instructions.

A prospective prime contractor must submit a completed certification or explanation to the individual or organization awarding the contract.

Each prospective subcontractor must submit a completed certification or explanation to the prime contractor for the project.

How to Obtain Forms:

EPA includes the certification form, instructions, and a copy of its implementing regulation (40 CFR Part 32) in each application kit. Applicants may reproduce these materials as needed and provide them to their prospective prime contractor, who, in turn, may reproduce and provide them to prospective subcontractors.

Additional copies/assistance may be requested from:

Compliance Branch
Grants Administration Division (PM-216F)
U.S. Environmental Protection Agency
401 M Street, SW
Washington DC 20460
(Telephone: 202-475-8025)

NON-COLLUSION AND CERTIFICATION STATEMENT

1. By submission of the Bid, each Bidder and, in the case of a joint Bid, each party to the joint Bid certifies as to his or her own organization, that in connection with the Bid:

a. The prices in the Bid have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to the prices with any other bidder or with any competitor;

b. Unless otherwise required by law, the prices quoted in the Bid have not knowingly been directly or indirectly disclosed to any other bidder or to any competitor prior to Bid opening; and

c. No attempt has been made or will be made by the Bidder to induce any other person or firm to submit or withhold a Bid for the purpose of restricting competition. Also, each Bidder shall submit a certification regarding compliance with Article 33 E-11 of the Illinois Criminal Code of 1961 [720 ILCS 5/33 E-11]; and

2. Each person signing the Bid shall certify that (check one):

--- He/she is the person in the Bidder's organization responsible for the decision as to the prices being bid and that he/she has not participated, and will not participate, in any action contrary to 1.a. through 1.c.; or

--- He/she is not the person in the Bidder's organization responsible for the decision as to the prices being bid but that he/she has been authorized to act as agent certifying that the persons determining the prices have not participated, and will not participate, in any action contrary to 1.a. through 1.c., and as their agent shall so certify. He/She shall also certify that he/she has not participated, and will not participate, in any action contrary to 1.a. through 1.c.

Sworn and subscribed to before me this
_____ day of _____

Notary Public or Other Officer
Authorized to Administer Oaths.
My Commission expires: _____

U.S. ENVIRONMENTAL PROTECTION AGENCY**CERTIFICATION OF NONSEGREGATED FACILITIES**

(Applicable to federally assisted construction contracts and related subcontracts exceeding \$10,000 that are not exempt from the Equal Opportunity clause.)

The federally assisted construction contractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom or otherwise. The federally assisted construction contractor agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause, and that he will retain such certification in his files.

Signature

Date

Name and Title of Signer

(Please type)

Firm Name

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

Section 00450-1

I. Disadvantaged Business Enterprise Policy

- A. It is the policy of the State of Illinois to award a fair share of sub-agreements to disadvantaged businesses. In complying with this requirement, contractors are required to take affirmative steps to assure that disadvantaged businesses are used when possible as sources of supplies, equipment, construction, and services as explained herein.
- B. These specifications define the terms, conditions, and requirements of the State Revolving Fund Loan Program, and the (Name of Loan Recipient) City of Washington policy and procedures for complying with these requirements.
- C. As required by the award conditions of USEPA's Assistance Agreement with IEPA, the fair share percentages are 5% for MBEs and 12% for WBEs.

II. Pre-Contract Award Oblations

- A. Bidders are required to advertise subcontracting opportunities and to negotiate with disadvantaged businesses prior to bid opening. Failure to document such affirmative efforts shall be deemed, relative to disadvantaged business compliance non-responsive.
- B. To establish a bid as responsible, the bidder will be required to document the proposed utilization of disadvantaged businesses with letters of intent signed by the bidder and by the disadvantaged business listed in the bid. The documentation requirements are outlined in Section III.
- C. (Name of Loan Recipient) City of Washington disadvantaged business policy clearly intends for bidders to contact and encourage the participation of disadvantaged businesses prior to bid opening. Affirmative efforts (the written record of conscientious and honest communications between the bidder and disadvantaged business) must be initiated and completed by the bidder prior to bid opening. All bidders must document compliance with the requirements of the disadvantaged business policy.

III. Evaluation of Disadvantaged Business Utilization and Affirmative Efforts

- A. As a prerequisite to demonstrate compliance with the (Name of Loan Recipient) City of Washington disadvantaged business policy, ALL bidders shall provide the following with its bid:
 - 1. Completed and signed certification from the bidder(s), attesting that the bidder will award no sub-agreements, including the procurement of equipment, materials, supplies and services, in the performance of this contract.

OR

2. "Certification of publication," or adequate evidence of proof of publication, including an actual copy of the newspaper advertisement from the "key" newspaper utilized by each bidder based upon the projects locality (reference attached map of Illinois identifying the "key" newspaper to be utilized by each region). The advertisement (reference attached "suggested" advertisement) must run one day at least **16 days prior** to bid opening.
3. List of all disadvantaged business enterprise (DBE) and non-DBE's that submitted proposals to the bidder along with the date of the proposal.
4. List of disadvantaged businesses not being utilized and justification for non-utilization.
5. Certification from the Bidder that Form 6100-2 (DBE Subcontractor Participation Form) has been provided to DBE subcontractors being utilized.
6. Completed and signed copies of Forms 6100-3 (DBE Subcontractor Performance Form) and Form 6100-4 (DBE Subcontractor Utilization Form).
7. Completed and signed certification from the bidder(s) utilizing disadvantaged businesses, attesting that the bidder has no controlling or dominating interest or conflict of interest with the disadvantaged business that is proposed to be utilized (reference attached certification for the information necessary).
8. In instances where the bidder(s) does not receive any proposals from disadvantaged businesses prior to bid opening, the bidder(s) must provide a written certification attesting that no responses or proposals were received (reference attached certification for information necessary).

NOTE: Data Sheet #1 may be used for this purpose.

Failure to submit the documentation pursuant to the requirements of A (1-8) above may cause rejection of the bid as non-responsive.

B. The low, responsive bidder will be deemed responsible with respect to the disadvantaged business requirements if:

1. The low, responsive bidder submits Form 6100-3 (DBE Subcontractor Performance Form) and Form 6100-4 (DBE Subcontractor Utilization Form).

Failure to submit the documentation pursuant to the requirements of B(1) above may cause rejection of the bid as non-responsive.

Where the bidder is considered non-responsible under this subsection, the owner will promptly advise the bidder, in writing, of the basis for the non-responsibility determination.

IV. Sanctions

- A. The (Name of Loan Recipient) City of Washington may reject one or all bids where the information submitted by the bidder(s) fails to objectively demonstrate compliance with the disadvantaged business requirements (i.e., failure to place the pre-bid advertisement by the bidder(s) at least 16 days prior to bid opening shall not be considered as objectively demonstrating compliance with the disadvantaged business requirements).
- B. Upon finding that any Party has not complied with the requirements of these specifications, including misrepresenting a firm as a disadvantaged business, any one or a combination of the following actions may be taken.
1. Declare the bidder, and/or subcontractor non-responsible and therefore ineligible for contract award.
 2. Disallow all contract costs associated with on-compliance.
 3. Refer any matter, which may be fraudulent to the Illinois Attorney General.
 4. Refer any matter, which may lead to criminal prosecution of a claim for funds to the Illinois Attorney General.

V. Post-Contract Award Compliance

- A. As required by the award conditions of USEPA's Assistance Agreement with IEPA, all sub-agreements of the prime contractor must identify that the fair share percentages are 5% for MBEs and 12 % for WBEs.
- B. After award of the prime contract copies of all disadvantaged business related sub-agreements between the prime contractor and subcontractors shall be submitted to the owner.
- C. Subsequent to Bid Submission, any changes in previously reported disadvantaged businesses utilization shall be handled in accordance with Part 33.302(b-h). If the contractor fails to initiate such actions, the owner may withhold payments and/or institute other appropriate sanctions.

Bidder Certification

I _____, do hereby certify that:
(Name)

1. I am _____ of the _____
(Position) (Firm)

and have authority to execute this certification on behalf of the firm;

2. This firm will award no sub-agreements, including the procurement of equipment, materials, supplies, and services, in the performance of this contract.

Name of Firm _____

Signature _____

Title _____

Date _____

Corporate Seal (where appropriate)

**Suggested Disadvantaged
Business Advertisement for Construction Contractors**

Notice to Disadvantaged Businesses

_____, _____, _____, is
(Name of Company) (Address of Company) (Telephone)

seeking disadvantaged businesses for the _____
(Name of Loan Recipient)

Project for subcontracting opportunities in the following areas: _____,

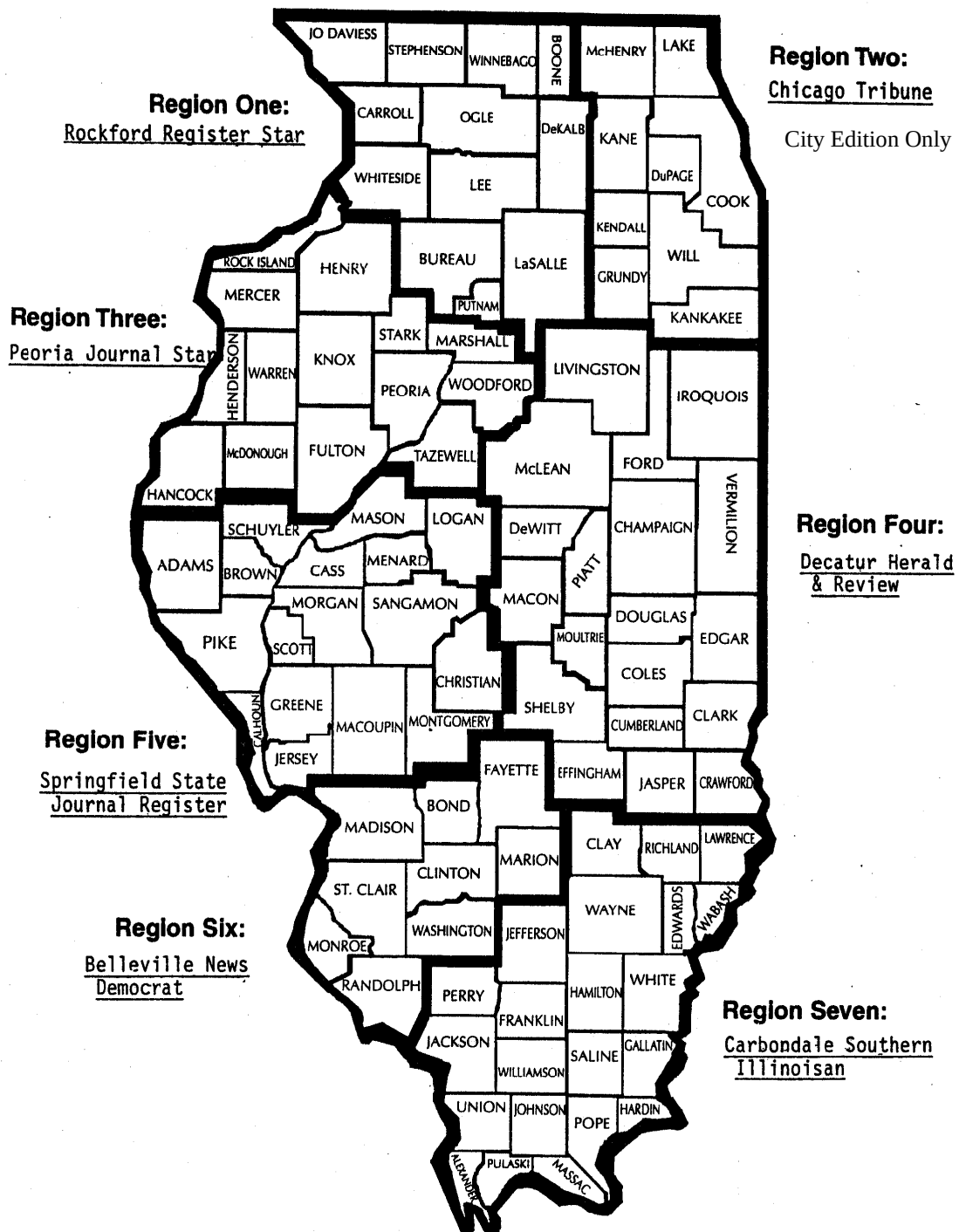
_____, _____. All disadvantaged businesses should contact, IN WRITING,

(certified letter, return receipt requested), _____ to discuss the
(Company Contact Person)

subcontracting opportunities. All negotiations must be completed prior to bid opening.

_____.
(Date of Bid Opening)

*The advertisement must clearly state the method of evaluating the proposals or quotations, and the relative importance attached to each criterion. Bidders must uniformly and objectively evaluate the proposals submitted by disadvantaged business in response to the advertisement based upon the evaluation criteria stated in the advertisement. The evaluation criteria must not be restrictive or exclusionary.



Data Sheet #1 Disadvantaged Business Participation Documentation

- 1) Completed and signed certification from bidder(s), attesting that the bidder will award no sub-agreements, including the procurement of equipment, materials, supplies and services in the performance of this contract.

OR

- 2) "Certificate of publication, or adequate evidence of proof of publication, including an actual copy of the newspaper advertisement from the "key" newspaper utilized by each bidder based upon the projects locality.

Dates of bidder advertisement: _____

Date of bid opening: _____

- 3) List of all disadvantaged business enterprises (DBE) and non-DBE's that submitted proposals to the bidder. Specify as DBE, along with the type of DBE, or non-DBE* with the following information:

Name of Company:

Name of Owners:

Address of Company:

E-mail Address of Company:

Telephone Number:

Date of Proposal:

* Business Type of DBE:

Description of work to be performed

(Furnish data for additional subcontractors on plain bond paper).

- 4) List of disadvantaged businesses that submitted proposals to the bidder but will not be utilized. Justification for non-utilization must be provided.

(If necessary, furnish data on plain bond paper.)

- 5) Certification from the Bidder that Form 6100-2 (DBE Subcontractor participation Form) has been provided to DBE subcontractors being utilized.
- 6) Completed and signed copies of Forms 6100-3 (DBE Subcontractor Performance Form) and Form 6100-4 (DBE Subcontractor Utilization Form).

- 7) Completed and signed certification from bidder(s) disadvantaged business, attesting that the bidder has no dominating or conflict of interest with the disadvantaged business to be utilized.
- 8) In instances where the bidder(s) does not receive any inquiries or proposals from disadvantaged businesses prior to bid opening, the bidder(s) must provide a written certification attesting that no responses or proposals were received.



Environmental
Protection Agency

OMB Control No: _____
Approved: _____
Approval Expires: _____

**Disadvantaged Business Enterprise Program
DBE Subcontractor Participation Form**

NAME OF SUBCONTRACTOR¹	PROJECT NAME
ADDRESS	CONTRACT NO.
TELEPHONE NO.	E-MAIL ADDRESS
PRIME CONTRACTOR NAME	

Please use the space below to report any concerns regarding the above EPA-funded project (e.g., reason for termination by prime contractor, late payment, etc.).

CONTRACT ITEM NO.	ITEM OF WORK OR DESCRIPTION OF SERVICES RECEIVED FROM THE PRIME CONTRACTOR	AMOUNT SUBCONTRACTOR WAS PAID BY PRIME CONTRACTOR

Subcontractor Signature _____

Title/Date _____

¹Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.



Environmental
Protection Agency

OMB Control No: _____
Approved: _____
Approval Expires: _____

**Disadvantaged Business Enterprise Program
DBE Subcontractor Performance Form**

NAME OF SUBCONTRACTOR¹		PROJECT NAME
ADDRESS		BID/PROPOSAL NO.
TELEPHONE NO.		E-MAIL ADDRESS
PRIME CONTRACTOR NAME		
CONTRACT ITEM NO.	ITEM OF WORK OR DESCRIPTION OF SERVICES BID TO PRIME	PRICE OF WORK SUBMITTED TO PRIME CONTRACTOR
Currently certified as an MBE or WBE under EPA's DBE Program? ____ Yes ____ No		
_____ Signature of Prime Contractor		_____ Date
_____ Print Name		_____ Title
_____ Signature of Subcontractor		_____ Date
_____ Print Name		_____ Title

¹Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

EPA FORM 6100-3 (DBE Subcontractor Performance Form)



Environmental
Protection Agency

OMB Control No: _____
Approved: _____
Approval Expires: _____

**Disadvantaged Business Enterprise Program
DBE Subcontractor Utilization Form**

BID/PROPOSAL NO.	PROJECT NAME
NAME OF PRIME BIDDER/PROPOSER	E-MAIL ADDRESS
ADDRESS	
TELEPHONE NO.	FAX NO.

The following subcontractors¹ will be used on this project:

COMPANY NAME, ADDRESS, PHONE NUMBER, AND E-MAIL ADDRESS	TYPE OF WORK TO BE PERFORMED	ESTIMATE D DOLLAR AMOUNT	CURRENTLY CERTIFIED AS AN MBE OR WBE?

I certify under penalty of perjury that the forgoing statements are true and correct. In the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302(c).

Signature Of Prime Contractor

Date

Print Name

Title

¹Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

**Bidder Certification Regarding the Use of
Disadvantaged Businesses**

I, _____, do hereby certify that:
Name

1. I am _____ of the _____ and have authority to execute this certification on behalf of the firm;
2. This firm, its partners or directors and officers does not possess a controlling interest in ownership or conflict of interest or any other authority to control the small, minority and/or women's business to be used during the performance of the contracts.
3. Form 6100-2 (DBE Subcontractor Participation Form) has been provided to all disadvantaged subcontractors being utilized.

Name of Firm _____

Signature _____

Title _____

Date _____

Corporate Seal (where appropriate)

**Bidder Certification for Advertisement Regarding Subcontracting
Opportunities for Disadvantaged Businesses**

I, _____, do hereby certify that:
(Name)

1. I am _____ of the _____ and have authority to
Name Firm
execute this certification on behalf of the firm;

2. This firm did not receive any proposals from disadvantaged business, prior to bid opening.

Date of Bid Opening

Name of Firm _____

Signature _____

Title _____

Date _____

Corporate Seal (where appropriate)

**NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL
EMPLOYMENT OPPORTUNITY
(EXECUTIVE ORDER 11246)**

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Timetables	Goals for minority participation for each trade	Goals for female participation in each trade
	4 . 4%	6 . 9%

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the contract is to be performed.
4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is City of Washington, Tazwell County, Illinois.

CONSTRUCTION CONTRACTORS AFFIRMATIVE ACTION REQUIERMENTS GOALS FOR MINORITY PARTICIPATION

(As published in the Friday, October 3, 1980 Federal Register)

FEMALE PARTICIPATION= 6.9% STATEWIDE

<u>County</u>	<u>Percent</u>	<u>County</u>	<u>Percent</u>	<u>County</u>	<u>Percent</u>
Adams	3.1	Jasper	11.4	Randolph	11.4
Alexander	11.4	Jefferson	11.4	Richland	11.4
Bond	11.4	Jersey	11.4	Rock Island	4.6
Boone	6.3	Jo Davis	0.5	Saline	3.5
Brown	3.1	Johnson	11.4	Sangamon	4.5
Bureau	18.4	Kane	19.6	Schuyler	3.3
Calhoun	11.4	Kankakee	9.1	Scott	4
Carroll	3.4	Kendall	18.4	Shelby	4
Cass	4	Knox	3.3	Stark	3.3
Champaign	7.8	Lake	19.6	St. Clair	14.7
Christian	4	La Salle	18.4	Stephenson	4.6
Clark	2.5	Lawrence	3.5	Tazwell	4.4
Clay	11.4	Lee	4.6	Union	11.4
Clinton	14.7	Livingston	18.4	Vermilion	4.8
Coles	4.8	Logan	4	Wabash	3.5
Cook	19.6	Macon	7.6	Warren	3.3
Crawford	2.5	Macoupin	11.4	Washington	11.4
Cumberland	4.8	Madison	14.7	Wayne	11.4
De Kalb	18.4	Marion	11.4	White	3.5
De Witt	4	Marshall	3.3	Whiteside	3.4
Douglas	4.8	Mason	3.3	Will	20.9
Du Page	19.6	Massac	5.2	Williamson	11.4
Edgar	4.8	McDonough	3.3	Winnebago	6.3
Edwards	3.5	McHenry	19.6	Woodford	4.4
Effingham	11.4	McLean	2.5		
Fayette	11.4	Menard	4.5		
Ford	4.8	Mercer	3.4		
Franklin	11.4	Monroe	14.7		
Fulton	3.3	Montgomery	11.4		
Gallatin	3.5	Morgan	4		
Greene	11.4	Moultrie	4		
Grundy	18.4	Ogle	4.6		
Hamilton	3.5	Peoria	4.4		
Hancock	3.4	Perry	11.4		
Hardin	5.2	Piatt	4.8		
Henderson	3.4	Pike	3.1		
Henry	4.6	Pope	5.2		
Iroquois	18.4	Pulaski	11.4		
Jackson	11.4	Putnam	18.4		

41 CFR 60**60-4.1 Scope and Application.**

This part applies to all contractors and subcontractors that hold any Federal or federally assisted construction contract in excess of \$10,000. The regulations in this part are applicable to all of a construction contractor's or subcontractor's construction employees who are engaged in on site construction including those construction employees who work on a non-Federal or nonfederally assisted construction site. This part also establishes procedures, which all Federal contracting officers and all applicants, as applicable, shall follow in soliciting for and awarding Federal or federally assisted construction contracts. Procedures also are established which administering agencies shall follow in making any grant, contract, loan, insurance, or guarantee involving federally assisted construction which is not exempt from the requirements of Executive Order 11246, as amended. In addition, this part applies to construction work performed by construction contractors and subcontractors for Federal nonconstruction contractors and subcontractors if the construction work is necessary in whole or in part to the performance of a nonconstruction contract or subcontract.

[43 FR 49254, OCT. 20, 1978; 43 FR 51404, NOV. 3, 1978]

60-4.2 Solicitations.

(a) All Federal contracting officers and all applicants shall include the notice set forth in paragraph (d) of this section and the Standard Federal Equal Employment Opportunity Construction Contract Specifications set forth in § 60-4.3 of this part in all solicitations for offers and bids on all Federal and federally assisted construction contracts or subcontracts to be performed in geographical areas designated by the Director pursuant to § 60-4.6 of the part. Administering agencies shall require the inclusion of the notice set forth in paragraph (d) of this section and the specifications set forth in § 60-4.3 of this part as a condition of any grant, contract, subcontract, loan, insurance or guarantee involving federally assisted construction covered by this Part 60-4.

(b) All nonconstruction contractors covered by Executive Order 11246 and the implementing regulations shall include the notice in paragraph (d) of this section in all construction agreements, which are necessary in whole or in part to the performance of the covered nonconstruction contract.

(c) Contracting officers, applicants and nonconstruction contractors shall give written notice to the Director within 10 working days of award of a contract subject to these provisions. The notification shall include the name, address and telephone number of the contractor; employer identification number; dollar amount of the contract, estimated starting and completion dates of the contract; the contract number; and geographical area in which the contract is to be performed.

(d) The following notice shall be included in, and shall be a part of, all solicitations for offers and bids on all Federal and federally assisted construction contracts or subcontracts in excess of \$10,000 to be performed in geographical areas designated by the Director pursuant to § 60-4.6 of this part (see 41 CFR 60-4.2(a)):

Notice of Requirement for Affirmative Action To Ensure Equal Employment Opportunity (Executive Order 11246)

1. The Offeror or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Time- tables	Goals for minority participation for each trade	Goals for female participation in each trade
	Insert goals for each year.	Insert goals for each year.

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and nonfederally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is (insert description of the geographical areas where the contract is to be performed giving the state, county and city, if any).

[43 FR 49254, OCT. 20, 1978; 43 FR 51401, NOV. 3, 1978, AS AMENDED AT 45 FR 65977, OCT. 3, 1980]

60-4.3 Equal Opportunity Clauses.

(a) The equal opportunity clause published at 41 CFR 60-1.4(a) of this chapter is required to be included in, and is part of, all nonexempt Federal contracts and subcontracts, including construction contracts and subcontracts. The equal opportunity clause published at 41 CFR 60-1.4(b) is required to be included in, and is a part of, all nonexempt federally assisted construction contracts and subcontracts. In addition to the clauses described above, all Federal contracting officers, all applicants and all nonconstruction contractors, as applicable, shall include the specifications set forth in this section in all Federal and federally assisted construction contracts in excess of \$10,000 to be performed in geographical areas designated by the Director pursuant to § 60-4.6 of this part and in construction subcontracts in excess of \$10,000 necessary in whole or in part to the performance of nonconstruction Federal contracts and subcontracts covered under the Executive order.

Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246)

1. As used in these specifications:

a. "Covered area," means the geographical area described in the solicitation from which this contract resulted:

b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;

c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.

d. "Minority" includes:

(i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

(ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);

(iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals

for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7 a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, nor the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, the Contractor must employ such apprentices and trainees during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The

Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore; along with whatever additional actions the Contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.

f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written

notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.

k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations, which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the

Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws, which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

(b) The notice set forth in 41 CFR 60-4.2 and the specifications set forth in 41 CFR 60-4.3 replace the New Form for Federal Equal Employment Opportunity Bid Conditions for Federal and Federally Assisted Construction published at 41 FR 32482 and commonly known as the Model Federal EEO Bid Conditions, and the New Form shall not be used after the regulations in 41 CFR Part 60-4 become effective.

[43 FR 49254, OCT. 20, 1978; 43 FR 51401, NOV. 3, 1978, AS AMENDED AT 45 FR 65978, OCT. 3, 1980]

60-4.4 Affirmative Action Requirements.

(a) To implement the affirmative action requirements of Executive Order 11246 in the construction industry, the Office of Federal Contract Compliance Programs previously has approved affirmative action programs commonly referred to as "Hometown Plans," has promulgated affirmative action plans referred to as "Imposed Plans" and has approved "Special Bid Conditions" for high impact projects constructed in areas not covered by a Hometown or an Imposed Plan. All solicitations for construction contracts made after the effective date of the regulations in this part shall include the notice specified in § 60-4.2 of this part and the specifications in § 60-4.3 of this part in lieu of the Hometown and Imposed Plans including the Philadelphia Plan and Special Bid Conditions. Until the Director has issued an order pursuant to § 60-4.6 of this part establishing goals and timetables for minorities in the appropriate geographical areas or for a project covered by Special Bid Conditions, the goals and timetables for minorities to be inserted in the Notice required by 41 CFR 60-4.2 shall be the goals and timetables contained in the Hometown Plan, Imposed Plan or Special Bid Conditions presently covering the respective geographical area or project involved.

(b) Signatories to a Hometown Plan (including heavy highway affirmative action plans) shall have 45 days from the effective date of the regulations in this part to submit under such a Plan (for the director's approval) goals and timetables for women and to include female representation on the Hometown Plan Administrative Committee. Such goals for female representation shall be at least as high as the goals established for female representation in the notice issued pursuant to 41 CFR 60-4.6. Failure of the signatories, within the 45-day period, to include female representation and to submit goals for women or a new plan, as appropriate, shall result in an automatic termination of the Office of Federal Contract Compliance Program's approval of the Hometown Plan. At any time the Office of Federal Contract Compliance Programs terminates or withdraws its approval of a Hometown Plan, or when the plan expires and another plan is not approved, the contractors signatory to the plan shall be covered automatically by the specifications set forth in § 60-4.3 of this part and by the goals and timetables established for that geographical area pursuant to § 60-4.6 of this part.

60-4.5 Hometown Plans

(a) A contractor participating, either individually or through an association, in an approved Hometown Plan (including heavy highway affirmative action plans) shall comply with its affirmative action obligations under Executive Order 11246 by complying with its obligations under the plan: *Provided*, That each contractor or subcontractor participating in an approved plan is individually required to comply with the equal opportunity clause set forth in 41 CFR 60-1.4; to make a good faith effort to achieve the goals for each trade participating in the plan in which it

has employees; and that the overall good performance by other contractors or subcontractors toward a goal in an approved plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the plan's goals and timetables. If a contractor is not participating in an approved Hometown Plan it shall comply with the specifications set forth in § 60-4.3 of this part and with the goals and timetables for the appropriate area as listed in the notice required by 41 CFR 60-4.2 with regard to that trade. For the purposes of this part 60-4, a contractor is not participating in a Hometown Plan for a particular trade if it:

- (1) Ceases to be signatory to a Hometown Plan covering that trade;
 - (2) Is signatory to a Hometown Plan for that trade but is not party to a collective bargaining agreement for that trade;
 - (3) Is signatory to a Hometown Plan for that trade but is party to a collective bargaining agreement with labor organizations, which are not or cease to be signatories to the same Hometown Plan for that trade;
 - (4) Is signatory to a Hometown Plan for that trade but is party to a collective bargaining agreement with a labor organization for that trade but the two have not jointly executed a specific commitment to minority and female goals and timetables and incorporated the commitment in the Hometown Plan for that trade;
 - (5) Is participating in a Hometown Plan for that trade which is no longer acceptable to the Office of Federal Contract Compliance Programs;
 - (6) Is signatory to a Hometown Plan for that trade but is party to a collective bargaining agreement with a labor organization for that trade and the labor organization and the contractor have failed to make a good faith effort to comply with their obligations under the Hometown Plan for that trade.
- (b) Contractors participating in Hometown Plans must be able to demonstrate their participation and document their compliance with the provision of the Hometown Plan.

[43 FR 49254, OCT. 20, 1978; 43 FR 51401, NOV. 3, 1978]

60-4.6 Goals and Timetables.

The Director, from time to time, shall issue goals and timetables for minority and female utilization, which shall be based on appropriate workforce, demographic, or other relevant data and which shall cover construction projects or construction contracts performed in specific geographical areas. The goals, which shall be applicable to each construction trade in a covered contractor's or subcontractor's entire workforce which is working in the area covered by the goals and timetables, shall be published as notices in the Federal Register, and shall be inserted by the contracting officers and applicants, as applicable, in the Notice required by 41 CFR 60-4.2. Covered construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed.

[45 FR 65978, OCT. 3, 1980]

60-4.7 Effect on Other Regulations.

The regulations in this part are in addition to the regulations contained in this chapter, which apply to construction contractors and subcontractors generally. See particularly, 41 CFR 60-1.4 (a), (b), (c), (d), and (e); 60-1.5; 60-1.7; 60-1.8; 60-1.26; 60-1.29; 60-1.30; 60-1.32; 60-1.41; 60-1.42; 60-1.43; and 41 CFR Part 60-3; Part 60-20; Part 60-30; Part 60-40; and Part 60-50.

60-4.8 Show Cause Notice.

If an investigation or compliance review reveals that a construction contractor or subcontractor has violated the Executive order, any contract clause, specifications or the regulations in this chapter and if administrative enforcement is contemplated, the Director shall issue to the contractor or subcontractor a notice to show cause which shall contain the items specified in paragraphs (i) through (iv) of 41 CFR 60-2.2(c)(1). If the contractor does not show good cause within 30 days, or in the alternative, fails to enter an acceptable conciliation agreement which includes where appropriate, make up goals and timetables, back pay, and seniority relief for affected class members, the OFCCP shall follow the procedure in 41 CFR 60-1.26(b): *Provided*, That where a conciliation agreement has been violated, no show cause notice is required prior to the initiation of enforcement proceedings.

[43 FR 49254, OCT. 20, 1978; 43 FR 51401, NOV. 3, 1978]

60-4.9 Incorporation by Operation of the Order.

By operation of the order, the equal opportunity clause contained in § 60-1.4, the Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246) contained in § 60-4.2, and the Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246) contained in § 60-4.3 shall be deemed to be a part of every solicitation or of every contract and subcontract, as appropriate, required by the order and the regulations in this chapter to include such clauses whether or not they are physically incorporated in such solicitation or contract and whether or not the contract is written.

NOTICE TO LABOR UNIONS OR OTHER ORGANIZATIONS OF WORKERS

NONDISCRIMINATION IN EMPLOYMENT

To: _____
(Name of union or organization of workers)

The undersigned currently holds contract(s) with _____
(name of applicant)

involving funds or credit of the U.S. Government or (a) subcontract(s) with a prime contractor holding such contract(s).

You are advised that under the provisions of the above contracts(s) or subcontract(s) and in accordance with Executive Order 11246, as amended, dated September 24, 1965, as amended, the undersigned is obliged not to discriminate against any employee or applicant for employment because of race, color, creed or national origin. This obligation not to discriminate in employment includes, but is not limited to, the following:

HIRING, PLACEMENT, UPGRADING, TRANSFER OR DEMOTION, RECRUITMENT,
ADVERTISING, OR SOLICITATION FOR EMPLOYMENT, TRAINING DURING
EMPLOYMENT, RATES OF PAY OR OTHER FORMS OF COMPENSATION, SELECTION
FOR TRAINING INCLUDING APPRENTICESHIP, LAYOFF OR TERMINATION.

This notice is furnished you pursuant to the provisions of the above contract(s) or subcontracts(s) and Executive Order 11246, as amended.

Copies of this notice will be posted by the undersigned in conspicuous places available to employees or applicants for employment.

(Contractor or Subcontractor)

(Date)

BUY AMERICAN CERTIFICATION

1. Identification of American-made Iron, Steel, and Manufactured Goods: Consistent with the terms of OWNER's bid solicitation and the provisions of ARRA Section 1605, the Bidder certifies that this bid reflects the Bidder's best, good faith effort to identify domestic sources of iron, steel, and manufactured goods for every component contained in the bid solicitation where such American-made components are available on the schedule and consistent with the deadlines prescribed in or required by the bid solicitation.

2. Verification of U.S. Production: The Bidder certifies that all components contained in the bid solicitation that are American-made have been so identified, and if this bid is accepted, the Bidder agrees that it will provide reasonable, sufficient, and timely verification to OWNER of the U.S. production of each component so identified.

3. Documentation Regarding Non-American-made Iron, Steel, or manufactured Goods: The Bidder certifies that for any component or components that are not American-made and are so identified in this bid, the Bidder has included in or attached to this bid one or both of the following, as applicable:

a. Identification of and citation to a categorical waiver published by the U.S. Environmental Protection Agency in the Federal Register that is applicable to such component or components, and an analysis that supports its applicability to the component or components;

b. Verifiable documentation sufficient to OWNER, as required in the bid solicitation or otherwise, that the Bidder has sought to secure American-made components but has determined that such components are not available on the schedule and consistent with the deadlines prescribed in the bid solicitation, with assurance adequate for the Bidder under the applicable conditions stated in the bid solicitation or otherwise.

4. Information and Detailed Justification Regarding Non-American-made Iron, Steel, or Manufactured Goods: The Bidder certifies that for any such component or components that are not so available, the Bidder has also provided in or attached to this bid information, including but not limited to the verifiable documentation and a full description of the bidder's efforts to secure any such American-made component or components, that the Bidder believes are sufficient to provide and as far as possible constitute the detailed justification required for a waiver under Section 1605 with respect to such component or components. The Bidder further agrees that, if this bid is accepted, it will assist OWNER in amending, supplementing, or further supporting such information as required by OWNER to request and, as applicable, implement the terms of a waiver with respect to any such component or components.

Sworn and subscribed to before me this
_____ day of _____

Notary Public or Other Officer
Authorized to Administer Oaths.
My Commission expires: _____

NOTICE OF INTENT TO AWARD

To: _____

Project Description: _____

The OWNER has considered the BID submitted by you for the above described WORK, in response to its Advertisement for Bids, dated _____ and Information for Bidders.

You are hereby notified that your BID will be accepted, contingent upon Illinois Environmental Protection Agency (IEPA) approval, for items in the amount of _____.

You will be required by the Information for Bidders to execute the Agreement and furnish the required CONTRACTOR'S Performance BOND, Payment BOND and certificates of insurance within ten (10) calendar days from the date of the final Notice to be sent upon IEPA approval, to you.

Dated this _____ day of _____.

OWNER

By: _____

Title: _____

NOTICE OF AWARD

To: _____

PROJECT Description: _____

The OWNER has considered the BID submitted by you for the above described WORK in response to its Advertisement for Bids dated _____, 20 _____ and Information for Bidders.

You are hereby notified that your BID has been accepted for items in the amount of \$_____.

You are required by the Information for Bidders to execute the Agreement and furnish the required CONTRACTOR'S Performance BOND, Payment BOND and certificates of insurance within ten (10) calendar days from the date of this Notice to you.

If you fail to execute said Agreement and to furnish said BONDS within ten (10) days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID BOND. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this _____ day of _____, 20 _____.

(Owner)

By _____

Title _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged,

by _____,

this the _____ day of _____, 20 _____.

By _____

Title _____

SECTION 00520

AGREEMENT

THIS AGREEMENT is by and between _____
(hereinafter called OWNER) and _____
(hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants set forth herein, agree as follows:

Article 1. WORK

1.01 CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Article 2. THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Article 3. ENGINEER

3.01 The Project has been designed by Strand Associates, Inc.[®] (hereinafter called ENGINEER), who is to act as OWNER's representative, assume all duties and responsibilities, and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents, except for Resident Project Representative services. Austin Engineering Co., Inc. will assume these duties and responsibilities and the rights and authority thereto in accordance with the Contract Documents.

Article 4. CONTRACT TIMES

4.01 Time of the Essence

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 Dates for Substantial Completion and Final Payment

A. The Work will be substantially complete on or before September 30, 2010 and will be completed and ready for final payment in accordance with Paragraph 14.07.B of the General Conditions on or before October 31, 2010.

4.03 Liquidated Damages

A. CONTRACTOR and OWNER recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty), CONTRACTOR shall pay to OWNER the following daily charge:

\$1500 for each day that expires after the time specified in Paragraph 4.02 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if CONTRACTOR shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER \$1500 for each day that expires after the time specified in Paragraph 4.02 for completion and readiness for final payment until the Work is completed and ready for final payment.

The above liquidated damages shall be applied separately to each of the substantial and final completion dates as shown in Paragraph 4.02.

Article 5. CONTRACT PRICE

5.01 OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents an amount in current funds as follows:

A. For all Work, at the prices stated in CONTRACTOR's Bid, attached hereto as an exhibit.

B. All specific cash allowances are included in the Contract Price and have been computed in accordance with Paragraph 11.02 of the General Conditions.

Article 6. PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

A. CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

6.02 Progress Payments; Retainage

A. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as established at the preconstruction conference during performance of the Work as provided in Paragraphs 6.02.A.1 and 6.02.A.2 below. All such payments will be measured by the schedule of values established in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements:

1. Prior to Substantial Completion, OWNER will retain an amount equal to 10% of each progress payment application until 50% of the Work has been completed. At 50% completion, further progress payment applications shall be paid in full to the CONTRACTOR and no additional amounts will be retained unless the ENGINEER certifies to the OWNER that the job is not proceeding satisfactorily. Amounts previously retained shall not be paid to the CONTRACTOR until substantial completion of the Work. At 50% completion of the Work, or any time thereafter when the character and progress of the Work is not satisfactory to OWNER on recommendation of ENGINEER, additional amounts may be retained, but in no event shall the total retainage be more than 10% of the value of the work completed.

2. Upon Substantial Completion, OWNER shall pay an amount sufficient to increase total payments to CONTRACTOR to 98% of the Work completed, less such amounts as ENGINEER shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions and less 100% of ENGINEER's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

6.03 Final Payment

A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said Paragraph 14.07.

Article 7. HIERARCHY

7.01 In resolving inconsistencies among two or more sections of the Contract Documents, precedence shall be given in the following order:

First:	WRITTEN AMENDMENTS
Second:	AGREEMENT
Third:	CHANGE ORDERS
Fourth:	ADDENDA
Fifth:	SUPPLEMENTARY CONDITIONS
Sixth:	GENERAL CONDITIONS
Seventh:	SPECIFICATIONS
Eighth:	DRAWINGS

Figure dimensions (numerical) on Drawings shall take precedence over dimensions measured utilizing a scale.

Article 8. CONTRACTOR'S REPRESENTATIONS

8.01 In order to induce OWNER to enter into this Agreement, CONTRACTOR makes the following representations:

A. CONTRACTOR has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

B. CONTRACTOR has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. CONTRACTOR is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress and performance of the Work.

D. CONTRACTOR has carefully studied (1) all reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions and (2) reports and drawings of a Hazardous Environmental Condition, if any, at the Site which has been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions.

E. CONTRACTOR has obtained and carefully studied (or accepts consequences of not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site that may affect the cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents and safety precautions and programs incident thereto.

F. CONTRACTOR does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

G. CONTRACTOR is aware of the general nature of work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Contract Documents.

H. CONTRACTOR has correlated the information known to CONTRACTOR, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.

I. CONTRACTOR has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that CONTRACTOR has discovered in the Contract Documents, and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

J. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

K. CONTRACTOR acknowledges to and for the benefit of OWNER and the State of Illinois that it understands the goods and services under this Agreement are being funded with monies made available by the federal American Recovery and Reinvestment Act of 2009 (ARRA) (or are being made available for a project being funded with monies made available by the federal ARRA) and such law contains provisions commonly known as "Buy American;" that requires all of the iron, steel, and manufactured goods used in the project to be produced in the United States ("Buy American Requirements") including iron, steel, and manufactured goods provided by CONTRACTOR pursuant to this Agreement. CONTRACTOR hereby represents and warrants to and for the benefit of OWNER and the State that (a) CONTRACTOR has reviewed and understands the Buy American Requirements, (b) all of the iron, steel, and manufactured goods used in the project will be and/or have been produced in the United States in a manner that complies with the Buy American Requirements, unless a waiver of the requirements is approved, and (c) CONTRACTOR will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the Buy American Requirements, as may be requested by OWNER or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by CONTRACTOR shall permit OWNER or State to recover as damages against CONTRACTOR any loss, expense, or cost (including without limitation attorney's fees) incurred by OWNER or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by OWNER). While CONTRACTOR has no direct contractual privity with the State, as a lender to OWNER for the funding of its project, OWNER and CONTRACTOR agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

L. CONTRACTOR shall not discriminate on the basis of race, color, national origin or sex in the performance of this Contract. CONTRACTOR shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by CONTRACTOR to carry out these requirements is a material breach of this Contract which may result in the termination of this Contract or other legally available remedies.

Article 9. CONTRACT DOCUMENTS

The Contract Documents consist of the following:

9.01 Contents

A. The Contract Documents consist of the following:

1. This Agreement (pages 00520-1 through 00520-_____, inclusive);
2. Performance bond (pages to 00600-1 through 00600-3, inclusive);
3. Payment bond (pages 00600-4 through 00600-6, inclusive);
4. Other bonds
 - a. _____ (pages _____ to _____ , inclusive);
 - b. _____ (pages _____ to _____ , inclusive);
 - c. _____ (pages _____ to _____ , inclusive);

5. General Conditions (pages 00700-1 through 00700-_____, inclusive);
6. Supplementary Conditions (pages 00800-1 through 00800-_____, inclusive);
7. Specifications as listed in the table of contents of the Project Manual;
8. Drawings _____

inclusive incorporated herein by reference with each sheet bearing the following general title:

as well as drawings listed in the table of contents that are bound at the back of these specifications.

9. Addenda (_____).

10. Exhibits to this Agreement (enumerated as follows:)

- a. Notice to Proceed (pages _____ to _____, inclusive);
- b. CONTRACTOR's Bid (pages _____ to _____);
- c. Supplemental Unit Prices are included as part of the Agreement except as noted:
(_____);
- d. Documentation submitted by CONTRACTOR prior to Notice of Award
(_____);
- e. (_____);

11. The following may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:

- a. Work Change Directives;
- b. Change Order(s).

B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the General Conditions.

Article 10. MISCELLANEOUS

10.01 Terms

A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 Assignment of Contract

A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation, monies that may become due and monies that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 Successors and Assigns

A. OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements, and obligations contained in the Contract Documents.

10.04 Severability

A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon OWNER and CONTRACTOR, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in triplicate. One counterpart each has been delivered to OWNER, CONTRACTOR, and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or identified by ENGINEER on their behalf.

This Agreement will be effective on _____, _____
(which is the Effective Date of the Agreement).

OWNER

Signature and Title (Seal)

ATTEST:

By:

Signature and Title

By:

Signature and Title

Address for Giving Notices:

Name:

Street:

City, State, Zip Code:

Phone:

Facsimile:

E-mail:

Designated Representative:

CONTRACTOR _____

Signature and Title (Seal)

ATTEST:

By: _____
Signature and Title

By: _____
Signature and Title

Address for Giving Notices:

Name: _____

Street: _____

City, State, Zip Code: _____

Phone: _____

Facsimile: _____

E-mail: _____

Designated Representative: _____

License No.: _____
(Where applicable)

(If CONTRACTOR is a corporation or a partnership, attach evidence of authority to sign.)

Agency Concurrence:

As lender or insurer of funds to defray the costs of this Contract, and without liability for any payments thereunder, the Agency hereby concurs in the form, content, and execution of this Agreement.

Agency: _____ By: _____

Date: _____ Title: _____

INSTRUCTIONS FOR EXECUTING CONTRACT

If the Agreement is to be signed by the Secretary of the corporation, the certificate below should be executed by some other officer of the corporation, under the corporate seal. In lieu of the foregoing certificate, there may be attached to the Agreement copies of so much of the records of the corporation which will show the official character and authority of the officers signing, duly certified by the secretary or assistant secretary under the corporate seal to be true copies.

The full name and business address of CONTRACTOR should be inserted and the Agreement should be signed with CONTRACTOR's official signature. Please have the name of the signing party printed under all signatures to the Agreement.

If CONTRACTOR is operating as a partnership, each partner should sign the Agreement. If the Agreement is not signed by each partner, there should be attached to the Agreement a duly authenticated power of attorney evidencing the signer's (signers') authority to sign such Agreement for and in behalf of the partnership.

If CONTRACTOR is an individual, the trade name (if CONTRACTOR is operating under a trade name) should be indicated in the Agreement and the Agreement should be signed by such individual. If signed by other than CONTRACTOR, there should be attached to the Agreement a duly authenticated power of attorney evidencing the signer's authority to execute such Agreement for and in behalf of CONTRACTOR.

If CONTRACTOR is a corporation, the following certificate should be executed:

I, _____, certify that I am the _____
Secretary of the corporation named as CONTRACTOR herein above; that
_____, who signed the foregoing Agreement on behalf of
CONTRACTOR was then _____ of said corporation;
that said Agreement was duly signed for and in behalf of said Corporation by authority of its governing
body, and is within the scope of its corporate powers.

(Corporate Seal)

END OF SECTION

SECTION 00600

PERFORMANCE BOND

Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

CONTRACTOR (*Name and Address*): SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

CONTRACT

Effective Date of Agreement: _____

Amount: _____

Description (*Name and Location*): _____

BOND

Bond Number: _____

Date (*Not earlier than Effective Date of Agreement*): _____

Amount: _____

Modifications to this Bond Form: _____

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Provide execution by additional parties, such as joint venturers, if necessary.

Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner for the performance of the Contract, which is incorporated herein by reference.

1. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 2.1.
2. If there is no Owner Default, Surety's obligation under this Bond shall arise after:
 - 2.1 Owner has notified Contractor and Surety, at the addresses described in Paragraph 9 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor, and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and
 - 2.2 Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 2.1; and
 - 2.3 Owner has agreed to pay the Balance of the Contract Price to:
 1. Surety in accordance with the terms of the Contract; or
 2. Another contractor selected pursuant to Paragraph 3.3 to perform the Contract.
3. When Owner has satisfied the conditions of Paragraph 2, Surety shall promptly, and at Surety's expense, take one of the following actions:
 - 3.1 Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or
 - 3.2 Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or
 - 3.3 Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 5 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or
 - 3.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:
 1. After investigation, determine the amount for which it may be liable to Owner and, as soon as practicable after the amount is determined, tender payment therefor to Owner; or
 2. Deny liability in whole or in part and notify Owner citing reasons therefor.
4. If Surety does not proceed as provided in Paragraph 3 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 3.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.
5. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 3.1, 3.2, or 3.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To the limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

- 5.1 The responsibilities of Contractor for correction of defective Work and completion of the Contract;
- 5.2 Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions of or failure to act of Surety under Paragraph 3; and
- 5.3 Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Contractor.

6. Surety shall not be liable to Owner or others for obligations of Contractor that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than Owner or its heirs, executors, administrators, or successors.

7. Surety hereby waives notice of any change, including changes of time, to Contract or to related subcontracts, purchase orders, and other obligations.

8. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located, and shall be instituted within two years after Contractor Default or within two years after Contractor ceased working or within two years after Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

9. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the address shown on the signature page.

10. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

11. Definitions.

11.1 Balance of the Contract Price: The total amount payable by Owner to Contractor under the Contract after all proper adjustments have been made, including allowance to Contractor of any amounts received or to be received by Owner in settlement of insurance or other Claims for damages to which Contractor is entitled, reduced by all valid and proper payments made to or on behalf of Contractor under the Contract.

11.2 Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

11.3 Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

11.4 Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or otherwise comply with the other terms thereof.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the Project is Bid.

FOR INFORMATION ONLY—(Name, Address and Telephone)

Surety Agency or Broker:

Owner's Representative (Engineer or other party):

SECTION 00600
PAYMENT BOND

Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

CONTRACTOR (*Name and Address*): SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

CONTRACT

Effective Date of Agreement: _____

Amount: _____

Description (*Name and Location*): _____

BOND

Bond Number: _____

Date (*Not earlier than Effective Date of Agreement*): _____

Amount: _____

Modifications to this Bond Form: _____

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Provide execution by additional parties, such as joint venturers, if necessary.

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.
2. With respect to Owner, this obligation shall be null and void if Contractor:
 - 2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants, and
 - 2.2 Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.
3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.
4. Surety shall have no obligation to Claimants under this Bond until:
 - 4.1 Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.
 - 4.2 Claimants who do not have a direct contract with Contractor:
 1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and
 2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and
 3. Not having been paid within the above 30 days, have sent a written notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.
5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.
6. Reserved.
7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.
8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.
9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated to the Contract. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders, and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. Definitions

15.1 Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

15.2 Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3 Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract, or to perform and complete or otherwise comply with the other terms thereof.

16. IMPORTANT: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the Project is located.

FOR INFORMATION ONLY – *(Name, Address, and Telephone)*

Surety Agency or Broker:

Owner's Representative *(Engineer or other)*:

NOTICE TO PROCEED

To: _____

Date: _____

Project: _____

You are hereby notified to commence WORK in accordance with the Agreement dated _____, 20 _____, on or before _____, 20 _____, and you are to complete the WORK within _____ consecutive calendar days thereafter. The date of completion of all WORK is therefore _____, 20 _____.

(Owner)

By _____

Title _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED
is hereby acknowledged by _____

this the _____ day of

_____, 20 ____.

By _____

Title _____

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the Controlling Law.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By



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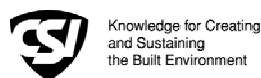
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These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor Nos. C-520 or C-525 (2002 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the EJCDC Construction Documents, General and Instructions (No. C-001) (2002 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. C-800) (2002 Edition).

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*--The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*--The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*--The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*--The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*--The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*--A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*--A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*--The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*-- Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*--The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*--The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*--The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*--See Paragraph 11.01.A for definition.

17. *Drawings*--That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*--The individual or entity named as such in the Agreement.

20. *Field Order*--A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

22. *Hazardous Environmental Condition*--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

23. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*--Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*--The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*--A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*--The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*--Polychlorinated biphenyls.

31. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*--A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Related Entity* -- An officer, director, partner, employee, agent, consultant, or subcontractor.

37. *Resident Project Representative*--The authorized representative of Engineer who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Schedule of Submittals*--A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

40. *Schedule of Values*--A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

41. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

42. *Site*--Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

43. *Specifications*--That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain

administrative requirements and procedural matters applicable thereto.

44. *Subcontractor*--An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

45. *Substantial Completion*--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

46. *Successful Bidder*--The Bidder submitting a responsive Bid to whom Owner makes an award.

47. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

48. *Supplier*--A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.

49. *Underground Facilities*--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

50. *Unit Price Work*--Work to be paid for on the basis of unit prices.

51. *Work*--The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

52. *Work Change Directive*--A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times

but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 Terminology

A. The following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following meaning.

B. Intent of Certain Terms or Adjectives

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered", "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. Day

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. Defective

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

- a. does not conform to the Contract Documents, or
- b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents, or
- c. has been damaged prior to Engineer's - recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. Furnish, Install, Perform, Provide

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement

or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule; indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or

responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of, their Related Entities, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor knew or reasonably should have known thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work

(unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample; (Subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or Engineer's consultants, including electronic media editions; or

2. reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaption by Engineer.

B. The prohibition of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's

sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party..

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the “technical data” contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such “technical data” is identified in the Supplementary Conditions. Except for such reliance on such “technical data,” Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor’s purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any “technical data” on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer’s Review:* After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner’s obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer’s findings and conclusions.

C. Possible Price and Times Adjustments

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor’s cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor’s making such final commitment; or

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

- a. reviewing and checking all such information and data,
- b. locating all Underground Facilities shown or indicated in the Contract Documents,
- c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and
- d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will

promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

A. Reports and Drawings: Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the Engineer in the preparation of the Contract Documents.

B. Limited Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered to Contractor written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to

entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06. G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified

in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection

from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insured (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.

a. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, (other than caused by flood) and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any

deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insured or additional insured (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract

Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or

received from the superintendent shall be binding on Contractor.

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole,

3) it has a proven record of performance and availability of responsive service; and

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times, and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time;

b) whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

c) whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified, and

b) available engineering, sales, maintenance, repair, and replacement services;

4) and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change,

B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. Engineer's Evaluation: Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. Special Guarantee: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. Engineer's Cost Reimbursement: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the charges of Engineer for making changes in the Contract

Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. Contractor's Expense: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 Concerning Subcontractors, Suppliers, and Others

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity, nor

2. shall anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual

or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 Taxes

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 Use of Site and Other Areas

A. Limitation on Use of Site and Other Areas

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. Removal of Debris During Performance of the Work: During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. Cleaning: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. Loading Structures: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 Record Documents

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 Safety and Protection

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Draw-

ings or Specifications or to the acts or omissions of Owner or Engineer or , or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

D. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the acceptable Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. Shop Drawings

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples*: Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals.

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals , any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:

a. all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; and

d. shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents

with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations, that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample Submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. Engineer's Review

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. Resubmittal Procedures

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 Continuing the Work

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or

disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 Contractor's General Warranty and Guarantee

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its Related Entities shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 Indemnification

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or

arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal

shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or via other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and

properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
2. the specific matters to be covered by such authority and responsibility will be itemized; and
3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.

C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 *Insurance*

A. Owner's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility in respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents and will not be changed without written consent of Owner and Engineer.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep

Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show

partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to, the Resident Project Representative, if any, and assistants, if any.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall

promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any bond to be given to a surety, the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim, shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part,

2. approve the Claim, or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and

Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to Engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have

resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expresses, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. Costs Excluded: The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A and 11.01.B.

C. Contractor's Fee: When all the Work is performed on the basis of cost-plus, Contractor's fee shall

be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. Documentation: Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. Cash Allowances

1. Contractor agrees that:

a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. Contingency Allowance

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 Unit Price Work

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an

allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted

by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 Delays

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 Access to Work

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and programs so that they may comply therewith as applicable.

13.03 Tests and Inspections

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to

be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or
2. correct such defective Work; or
3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications .

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress

payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. Applications for Payments

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. Review of Applications

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations on the Site of the executed Work as an experienced and qualified design professional and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

b. that there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent

inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
- b. the Contract Price has been reduced by Change Orders;
- c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
- d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. Reduction in Payment

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

- a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
- b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
- c. there are other items entitling Owner to a set-off against the amount recommended; or
- d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects to Owner's satisfaction the reasons for such action.

3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

14.03 Contractor's Warranty of Title

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 Substantial Completion

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, , Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will within 14 days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said 14 days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial

Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to complete or correct items on the tentative list.

14.05 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions.

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals

that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. Application for Payment

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;

b. consent of the surety, if any, to final payment;

c. a list of all Claims against Owner that Contractor believes are unsettled; and

d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations

under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and , will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance

with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion),

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be

governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions, or

2. agrees with the other party to submit the Claim to another dispute resolution process, or

3. gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00800

SUPPLEMENTARY CONDITIONS

A. These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

B. The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below which are applicable to both the singular and plural thereof.

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SC-1.01.A Defined Terms

Insert in the first sentence after the phrase “printed with initial capital letters” the following phrase:

“or with all capital letters”

SC-1.01.A.17 Drawings

The following Drawings are part of the Contract Documents:

Drawings titled “Phase 1 Improvements–Sewage Treatment Plant No. 2, Contract 1-2009, City of Washington, Illinois, Sheets No. 1 through No. 65, prepared by Strand Associates, Inc.® and drawings listed in the table of contents that are bound at the back of these specifications.

SC-1.01.A.52 Work Change Directive

Amend the phrase “and signed by OWNER” in the first sentence of Paragraph 1.01.A.52. of the General Conditions to read as follows:

“and signed by OWNER and CONTRACTOR.”

SC-2.01 Delivery of Bonds and Evidence of Insurance

Delete Paragraph 2.01.A of the General Conditions in its entirety and insert the following in its place:

A. When CONTRACTOR delivers the executed counterparts of the Agreement to OWNER, CONTRACTOR shall also deliver to OWNER such bonds, insurance certificates, insurance endorsements, and other documents as CONTRACTOR may be required to furnish.

Delete Paragraph 2.01.B of the General Conditions in its entirety and insert the following in its place:

B. Evidence of Insurance: Before any Work at the Site is started, CONTRACTOR shall deliver to OWNER with copies to each additional insured identified in the Supplementary Conditions OWNER-approved copies of certificates of insurance, copies of endorsements, and other evidence of insurance which either of them or any additional insured may reasonably request, which CONTRACTOR is required to purchase and maintain in accordance with Paragraphs 5.04 and 5.06.

SC-2.03 Commencement of Contract Times; Notice to Proceed

In the last sentence of Paragraph 2.03 of the General Conditions, change “sixtieth day” to “eighty-fifth day.”

SC-2.05 Before Starting Construction

Add the following subparagraph to Paragraph 2.05.A of the General Conditions:

4. a proposed listing of subcontractors and major material and equipment suppliers. The list shall include any proposed substitutions in accordance with Paragraph 6.05 of the General Conditions.

SC-3.03.A Reporting

Add the following language at the end of Paragraph 3.03.A. of the General Conditions:

4. If CONTRACTOR proceeds with work that CONTRACTOR had actual knowledge or should have known that a conflict, error, ambiguity, or discrepancy existed as indicated above, correction of work constructed without such notification to ENGINEER shall be at CONTRACTOR's expense, (except in an emergency as authorized by Paragraph 6.16.A.).

SC-4.02 Subsurface and Physical Conditions

Add the following paragraphs immediately after Paragraph 4.02.B:

C. In the preparation of Drawings and Specifications, ENGINEER relied upon the following reports and drawings of explorations and tests of subsurface conditions at the Site:

1. Report dated December 6, 2006, prepared by Whitney & Associates, of Peoria, Illinois, entitled: Geotechnical Engineering Report of Site Investigation Washington Sewage Treatment Plant #2 Improvements, for Washington, Illinois, consisting of 14 pages plus Appendix.

The technical data in the above report(s), upon which the CONTRACTOR may rely, consists of boring logs, test results, and boring locations all as of the date made.

ENGINEER accepts no responsibility for accuracy of the soil data or water level information. Soil information, included with these Contract Documents, was not obtained for the purposes of designing excavations and trenches. Soil information was used by ENGINEER for design purposes only. CONTRACTOR shall assure itself by personal examination as to subsurface conditions and shall provide its own investigations and make its own assumptions to comply with OSHA and any other applicable laws and regulations regarding excavation and trenching requirements.

D. In the preparation of Drawings and Specifications, ENGINEER relied upon the reports and drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the Site:

1. Drawings dated January 20, 1997, prepared by Daily and Associates Engineers, Inc., of Champaign-Peoria, Illinois, entitled: Record Drawings—Plans for Sewage Treatment Plant No. 2 Expansion, for The City of Washington, Illinois, consisting of 84 sheets numbered G1 to E16, inclusive.
2. Drawings dated August 1987, prepared by Daily and Associates Engineers, Inc., of Champaign, Peoria, and Bloomington, Illinois, entitled: Improvements to Sewage Treatment Plant No. 2 Storm Water Pumping Facilities, for City of Washington, Illinois, consisting of 10 sheets numbered 1 to 9, and Addendum No. 1, Sheet 1, inclusive.
3. Drawings dated November 1971, prepared by Daily and Associates Engineers, Inc., of Champaign, Peoria, and Bloomington, Illinois, entitled: Plans for Sewage Treatment Facilities and Interceptor System, for City of Washington, Illinois, consisting of 69 sheets numbered 1 to 69, inclusive.

None of the contents of such drawings include technical data on which CONTRACTOR may rely.

E. The reports and drawings identified above are not part of the Contract Documents, but the "technical data" contained therein upon which CONTRACTOR may rely, as expressly identified and established above, are incorporated in the Contract Documents by reference. CONTRACTOR is not entitled to rely upon any other information and data known to or identified by OWNER or ENGINEER.

F. Copies of reports and drawings identified in SC-4.02.C and SC-4.02.D that are not included with the Bidding Documents may be examined at the City of Washington, 115 West Jefferson, Washington, IL 61571 during regular business hours.

SC-4.04 Underground Facilities

CONTRACTOR is referred to the General Requirements for requirements for keeping records of Underground Facilities and allowing facility owners to inspect.

SC-4.05 Reference Points

CONTRACTOR is referred to the General Requirements for additional requirements for laying out the work.

SC-4.06 Hazardous Environmental Conditions

Delete Paragraphs 4.06.A and 4.06.B in their entirety and insert the following:

A. No reports or drawings related to Hazardous Environmental Conditions are known to OWNER or ENGINEER.

B. Not Used.

SC-5.01 Performance and Payment Bonds

The forms of the performance and payment Bonds attached hereto shall be used for the Contract. Note instructions thereon as to the form applicable. Each form contemplates one corporate surety only. In case co-sureties or individual sureties will be furnished, proper forms therefore shall be obtained. Besides the stipulations of Paragraphs 5.01 through 5.03 of the General Conditions, the surety on the Bonds shall provide a certificate indicating surety is licensed to underwrite contracts in the jurisdiction of the project location which shall be attached to the Bonds.

Every Bond must run to OWNER.

If the principal is an individual, his/her full name and residence shall be inserted in the body thereof, and he/she shall sign the Bonds with his/her usual signature on the line opposite the scroll seal. If the principals are partners, their individual names shall appear in the body of the Bonds, with the recital that they are partners comprising a firm, naming it, and all the members of the firm shall execute the Bonds as individuals.

The signature of a witness shall appear in the appropriate places, attesting the signatures of each individual party to the Bonds.

If the principal is a corporation, the name of the state in which incorporated shall be inserted in the appropriate place in the body of the Bonds, and said instrument shall be executed and attested under the corporate seal as indicated on the form. If the corporation has no seal, the fact shall be stated, in which case a scroll or adhesive seal shall appear following the corporate name. This also applies to execution by surety.

The date of the Bonds must not be prior to the date of the Contract for which given.

A power of attorney, authorizing the execution of the Bonds by an attorney-in-fact, or agent, shall be attached to one executed counterpart of the Bonds.

SC-5.02.A Insurers

Insurance is to be placed with insurance companies with a Best's rating of no less than A.

SC-5.03 Certificates of Insurance

Add the following new paragraphs immediately after Paragraph 5.03.B:

C. Failure of OWNER or ENGINEER to demand such certificates or other evidence of full compliance with these insurance requirements or failure of OWNER or ENGINEER to identify a deficiency from evidence provided shall not be construed as a waiver of CONTRACTOR's obligation to maintain such insurance.

D. By requiring such insurance and insurance limits herein, OWNER does not represent that coverage and limits will necessarily be adequate to protect CONTRACTOR, and such coverage and limits shall not be deemed as a limitation on CONTRACTOR's liability under the indemnities granted to OWNER in the Contract Documents.

SC-5.04 CONTRACTOR's Liability Insurance

Add the following paragraph immediately after Paragraph 5.04.B:

C. The limits of liability for the insurance required by Paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations. The types of insurance and the limits of liability indicated are the minimum required. Neither OWNER or ENGINEER warrant the adequacy of the types of insurance or the limits of liability required. Any policy exclusions shall be indicated on the insurance certificate. Insurance shall be provided on an occurrence form basis. CONTRACTOR shall provide verification of all coverages with or on the insurance certificate.

1. Workers' Compensation, and related coverages under Paragraphs 5.04.A.1 and A.2 of the General Conditions:

a.	State:	Statutory
b.	Applicable Federal (e.g., Longshoreman's):	Statutory
c.	Employer's Liability:	
	Bodily Injury by Accident:	
	Each Accident	\$ 1,000,000
	Bodily Injury by Disease:	
	Each Employee	\$ 1,000,000
	Policy Limit	\$ 1,000,000

2. CONTRACTOR's General Liability under Paragraphs 5.04.A.3 through A.6 of the General Conditions which shall be written on a commercial general liability form and which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of CONTRACTOR:

a. Policy Limits:

1)	Each Occurrence Limit (Bodily Injury and Property Damage)	\$ 1,000,000
2)	Medical Expense Limit (Any One Person)	\$ 10,000
3)	Personal and Advertising Injury Limit (Per Person/Organization)	\$ 1,000,000
4)	General Aggregate Limit (other than P-CO)	\$ 3,000,000
5)	Products–Completed Operations Aggregate Limit	\$ 1,000,000

b. Policy shall include as a minimum the following coverages:

- 1) Broad Form Property Damage Coverage.
- 2) An elimination of the exclusions with respect to property under the care, custody, or control of CONTRACTOR. In lieu of elimination of the exclusion, CONTRACTOR may provide Builder's Risk or Installation Floater coverage for property under the care, custody, or control of CONTRACTOR.
- 3) Explosion, Collapse, and Underground coverages where applicable under Property Damage Liability Insurance.
- 4) Contractual Liability Coverage.
- 5) Independent Contractor Coverage.
- 6) General Aggregate Limits specified above shall apply separately to this project by attachment of:

"Amendment of Limits of Insurance–Designated Projects" Endorsement (ISO Form No. CG 25011185) or "Amendment–Aggregate Limits of Insurance–Per Project" Endorsement (ISO Form CG 25031185) or equivalent endorsement coverage.

3. Commercial Automobile Liability under Paragraph 5.04.A.6. of the General Conditions:

a. Policy Limits:

Bodily Injury:

Each Person	\$ 1,000,000

If an OCP or PMPL policy is provided, CONTRACTOR shall provide originals of the Final OCP or PMPL to all insured and additional insured parties.

F. Endorsements, OCP policy, PMPL policy, or General Liability policy shall not exclude supervisory or inspection services.

CONTRACTOR shall also provide an Additional Insured Endorsement for the automobile policy.

G. Policies of insurance shall also include Austin Engineering Co., Inc. as additional insureds under the provisions of Paragraphs 5.04.A.3 through 5.04.A.5 of the General Conditions.

SC-5.04.B Additional Insureds Coverage

5.04.B.1 Additional Insureds

Delete from the first sentence of Paragraph 5.04.B.1 of the General Conditions, the phrase “(subject to any customary exclusion regarding professional liability).”

5.04.B.3 and 5.04.B.7 Products and Completed Operations Insurance

Amend in Paragraphs 5.04.B.3 and 5.04.B.7 of the General Conditions the phrase “completed operations insurance” to read “products and completed operations insurance.”

5.04.B.5 Insurance Policies

Delete the phrase “materially changed” and insert the following in its place:

“materially changed with respect to coverage on the Project.”

SC-5.06.A Property Insurance

Delete Paragraph 5.06.A of the General Conditions in its entirety and insert the following in its place:

A. CONTRACTOR shall purchase and maintain property insurance upon the Work at the Site in the amount of full replacement cost thereof. Insurance shall be completed value form.

1. This insurance shall:

a. include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, and any other individuals or entities identified herein, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured (Insurance certificates shall specifically indicate by name the additional insureds which are to include OWNER and ENGINEER as well as other individuals or entities so identified.);

b. be written on a Builder's Risk “all-risk” form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism, and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (including that caused by flood and hydrostatic pressure), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

c. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

d. cover the total value of materials and equipment supplied under the Contract from the time CONTRACTOR takes possession of them until they are installed and tested by CONTRACTOR and the project is accepted as complete by OWNER under an endorsement to this policy or in the form of Installation Floater Insurance of the "all risk" type;

e. allow for partial utilization of the Work by OWNER;

f. include testing and startup; and

g. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR, and ENGINEER with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

2. CONTRACTOR shall be responsible for any deductible or self-insured retention.

3. The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with this Paragraph SC-5.06.A shall comply with the requirements of Paragraph 5.06.C. of the General Conditions.

SC-5.06.A.1 Additional Insureds

Policy shall also include Austin Engineering Co., Inc. as additional insureds under the provisions of Paragraph 5.06.A.1. of the General Conditions.

SC-5.06.B Boiler and Machinery and Additional Property Insurance

Delete Paragraph 5.06.B of the General Conditions in its entirety and insert the following in its place:

B. CONTRACTOR shall purchase Builder's Risk, Installation Floater, or Boiler and Machinery Insurance or a combination thereof to protect CONTRACTOR's interests in the materials and equipment which will also include the interests of OWNER, Subcontractors, ENGINEER, and any other individuals or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured. Insurance certificate shall specifically indicate by name the additional insureds which are to include OWNER, ENGINEER, and Subcontractors as well as other individuals or entities so identified. CONTRACTOR's coverage shall extend until the materials and equipment are installed and tested by CONTRACTOR and the Project is accepted as complete by OWNER. CONTRACTOR's coverage shall insure against at least the following perils: accident, mechanical breakdown, electric arcing, and problems arising during testing because of defects.

Policy shall also include Austin Engineering Co., Inc. as additional insureds under the provisions of Paragraph 5.06.B of the General Conditions.

SC-5.06.D Deductible Provisions

Delete the first sentence of Paragraph 5.06.D of the General Conditions and insert the following in its place:

CONTRACTOR shall pay all deductible provisions of insurances. The maximum deductible shall be \$5,000.

SC-5.06.E Policies of Insurance

Delete Paragraph 5.06.E. of the General Conditions.

SC-6.02 and 6.03 Working Hours, Limitations, Scheduling, Etc.

See the General Requirements for special requirements concerning working hours.

SC-6.03.B Materials and Equipment Warranty

Add the following to the end of Paragraph 6.03.B of the General Conditions:

Suppliers shall be deemed to impliedly warrant that their products and all component materials incorporated into them are suitable and fit for the intended use of such products and shall be free from defect in material, workmanship or design, such warranty to run to the benefit of OWNER and ENGINEER. The foregoing applies whether the products or their component materials are specified in the Contract Documents or are of Supplier's design.

SC-6.05 Substitutes and "Or Equal" Items

Add the following paragraph to the end of Paragraph 6.05:

G. All requirements of Paragraph 6.05 shall apply to review and acceptance of Equipment Alternatives listed in the Lump Sum Base Bid.

SC-6.06 Concerning Subcontractors, Suppliers and Others

Add the following to Paragraph 6.06.A of the General Conditions:

If OWNER or ENGINEER after due investigations has reasonable objections to any proposed Subcontractor, Supplier, or other individual or entity, either may request CONTRACTOR submit an acceptable substitute without an increase in Contract Price.

Add the following paragraph immediately after Paragraph 6.06.G of the General Conditions:

H. OWNER or ENGINEER may furnish to any Subcontractor or Supplier to the extent practicable, information about amounts paid to CONTRACTOR on account of Work performed for CONTRACTOR by a particular Subcontractor or Supplier.

SC-6.08 Permits

Delete last sentence of Paragraph 6.08.A and add the following in its place.

See General Requirements and technical specification sections for utility charge provisions.

Add Paragraph 6.08.B as follows:

See General Requirements for additional permit information.

SC-6.09 Laws and Regulations

CONTRACTOR shall comply with Illinois Citizens Act, which requires contractors to use Illinois laborers on all public works construction and improvement projects during a period of excessive unemployment. Excessive unemployment is defined as any month immediately following 2 consecutive calendar months that the Illinois unemployment rate exceeds 5%. IDOL takes action against employers who hire non-Illinois workers on public projects if Illinois workers were available and qualified.

SC-6.10 Taxes

No charge will be allowed for taxes from which OWNER is exempt. OWNER is not liable for the Illinois Retailer's Occupation Tax, the Service Occupation Tax (both state and local), the Use Tax, and the Service Use Tax. OWNER is exempt from Federal Excise and Transportation Tax. Refer to Illinois Administrative Code 64-216, Section 130.2075 for details.

Exemption No. E-9993-0811-05. Said taxes shall not be included in the Contract Price.

SC-6.12 Record Documents

In Paragraph 6.12.A. of the General Conditions, change the reference as follows:

In the first sentence change the word "one" to "two."

SC-6.14 Competent Person

Add the following paragraph at the end of Paragraph 6.14.A of the General Conditions:

B. CONTRACTOR shall keep at the Site at all times during the progress of the Work a competent person to comply with OSHA trenching and excavation requirements. The competent person shall be one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

SC-6.17 Shop Drawings

Add the following paragraphs immediately after Paragraph 6.17.E:

F. CONTRACTOR shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than two submittals. ENGINEER will record ENGINEER's time for reviewing subsequent submittals of Shop Drawings, samples or other items requiring approval and CONTRACTOR shall reimburse OWNER for ENGINEER's charges for such time.

G. In the event that CONTRACTOR requests a substitution for a previously approved item, CONTRACTOR shall reimburse OWNER for ENGINEER's charges for such time unless the need for such substitution is beyond the control of CONTRACTOR.

SC-6.20 Indemnification

Add the following to the end of Paragraph 6.20.A of the General Conditions:

In addition, CONTRACTOR shall indemnify, hold harmless, and pay for the defense of OWNER and ENGINEER from and against claims, losses, or damages in regard to any act or failure to act by OWNER or ENGINEER in connection with general supervision, inspection and/or coordination of CONTRACTOR's operations.

CONTRACTOR shall, at its own expense, appear, defend, and pay all fees of attorneys and all costs and other expenses arising therefrom or incurred in connection therewith; and, if any judgments shall be rendered against any individual or entity indemnified hereunder in any such action, CONTRACTOR shall, at its own expense, satisfy and discharge same. CONTRACTOR expressly understands and agrees that any Letter of Credit or insurance protection required by the Contract, or otherwise provided by CONTRACTOR, shall in no way limit the responsibility to indemnify, keep and, save harmless, and defend any individual or entity indemnified hereunder as herein provided.

CONTRACTOR shall also indemnify and hold harmless OWNER, ENGINEER, ENGINEER's consultants and the officers, directors, employees, agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs or awards) arising out of Worker's Compensation claims and caused in whole or in part by any negligent act or omission of CONTRACTOR, any subcontractor, any supplier, any individual or entity directly or indirectly employed by any of them to perform or furnish any of the work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity.

Delete Paragraph 6.20.C.1 and 6.20.C.2. Insert new Paragraphs 6.20.C.1 and D:

1. the preparation of Drawings, Specifications, or Property Surveys.

D. For any matter for which ENGINEER is indemnified under Paragraph 6.20.A, CONTRACTOR shall pay for ENGINEER's reasonable defense, including, but not limited to, all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs or awards until ENGINEER is found negligent. If ENGINEER is found negligent, ENGINEER shall reimburse CONTRACTOR for the prorata extent of ENGINEER's negligence for the cost of ENGINEER's reasonable defense.

SC-9.02 Visits to Site

Change the first sentence of Paragraph 9.02.A to read "ENGINEER will make visits to the site when requested by OWNER in accordance with the terms of the agreement between ENGINEER and OWNER."

SC-9.03 Resident Project Representative

Austin Engineering Co., Inc. will assume the duties and responsibilities of the resident project representative on the Project.

The duties and responsibilities of the resident project representative include the following:

1. Review schedules as required in Paragraph 2.05.A of the General Conditions and amendment thereto.
2. Attend conferences and meetings with CONTRACTOR.
3. Serve as liaison between ENGINEER and CONTRACTOR and help ENGINEER serve as liaison between OWNER and CONTRACTOR.
4. Conduct on-site observation of the work.
5. Observe tests, equipment, and system startups.
6. Report to ENGINEER when clarifications and interpretations of the Contract Documents are needed. Consider, evaluate, and report to ENGINEER, CONTRACTOR's requests for modification.
7. Maintain orderly records, keep a daily log (when on a part-time basis, keep log for days visiting site), and furnish periodic reports to ENGINEER of the progress of the Work.
8. Before project completion, prepare final list of items to be completed or corrected and make recommendations to ENGINEER concerning acceptance of the Work.

The resident project representatives shall not:

1. Authorize any deviation from the Contract Documents or substitutions of materials or equipment.
2. Exceed limitations of ENGINEER's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of CONTRACTOR, Subcontractor, or Contractor's superintendent.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences, or procedures of construction.
5. Advise on, issue directions regarding, or assume control over safety precautions and programs in connection with the Work.
6. Accept shop drawing or sample submittals from anyone other than CONTRACTOR.
7. Authorize OWNER to occupy the Project in whole or in part.
8. Participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by ENGINEER.

SC-12.01 Change of Contract Price

Clarification of Paragraph B.2: The overhead and profit allowance for lump sum work shall be in accordance with Paragraph 12.01.C.2 unless OWNER and CONTRACTOR agree that these allowances are not appropriate for the Work involved.

Delete Paragraph C.2.e and insert the following:

- e. the amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost; and

SC-13.02 Access To Work

Add the following paragraph after Paragraph 13.02.A of the General Conditions:

B. Representatives of the Illinois Environmental Agency (IEPA), or any of their duly authorized representatives will have full access to and the right to examine any pertinent books, documents, papers and records of CONTRACTOR involving transactions related to the project. Refer to the General Requirements for additional requirements.

SC-13.03.A Tests and Inspections

Add the following to the beginning of Paragraph 13.03.A of the General Conditions:

All Work is subject to testing to indicate compliance with Contract Document requirements. Duplicate copies of test results of all tests required shall be submitted to ENGINEER. Testing laboratories are subject to the approval of ENGINEER. Tests and inspection of work may be conducted by OWNER or an independent laboratory employed by OWNER. Tests may also be performed in the field by ENGINEER as a basis for acceptance of the Work.

Add the following to the end of Paragraph 13.03.A. of the General Conditions:

Samples required for testing shall be furnished by CONTRACTOR at no cost to OWNER. In the event that completed Work does not conform to specification requirements during the initial test, the Work shall be corrected and retested for conformance. The entire cost of retesting completed Work shall be borne by CONTRACTOR. This shall include the extra cost for inspection to OWNER which will be deducted from the final amount due CONTRACTOR.

SC-13.07.A Correction Period

Delete in Paragraph 13.07.A of the General Conditions the phrase "If within one year after the date of substantial completion" and insert in its place the following:

"If within one year of the date of final payment or from the date established by ENGINEER that the work or portion thereof began operating or was used in a continuous, satisfactory manner for its intended purpose"

SC-14 Payment to CONTRACTOR and Completion

Replace "ENGINEER" with "OWNER" in all paragraphs in Article 14. OWNER will review and approve all pay applications and will make all inspections and issue documentation as specified in Article 14.

SC-14.02.A Applications for Progress Payment

Add the following paragraph after Paragraph 14.02.A.3 of the General Conditions:

4. CONTRACTOR shall submit with each pay request CONTRACTOR's partial waiver of lien for the full amount of the requested payment. Beginning with the second pay request, and with each succeeding pay request, CONTRACTOR shall submit partial waivers of lien for each Subcontractor and Supplier showing that the amount paid to date to each is at

least equivalent to the total value of Subcontractor's or Supplier's work, less retainage, included on the previous pay request. CONTRACTOR shall submit with each pay request a signed Waiver of Lien Log clearly documenting the following:

- a. The names of all Subcontractors/Suppliers on the project.
 - b. Contract amounts for each Subcontractor/Supplier.
 - c. Amount paid to date to each Subcontractor/Supplier.
 - d. Lien waivers provided with current pay application for previous month's payments.
 - e. Amount to be paid to each Subcontractor/Supplier included in the pending pay request.
 - f. Remaining balance for each Subcontractor/Supplier.
5. CONTRACTOR shall submit one original and one copy on 8-1/2 by 11 paper of each lien waiver submitted.
6. CONTRACTOR shall submit six copies of each pay request for approval.
7. No advanced payment for shop drawing preparation will be made. Shop drawing costs will be paid when equipment and materials are delivered and suitably stored on the site.
8. All stored equipment and materials for which payment is requested shall have two copies of invoices included with the pay request. Equipment shall be identified thoroughly on the invoices, including serial numbers.
9. Payment for the stored equipment and material which are on the site shall not exceed the invoiced amount for each item, less the Contract retainage. The overhead and profit for the stored items shall not be invoiced until the item is installed.
10. Payment for off-site storage is normally reserved for sensitive or very large pieces of equipment that in ENGINEER's opinion would not be practical to have stored on the site. Payment for off-site stored items shall be limited to 75% of the invoiced value of the item, less Contract retainage. CONTRACTOR shall reimburse OWNER the cost of inspecting off-site stored items. When off-site storage is approved, CONTRACTOR shall provide Insurance Certificates and Document of Ownership to OWNER.
11. Payment for PLC and SCADA programming shall be limited to 75% of the invoiced time spent, less Contract retainage.

To allow this payment value, programming must be completed by area and system. CONTRACTOR must provide the following:

- a. Signed certification by an officer of CONTRACTOR and electrical subcontractor that work has been completed.
- b. Ladder diagram or function block dump with complete descriptive narrative in PDF format.
- c. Database cross reference report for graphics (if applicable).

- d. I/O partition list.
- e. Smart I/O (Devicenet, profibers, control net, Ethernet I/O, field bus, etc.) configuration report.
- f. Processor configuration report.
- g. Subroutine listing.

SC-14.02.C Payment Becomes Due

Delete in Paragraph 14.02.C.1 of the General Conditions the phrase "ten days."

Add the following to the end of Paragraph 14.02.C.1 of the General Conditions:

After receipt of loan disbursement funding for the Application for Payment from IEPA Water Pollution Control Fund but not to exceed thirty-five days.

SC-14.05 Partial Utilization

Add the following paragraph immediately after Paragraph 14.05.A.3, which is to read as follows:

4. OWNER may at any time request CONTRACTOR in writing to permit OWNER to take over operation of any part of the Work although it is not substantially complete. A copy of such request will be sent to ENGINEER, and within a reasonable time thereafter, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of that part of the Work to determine its status of completion and will prepare a list of the items remaining to be completed or corrected thereon before final payment. If CONTRACTOR does not object in writing to OWNER and ENGINEER that such part of the Work is not ready for separate operation by OWNER, ENGINEER will finalize the list of items to be completed or corrected and will deliver such lists to OWNER and CONTRACTOR together with a written recommendation as to the division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, utilities, insurance, warranties, and guarantees for that part of the Work which will become binding upon OWNER and CONTRACTOR at the time when OWNER takes over such operation (unless they shall have otherwise agreed in writing and so informed ENGINEER). During such operation and prior to Substantial Completion of such part of the Work, OWNER shall allow CONTRACTOR reasonable access to complete or correct items on said list and to complete other related Work.

Paragraph 14.05.A.4 shall be renumbered to 14.05.A.5.

SC-14.07 Final Application for Payment

Insert the following before the last sentence of Paragraph 14.07.A.3. of the General Conditions:

CONTRACTOR's request for final payment shall also include CONTRACTOR's final waiver of lien which shall be for the full amount of Contract, including any change orders thereto, and final waivers of lien from all subcontractors and suppliers for which final waivers of lien have not previously been submitted.

Delete in Paragraph 14.07.C.1 of the General Conditions the phrase "thirty days."

Add the following to the end of Paragraph 14.07.C.1 of the General Conditions:

After receipt of loan disbursement funding for the Final Application for payment from the IEPA Water Pollution Control Fund but not to exceed forty-five days.

END OF SECTION

PRODUCER Section 00480-8	THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.	
	INSURERS AFFORDING COVERAGE	NAIC #
INSURED Section 00480-6	INSURER A: Section 00480-5	
	INSURER B:	
	INSURER C:	
	INSURER D:	
	INSURER E:	

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR ADD'L LTR INSRD	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS
Se	GENERAL LIABILITY Se COMMERCIAL GENERAL LIABILITY CLAIMS MADE Se OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: POLICY Se PRO-JECT LOC				EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) \$ MED EXP (Any one person) \$ PERSONAL & ADV INJURY \$ GENERAL AGGREGATE \$ PRODUCTS - COMP/OP AGG \$
Se	AUTOMOBILE LIABILITY Se ANY AUTO ALL OWNED AUTOS SCHEDULED AUTOS HIRED AUTOS NON-OWNED AUTOS				COMBINED SINGLE LIMIT (Ea accident) \$ BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$
	GARAGE LIABILITY ANY AUTO				AUTO ONLY - EA ACCIDENT \$ OTHER THAN EA ACC \$ AUTO ONLY: AGG \$
Se	EXCESS/UMBRELLA LIABILITY Se OCCUR CLAIMS MADE DEDUCTIBLE RETENTION \$				EACH OCCURRENCE \$ AGGREGATE \$ \$ \$ \$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? If yes, describe under SPECIAL PROVISIONS below				Se WC STATUTORY LIMITS OTH-ER E.L. EACH ACCIDENT \$ E.L. DISEASE - EA EMPLOYEE \$ E.L. DISEASE - POLICY LIMIT \$
	OTHER Section 00480-1				Section 00450-1

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES / EXCLUSIONS ADDED BY ENDORSEMENT / SPECIAL PROVISIONS

Section 00450-2

CERTIFICATE HOLDER

CANCELLATION

Section 00480-4

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL Secti DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

SPECIFICATIONS

SECTION 01010

SUMMARY OF WORK

PART 1—GENERAL

1.01 DIVISION ONE

- A. The requirements of Division 1 apply to all sections of the Contract(s).

1.02 PROJECT SCOPE

- A. CONTRACTOR shall provide all items, articles, materials, operations or methods mentioned or scheduled on the Drawings or herein specified: including all labor, supervision, equipment, incidentals, taxes and permits necessary to complete the Work as described within the Contract Documents. CONTRACTOR shall install all items provided by OWNER as mentioned or scheduled on the Drawings or herein specified.

1.03 CONTRACT DOCUMENTS—INTENT AND USE

- A. Intent of Documents:
 - 1. Singular notations and specifications shall be considered plural where application is reasonably inferred.
 - 2. Mention or indication of extent of work under any division or Specification section is done only for convenience of CONTRACTOR and shall not be construed as describing all work required under that division or section.
 - 3. Some individual sections may contain a list of related sections. The list of related sections in individual sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. CONTRACTOR may not rely upon this listing for determination of scope of work. Other sections of the Specifications, not referenced in individual sections shall apply as required for proper performance of the Work.
 - 4. Command type sentences may be used in the Contract Documents. These sentences refer to and are directed to CONTRACTOR.
 - 5. Symbols for various elements and systems are shown on the Drawings. Should there be any doubt regarding the meaning or intent of the symbols used, a written interpretation shall be obtained from ENGINEER.
- B. Use of Documents:
 - 1. CONTRACTOR shall examine all Specifications and Drawings for the Work, including those that may pertain to Work CONTRACTOR does not normally perform with its own forces.
 - 2. CONTRACTOR shall use all of the Project Drawings and Specifications:
 - a. For a complete understanding of the Project.
 - b. To determine the type of construction and systems required.
 - c. For coordination with other contractors.
 - d. To determine what other work may be involved in various parts or phases.
 - e. To anticipate and notify others when work by others will be required.
 - f. And all other relevant matters related to the project.
 - 3. CONTRACTOR is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its Work, as may be shown or inferred by the entire set of Project Drawings and Specifications.

1.04 CONSTRUCTION REQUIREMENTS

A. General Information and Requirements:

1. Currently, wastewater treatment at the City of Washington Sewage Treatment Plant No. 2 (STP No. 2) consists of manual bar screening, influent pumping, aerated grit removal, activated sludge aeration followed by final clarification and sand filtration. During wet weather periods excess flow above about 3 mgd is pumped to the Excess Flow Lagoon. The excess flows are typically stored and diverted back to the head of STP No. 2 during dry weather periods. On occasion, during peak wet weather periods when the lagoon is full, overflow from the Excess Flow Lagoon is sent to the chlorine contact tanks, disinfected, blended with effluent from STP No. 2, and discharged to Farm Creek. Waste activated sludge is stabilized in aerobic digesters, stored in a liquid sludge storage tank, dewatered in Sludge Drying Beds, and then disposed of on farm land.
2. Wastewater treatment during construction must be continuous and the treatment efficiency must be equal to that achieved prior to the start of construction.
3. It shall be the responsibility of CONTRACTOR to not in any way impair the normal treatment or operating efficiency of the facilities, regardless of the work underway. No bypassing of raw or partially treated wastewater to receiving stream shall occur at any time as a result of construction. In general, this requires that new facilities be complete and ready for service, or that temporary facilities be provided, prior to removing existing units from service for modification or repair. CONTRACTOR shall provide all temporary piping, bypass pumping, temporary electrical, and temporary construction required to complete the Work.
4. Operation of existing treatment facilities will be the responsibility of OWNER. CONTRACTOR shall cooperate with OWNER's staff at all times and removal of any operating units from service shall be coordinated by CONTRACTOR with OWNER. A minimum of 48 hours prior to making any process or electrical connections to existing facilities or modification or demolition of existing facilities, CONTRACTOR shall notify OWNER in writing. At the time of notification, CONTRACTOR shall submit a schedule for completion of the Work, including a description of measures that will be taken to minimize the impact to existing facilities.
5. Unless otherwise specified or shown on the Drawings, new facilities shall be completed and ready for service and placed into successful operation before existing facilities are taken out of service for modification/upgrading. No more than one existing treatment unit may be taken out of service at a time when making piping interconnections, etc., so that the remaining units are available for treatment. CONTRACTOR shall coordinate taking units out of service and placing units back in service with OWNER.
6. Except as specified, OWNER will drain existing tanks to the level of the lowest existing drain line or will remove tank contents using existing piping and pumping equipment. Subsequent cleaning or further draining and/or pumping shall be provided by CONTRACTOR. If there exists sludge, grit, or other residue that cannot be drained or pumped in its present state, it shall be the responsibility of CONTRACTOR to remove and dispose of this material. CONTRACTOR shall be responsible for removal and disposal of all sludge, scum grit, debris, and other material in existing influent wet well, Excess Flow Inlet/Outlet Basin, West Aeration Tank/Aerobic Digester, East Aerobic Digester, and existing west clarifiers (No. 1 and No. 2).
7. Access: CONTRACTOR shall maintain plant site roadways open at all times to meet OWNER's requirements, including access for sludge hauling vehicles and chemical deliveries. Construction of the phosphorous removal chemical storage facilities south

of the new Screening Building shall be delayed as necessary to allow access to STP No. 2 from the west access drive. CONTRACTOR shall be responsible for maintaining roadways in driveable condition, including placement of temporary stone and gravel and providing drainage as necessary. All city-owned roadways around the treatment facility shall be cleaned of construction site materials, soil, and debris as necessary.

8. Outage Plan: CONTRACTOR shall submit for review a detailed outage plan which includes time scheduled for work activities necessary to remove unit processes, tanks, piping, electrical service, equipment, or structure from service. The plan shall be in writing and also in the form of a bar graph. The outage plan shall be coordinated with the work construction schedule and shall be updated monthly. The outage plan shall follow the construction sequence specified herein and shall include the length of time required to complete said work. The length of time unit processes are out of service shall be minimized. To that end, all new equipment, tools, and materials required for the Work shall be readily available when outage is implemented to minimize down time of unit processes.

B. Construction Sequence:

1. The following construction sequence is provided as a general guideline for the information and for the benefit of CONTRACTOR. This construction sequence is not intended to dictate means, method of construction or direct construction activities. This construction sequence is a conceptual general construction sequence with minimum recommended outage, shutdowns, and operating units to be maintained in service. The general construction sequence is projected to allow the Work to be completed while maintaining treatment of the sewage treatment plant. It is not intended to be all inclusive and does not list all work elements or details that are required to complete the Work, complete treatment processes, or place unit processes in service. CONTRACTOR shall be responsible for implementing any additional details required, including temporary piping, bypass pumping, or temporary construction at no additional cost to OWNER.
2. CONTRACTOR may propose alternate sequence or modifications to this sequence. OWNER will review the proposed modification and determine if such modification of the sequence interferes with the proper operation of the treatment activities. Any modifications to this general construction sequence shall be proposed in writing and shall be approved by OWNER prior to their implementations.
3. New Screening Building, Oxidation Ditch, and Clarifier No. 2 shall be completed and placed in service prior to modifying existing west Aeration Tank/Aerobic Digester, existing West Clarifiers, or modifying existing pressure filters in the RAS Pumping Building.
 - a. Existing excess flow (24 inch-EF) piping from existing wet well to Excess Flow Inlet Structure shall be rerouted prior to construction of Screening Building or Oxidation Ditch. Existing Excess Flow Lagoon (8-inch D) piping from Excess Flow Inlet Structure shall also be rerouted prior to construction of Oxidation Ditch.
 - b. Existing Secondary Effluent (24-inch SE) piping shall be rerouted from the downstream of the existing Effluent Parshall Flume to the existing Plant Effluent Headwall prior to excavation for Clarifier No. 1 or No. 2.
 - c. Raw wastewater (12-in RW) piping from new Screening Building to existing Grit Tank effluent piping shall be complete before placing the Screening Building in service.
 - d. For both items a and b above, new rerouted piping shall be completed and tested prior to making existing upstream and downstream piping connections. Piping connections shall be completed as quickly as possible. CONTRACTOR shall provide bypass pumping necessary to make connections or shall complete

- upstream and downstream connections within a 4-hour low flow nighttime period when OWNER can temporarily shut off sewage coming to STP No. 2.
4. Modifications to existing influent pumping facilities including Wet Well and Dry Well shall be completed prior to placing new Screening Building, Oxidation Ditch, and Clarifier No. 2 in service.
 - a. Piping modifications in the Wet Well shall be completed as quickly as possible. CONTRACTOR shall have all necessary materials and equipment on site to complete the Work and new piping shall be painted prior to the Wet Well being taken out of service. CONTRACTOR shall provide bypass pumping to complete the Work or shall complete work within two 4-hour low flow nighttime periods when OWNER can shut off sewage flow coming to STP No. 2.
 - b. When modifying existing pumping facilities in the Dry Well, only one of the two existing larger pumps shall be taken out of service at a time. Each pump shall be removed, rebuilt, and reinstalled in the new location and placed into operation before taking the other pump out of service. When the Wet Well must be taken out of service or Wet Well level lowered to complete piping modifications in the Dry Well, piping modifications shall be completed as quickly as possible. CONTRACTOR shall have all necessary materials and equipment on site to complete the Work. CONTRACTOR shall provide bypass pumping to complete the Work or shall complete work within no more than two 4-hour low flow periods when OWNER can shut off sewage flow coming to STP No. 2.
 5. Except as noted below, modifications to existing pressure filter building including demolition and conversion to RAS Pumping Building shall be completed after New Screening Building, Oxidation Ditch, and Clarifier No. 2 have been completed and placed in service.
 - a. New electrical service shall be provided to RAS Pumping Building. New masonry wall and electrical work necessary for operation of Screening Building, Oxidation Ditch, and Clarifier No. 2 shall be completed.
 - b. CONTRACTOR shall provide temporary RAS pumps, WAS pumps, piping, appurtenances, and controls until the RAS Pumping Building is substantially complete. Temporary RAS piping shall be provided from Clarifier No. 2 to the Anoxic Zone of the Oxidation Ditch. A minimum of two temporary RAS pumps shall be provided, each with a capacity of 750 gpm. CONTRACTOR may utilize the new scum well for temporary RAS pumping. The ability to divert part of the RAS to the existing aerobic digesters for wasting is also required. CONTRACTOR shall submit proposed details for temporary RAS and WAS system in writing and shall be approved by OWNER prior to implementation.
 - c. CONTRACTOR shall keep existing nonpotable plant water system operational or make provisions for providing nonpotable water for seal water, excess flow chlorination, and yard hydrants.
 6. When the new Screening Building, Oxidation Ditch, and Clarifier No. 2 are complete and ready for startup and temporary RAS/WAS provisions are in place and operational, CONTRACTOR is responsible for startup. The Oxidation Ditch and Final Clarifier No. 2 shall be filled with groundwater from the dewatering wells. All mechanical equipment shall have been checked by the equipment manufacturers and written notice shall be provided that equipment is ready for starting the plant.
 - a. CONTRACTOR shall be responsible for conveying activated sludge from the existing west aeration tanks to the new oxidation ditch that is filled with groundwater. This will be utilized for seeding the new Oxidation Ditch with microorganisms required for the activated sludge process. Since the drain valve from one of the existing aeration tanks is not operational, CONTRACTOR shall

- pump contents to the adjacent aeration tank, and that aeration tank drain valve can be opened to allow contents to drain back to the existing Wet Well.
- b. Demolition of existing aeration tanks cannot proceed until NPDES permit treatment levels are achieved.
 - 7. Clarifier No. 1 and Chlorine Contact Tank may be completed before or after the Screening Building, Oxidation Ditch, and Clarifier No. 2 have been placed in service. However, Clarifier No. 1 and Chlorine Contact Tank cannot be placed in service until the modifications to the RAS Pumping Building have been completed. Prior to placing the Chlorine Contact Tank in service, the existing effluent Parshall Flume shall be removed and 24 inches SE piping installed.
 - 8. Dewatering Beds may be completed independent of other work.
 - 9. CONTRACTOR shall remove at least the top 6 inches of any finished base course on all roads and replace with new base course to remove mud, soil, and debris that will have accumulated during construction. The roads shall be regarded and prepare for final grade prior to receiving the asphaltic concrete pavement.

1.05 CONTRACTOR USE OF SITE

A. General:

- 1. The "area of the site" referred to in these specifications shall be as shown on the Drawings. If the "area of the site" is not shown, OWNER's property lines, the project right-of-way or the easements obtained for the project shall be considered the "area of the site."
- 2. Construction activities shall be confined within the "area of the site" limits.
- 3. From the start of work to completion CONTRACTOR is responsible for the care of the site and the premises which are affected by operations of Work of this Contract.
- 4. Except for permanent site improvements provided under the Contract, CONTRACTOR shall restore property disturbed during the Work, to the conditions which previously existed.
- 5. Work in occupied spaces shall be restricted to specified Work and essential activities, such as making necessary connections and extending services or constructing temporary access ways. Such work shall be scheduled in advance with OWNER.

B. Parking and Deliveries:

- 1. CONTRACTOR is responsible for control of traffic by vehicles and persons within the limits of its operations.
- 2. Parking for employees, subcontractors, and agents of CONTRACTOR shall be in areas subject to approval of OWNER.
- 3. Access to the site for delivery of construction material or equipment shall be subject to approval of OWNER.

1.06 EXISTING SERVICES, STRUCTURES AND UNDERGROUND FACILITIES

- A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security systems, and similar work shall be kept to an absolute minimum and shall be limited to times approved by OWNER.
- B. If deemed necessary by OWNER, such work shall be accomplished after OWNER's normal office hours.
- C. Work shall not commence until all labor, materials and equipment are available so Work can continue without interruption or delay.

- D. Should uncharted or incorrectly charted piping or other utilities be encountered during installation, notify OWNER and consult with utility owner immediately for directions.
- E. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation and repair any damaged utilities to satisfaction of utility owner.
- F. CONTRACTOR shall not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.
- G. Any accidental interruption of services shall be repaired immediately, including provision of temporary facilities until permanent repairs can be made.
- H. Prior to any excavation, demolition, or drilling on site, CONTRACTOR shall contact owners of the underground facilities in and near the construction area of the intent to excavate, demolish, or drill. As part of this notification requirement, CONTRACTOR shall contact "JULIE." CONTRACTOR shall be aware that not all owners participate in "JULIE." A call to this agency shall not absolve CONTRACTOR of the requirements for contacting owners of all underground facilities in and near the construction area. CONTRACTOR shall give reasonable advance notice to "JULIE" and other owners for the notification which shall not be less than the minimum advance notification required.
- I. CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of structures and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such structures and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.
- J. CONTRACTOR shall keep an accurate and complete record of all such structures and Underground Facilities encountered and shall provide OWNER a copy of this record. The record shall include a description of the item encountered, opinion as to conditions, and adequate measurements and depths so that the item can be located in the future.
- K. CONTRACTOR shall inspect all structures and Underground Facilities for condition and soundness. Unsound conditions shall be reported to the structure or facility owner immediately after exposing. CONTRACTOR shall not proceed with the work until the structure or facility owner has been notified. OWNER shall then be given time to inspect and correct, if required, the structure or Underground Facility. CONTRACTOR may make claim under the provisions of Articles 11 and 12 of the General Conditions should CONTRACTOR feel a price or time adjustment is justified.
- L. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing structure or Underground Facility encountered shall be paid for by CONTRACTOR.
- M. Whenever ENGINEER feels it is necessary to explore and excavate to determine the location of existing structures and Underground Facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is required to perform additional work in making the explorations and excavations, extra compensation will be allowed as provided for in the General Conditions.

1.07 PROTECTION OF WORK AND IMPROVEMENTS

- A. CONTRACTOR shall protect the property of OWNER, existing improvements, and the Work installed by CONTRACTOR and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.
- B. CONTRACTOR shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.
- C. CONTRACTOR shall keep property, existing improvements and the Work, including structures, mains, fittings and accessories free from dirt and foreign matter at all times.
- D. CONTRACTOR shall provide temporary plugging of openings, holes and pipe ends that are existing or that CONTRACTOR has installed.
- E. Property, improvements and Work damaged by CONTRACTOR shall be repaired or replaced by CONTRACTOR to the satisfaction of OWNER.

1.08 AVAILABILITY OF LANDS

- A. Easements were not obtained for this project. CONTRACTOR shall contain its operation to within the rights-of-way or lands upon which the work is to be performed.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01019

CONTRACT CONSIDERATIONS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Cash allowances.
 - 2. Measurement and Payment–Lump Sum.
 - 3. Supplemental Unit Prices.

1.02 CASH ALLOWANCES

- A. See Paragraph 11.02 of the General Conditions for costs to be included in allowances.
- B. See individual Specification sections for allowances to be included in the Bid.

1.03 MEASUREMENT AND PAYMENT–LUMP SUM

- A. No separate measurement for payment will be performed for Lump Sum Work.
- B. CONTRACTOR shall estimate percentage of Work completed. ENGINEER will review CONTRACTOR's estimate of quantity of Work completed.
- C. Payment will be made based on the percentage of the Contract completed less retainage and/or liquidated damages.
- D. Unless noted otherwise, all Work described in the Specifications and/or shown on the Drawings shall be included in the Lump Sum Bid.

1.04 SUPPLEMENTAL UNIT PRICES

- A. Supplemental unit prices shall be provided as indicated in the Bid Form.
- B. Refer to sections of the specifications identified in the Bid Form for specific information on use of supplemental unit prices.
- C. Where quantities are specified, the Bid shall include the amount equal to the specified quantity times the supplemental unit price.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01039

COORDINATION, FIELD ENGINEERING, AND MEETINGS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Coordination.
 - 2. Field engineering.
 - 3. Progress meetings.
 - 4. Preinstallation meetings.

1.02 COORDINATION

- A. CONTRACTOR shall coordinate scheduling, submittals, and work of the various sections of the work to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later. See Section 01010—Summary of Work for specific construction sequence.
- B. CONTRACTOR shall verify utility requirements and characteristics of operating equipment are compatible with building utilities and coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. CONTRACTOR shall coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings and shall follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, except as otherwise indicated, CONTRACTOR shall conceal pipes, ducts, and wiring within the construction and coordinate locations of fixtures and outlets with finish elements.
- E. CONTRACTOR shall coordinate completion and clean up of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNER's occupancy.
- F. After OWNER occupancy of premises, CONTRACTOR shall coordinate access to Site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of OWNER's activities.

1.03 FIELD ENGINEERING

- A. CONTRACTOR shall locate and protect property stakes, legal survey monuments, benchmarks, and survey control and reference points. CONTRACTOR shall pay for replacement of disturbed property stakes and legal survey monuments by a Registered Land Surveyor acceptable to OWNER and for replacement of benchmarks and survey control and reference points provided by ENGINEER.

- B. CONTRACTOR shall provide field engineering services as required to establish elevations, lines, and levels, utilizing recognized engineering survey practices.
- C. CONTRACTOR shall be responsible for all lines, elevations, and measurements of buildings, structures, piping, utilities, and other work executed by CONTRACTOR under the Contract. CONTRACTOR must exercise proper precaution to verify figures before laying out the Work, and will be held responsible for any error resulting from its failure to exercise such precaution.

1.04 PROGRESS MEETINGS

- A. Progress meetings will be held throughout progress of the Work at intervals agreed to by OWNER, ENGINEER, and CONTRACTOR. Interval will generally be monthly.
- B. CONTRACTOR's project manager, job superintendent, major subcontractors and suppliers shall attend as appropriate to agenda topics for each meeting. CONTRACTOR's representatives shall have authority to bind CONTRACTOR to decisions at the meetings.
- C. At the meetings, CONTRACTOR shall submit typed reports detailing progress of the Work, compliance with submitted progress schedules and future construction plans affecting the schedule of the Work.
- D. OWNER will prepare and distribute minutes to all attending parties.

1.05 PREINSTALLATION MEETING

- A. When required in individual specification sections, CONTRACTOR shall convene a preinstallation meeting at Work Site prior to commencing Work of the section.
- B. CONTRACTOR shall require attendance of parties directly affecting, or affected by, work of the specific section.
- C. CONTRACTOR shall notify ENGINEER seven days in advance of meeting date.
- D. CONTRACTOR shall prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. CONTRACTOR shall record minutes and distribute copies within two days after meeting to participants, with two copies to ENGINEER, participants, and those affected by decisions made.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01045

CUTTING, PATCHING AND ALTERATIONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for all cutting, fitting, patching, and other alterations required to complete the Work as specified herein or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the Work to install improperly sequenced Work.
 - 3. Remove and replace defective Work.
 - 4. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 5. Remove samples of installed Work as specified for testing.
 - 6. Provide penetrations of surfaces for installation of piping and electrical conduit.
 - 7. Rehabilitate or renovate existing spaces.

1.02 REFERENCES

- A. ANSI A10 Safety Requirements for Construction and Demolition.

1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform all cutting, patching, and alterations in strict accordance with pertinent requirements of these Specifications.
- B. Except as modified by governing codes, CONTRACTOR shall comply with the applicable provision and recommendations of ANSI A10.

1.04 SUBMITTALS

- A. CONTRACTOR shall submit a written request to OWNER well in advance of executing any cutting or alteration which affects the following:
 - 1. Work of OWNER or any separate contractor.
 - 2. Structural value or integrity of any element of the Project.
 - 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 4. Efficiency, operational life, maintenance, or safety of operational elements.
 - 5. Visual qualities of sight-exposed elements.
- B. The request shall include:
 - 1. Description of affected work.
 - 2. The necessity for cutting, patching, or alteration.
 - 3. Effect on work of OWNER or any separate contractor, or on the structural or weather-proof integrity of the Project.
 - 4. Description of proposed work to include:
 - a. Scope of cutting, patching, or alteration.
 - b. Trades who will execute the work.
 - c. Products proposed to be used.

- d. Extent of refinishing to be done.
 - 5. Alternatives to cutting and patching.
 - 6. Written permission of any separate contractor whose work will be affected.
- C. Submit written notice to OWNER designating the date and the time the Work will be uncovered or executed.

1.05 SCHEDULING AND COORDINATION

- A. All work under this section shall be coordinated with OWNER's work forces and those of other contractors and shall be accomplished at times acceptable to OWNER.
- B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service to the existing building, notify ENGINEER and OWNER 72 hours in advance and obtain OWNER's approval before proceeding with this phase of the work. Temporary facilities, if required, shall be in place prior to disruption of service.

PART 2-PRODUCTS

2.01 NEW MATERIALS

- A. For replacement of work removed, CONTRACTOR shall use materials which comply with the pertinent sections of these Specifications.
- B. All new materials for patching and extending work shall match existing products and work.
- C. CONTRACTOR shall determine type and quality of existing products by inspection and any necessary testing, and workmanship by use of existing as the standard.

2.02 SALVAGEABLE MATERIAL

- A. Materials or items designated to be reinstalled or to become the property of OWNER shall be as specified or as shown on the Drawings.
- B. CONTRACTOR shall remove such items with care under the supervision of the trade responsible for reinstallation.
- C. CONTRACTOR shall store these materials (off-site if necessary) and protect from damage until they are incorporated into the new work.
- D. Items which are not to be reinstalled but are to become the property of OWNER shall be removed by CONTRACTOR with care, cleaned, and stored in a location at the Site to be approved by OWNER.
- E. Materials or items damaged in its removal shall be replaced by CONTRACTOR with similar new material at no additional cost to OWNER.
- F. Where existing equipment or fixtures are indicated to be reused, CONTRACTOR shall repair such equipment and refinish as specified elsewhere.

2.03 UNSALVAGEABLE MATERIALS

- A. Materials or items demolished and not designated to become the property of OWNER or not designated to be reinstalled shall become the property of CONTRACTOR and shall be removed from the site and legally and properly disposed of by CONTRACTOR.
- B. Materials shall be removed by CONTRACTOR in a manner that will avoid damage to materials or equipment to remain.

PART 3—EXECUTION

3.01 INSPECTION

- A. CONTRACTOR shall inspect existing conditions including elements subject to movement or damage during cutting, patching, and other alterations.
- B. After uncovering the work, CONTRACTOR shall inspect conditions affecting installation of new products or performance of new work.
- C. CONTRACTOR shall report unsatisfactory or questionable conditions to ENGINEER in writing.
- D. CONTRACTOR shall not proceed with work until unsatisfactory or questionable conditions are resolved.
- E. Beginning of cutting, patching, and alterations work means acceptance of existing conditions by CONTRACTOR.

3.02 PREPARATION AND PROTECTION

- A. CONTRACTOR shall provide temporary bracing, shoring, needling, and support of the structure during alterations work as necessary to prevent collapse, settling, or deflection and to protect persons and property from injury or damage.
- B. Temporary supports must adequately carry all existing and imposed load.
- C. CONTRACTOR shall provide and maintain temporary protection of surface finishes, equipment, and adjacent work designated to remain where demolition, removal, and new work is being done, connections are being made, materials are being handled, or equipment is being removed.
- D. CONTRACTOR shall provide temporary partitions or barriers to contain all dust, dirt and debris from entering into finished areas.
- E. CONTRACTOR shall provide adequate fire protection in accordance with local Fire Department requirements.
- F. CONTRACTOR shall provide waterproofing, weather protection, heat, and other facilities for that portion of the work which may be exposed by cutting and patching, demolition, or other alterations.

- G. CONTRACTOR shall cut, move, or remove items as necessary for access to alterations and renovations work and replace and restore at completion of work.
- H. CONTRACTOR shall prepare surfaces and remove surface finishes to provide for proper installation of new work and new finishes.
- I. CONTRACTOR shall be responsible for any damage to the existing structure or its contents directly or indirectly by its crews or those of its subcontractors.

3.03 PERFORMANCE

- A. CONTRACTOR shall accomplish all work of cutting, removal, demolition, patching or other alterations using only persons skilled in the appropriate trade.
- B. CONTRACTOR shall execute the work in a careful and orderly manner, with the least possible disturbance to the occupants of the building.
- C. CONTRACTOR shall execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.
- D. CONTRACTOR shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
- E. CONTRACTOR shall fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- F. CONTRACTOR shall thoroughly clean and prepare all surfaces to receive new finish or covering to completely remove all dirt, dust, grease, oil, paint, loose materials, and soil.
- G. CONTRACTOR shall refinish entire surface as necessary to provide an even finish to match adjacent finishes:
 - 1. For continuous surfaces, refinish to nearest intersection.
 - 2. For an assembly, refinish entire unit.

3.04 DEMOLITION, CUTTING, AND REMOVAL

- A. Cutting and removal of construction shall be performed by CONTRACTOR so as not to cut or remove more than is necessary and so as not to damage adjacent work.
- B. CONTRACTOR shall cut out embedded anchorages and attachment items as required to properly provide for patching and repair of the respective finishes.
- C. CONTRACTOR shall not cut structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.
- D. CONTRACTOR shall not cut operational elements and safety components in a manner resulting in decreased performance, shortened useful life, or increased maintenance.
- E. CONTRACTOR shall not cut work exposed to view (exterior or interior) in a manner resulting in noticeable reduction of visual qualities as determined by OWNER.

- F. Construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of careless cutting or demolition and is unsuitable for use intended shall be removed and replaced at no additional cost to OWNER.
- G. CONTRACTOR shall clean demolished areas and remove debris, waste, and rubbish from the building at the conclusion of each day's work.
- H. CONTRACTOR shall not let piled waste material endanger the structure.

3.05 PATCHING, EXTENDING, AND MATCHING

- A. Patching work shall conform to the standards of the Specifications where applicable and where not specified, work shall conform to the highest standards of the applicable trade.
- B. CONTRACTOR shall patch construction to match adjacent work unless noted otherwise.
- C. Patching or restoration shall be carried to natural breaks (e.g., corners) wherever possible.
- D. CONTRACTOR shall provide adequate support to substrate for patching finishes.
- E. At locations in existing areas where partitions are removed, CONTRACTOR shall patch floors, walls, and ceiling with finish material to match adjacent surfaces.
- F. Transitions:
 - 1. Where new work abuts or finishes flush with existing work, CONTRACTOR shall make the transition as smooth as possible.
 - 2. Patched work shall match adjacent work in texture and appearance so as to make the patch or transition invisible to the eye at a distance of 3 feet.
 - 3. Where masonry, tile, plaster, metal or other finished surface is cut in such a way that a smooth transition is not possible, CONTRACTOR shall terminate the existing surface in a neat fashion along a straight line at a natural line of division and provide trim appropriate to the finished surface.
 - 4. Where two or more spaces are indicated to become one space, CONTRACTOR shall rework floors and ceilings so that horizontal planes are without breaks, steps, or bulkheads, unless shown otherwise.
 - 5. In case of extreme level changes (3 inches or more) review condition with ENGINEER prior to making transition.
 - 6. CONTRACTOR shall restore existing work that is damaged during patching operations to a condition equal to its construction at the time of the start of work.

3.06 UNANTICIPATED MECHANICAL AND ELECTRICAL WORK EXPOSED

- A. Where unanticipated mechanical piping or electrical conduit is exposed during removal of partitions or walls, removal or rerouting shall be accomplished by CONTRACTOR as applicable.
 - 1. Rerouted piping shall be located and shall be connected to maintain all functions in proper operations.
 - 2. Abandoned piping may be left in place where it is buried in floors or walls, providing that it is completely disconnected from its source.
 - 3. There shall be no "dead end" gas, water, sewer, or vent piping existing in the completed work.

4. Unless otherwise shown, abandoned piping, ductwork, conduit, or other mechanical or electrical items in chases, vertical enclosures, or concealed above ceilings shall be completely removed.
- B. Removals, capping, or otherwise terminating services which are abandoned shall be accomplished without additional cost to OWNER.
- C. Relocation of services resulting from unanticipated conflicts of new and existing work in concealed spaces shall be paid for in accordance with the General Conditions.

END OF SECTION

SECTION 01060

REGULATORY REQUIREMENTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. OSHA Requirements.
 - 2. Roadway Limits.
 - 3. Permits.
 - 4. Wage Rates.
 - 5. Loan Rules.

1.02 OSHA REQUIREMENTS

- A. All work including site safety, equipment, materials, and fabricated items provided under the Contract shall comply with the provisions of the "Occupational Safety and Health Act."

1.03 ROADWAY LIMITS

- A. CONTRACTOR shall comply with roadway weight restrictions including seasonal weight restrictions.

1.04 PERMITS

- A. The following permits were obtained by OWNER and included as an attachment to this Division:
 - 1. Illinois Environmental Protection Agency Construction Permit.
 - 2. Illinois Department of Natural Resources, Office of Water Resources Permit No. DS2009031.
- B. The following permits have been applied for by OWNER: Illinois Environmental Protection Agency Notice of Intent—General Permit to Discharge Storm Water Construction Site Activities.
- C. CONTRACTOR shall comply with all provisions of these permits and shall be responsible for notifications as required by these permits. CONTRACTOR shall obtain all other permits required for the Work. Where the requirements of any permit is more restrictive than the Drawings or the Specifications, the permit requirements shall govern.
- D. A building permit will not be required from OWNER.
- E. Any permits required for dewatering operations shall be obtained and paid for by CONTRACTOR.

1.05 WAGE RATES

- A. CONTRACTOR and any subcontractor shall pay all laborers, workers, and mechanics performing work under the Contract not less than the prevailing wages in accordance with the Davis-Bacon Act (40 USC 276a through 276a-5). Wage rates are available on the U.S. Government Printing Office website at www.gpo.gov/davisbacon and at the office of OWNER.
- B. CONTRACTOR shall keep or cause to be kept a record of employees and wages paid as required by the Davis-Bacon Act. CONTRACTOR shall also require each subcontractor employed on the project to keep these same records. In accordance with the Davis-Bacon Act, CONTRACTOR shall submit certified payroll records on a weekly basis to OWNER, along with a statement affirming that such records are true and accurate, that the wages paid to each worker are not less than the required prevailing rate and that CONTRACTOR is aware that filing records he or she knows to be false is unlawful.
- C. The certified payroll records shall include for every worker employed on the project the name, address, social security number, work classification, hourly wages paid in each pay period, daily and weekly number of hours worked, deductions made, and actual wages paid. Forms are available from the U.S. Department of Labor website at www.dol.gov/compliance/laws/comp-dbra.htm.
- D. If at the time this Contract is executed, or if during the term of this Contract, there is excessive unemployment in Illinois as defined in the employment of Illinois Workers on Public Works Act, 30 ILCS 570-0.01 *et seq.*, as two consecutive months of unemployment exceeding 5%, CONTRACTOR agrees to employ Illinois laborers. An "Illinois laborer" is defined as any person who has resided in Illinois for at least 30 days and intends to become or remain an Illinois resident.

1.06 LOAN RULES

- A. CONTRACTOR shall comply with Illinois Administrative Code, Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter II: Environmental Protection Agency, Part 369: Procedures for Issuing Loans from the Water Pollution Control Loan Program. Copies of relevant sections are attached at the end of Division 1.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01090

REFERENCE STANDARDS AND DEFINITIONS

PART 1—GENERAL

1.01 SUMMARY

A. Work Included:

1. Reference Standards:

- a. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
- b. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is CONTRACTOR's responsibility to provide materials and workmanship which meet or exceed that specifically named code or standard.
- c. It is also CONTRACTOR's responsibility, when so required by the Contract Documents, to deliver to ENGINEER all required proof that the material or workmanship, or both, meet or exceed the requirements of the specifically named code or standard.

2. Definitions:

- a. A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon.
- b. Certain terms used in the Contract Documents are defined generally in this section to supplement definitions of the Agreement, General Conditions, Supplementary Conditions, and other general contract documents.
- c. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the Work.

- ###### B. Related Work Described Elsewhere: The specific naming of codes or standards occurs on the Drawings and in other sections of these Specifications.

1.02 QUALITY ASSURANCE

A. Familiarity with Pertinent Codes and Standards:

1. It is CONTRACTOR's responsibility to verify the requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.
2. When required by individual sections of these specifications, CONTRACTOR shall obtain a copy of each pertinent code or standard and maintain the copies at the job site during submittals, planning, and progress of the Work until Substantial Completion of the Work is attained.

B. Overlapping or Conflicting Requirements:

1. Where compliance with two or more industry standards or sets of requirements are specified, and the overlapping of those standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement (which is generally recognized to be also most costly) is intended and will be enforced, unless

more detailed language written directly into Contract Documents clearly indicates that a less stringent requirement is acceptable.

2. Refer all uncertainties to ENGINEER for decision before proceeding.

1.03 REFERENCE STANDARDS

- A. Applicable standards of the construction industry are made a part of the Contract Documents by reference as if copied directly into the Contract Documents, or as if published copies were bound herewith. See Article 3.02 of the General Conditions for additional provisions regarding references.
- B. Standards referenced directly in the Contract Documents or by governing regulation, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
- C. Nonreference standards are hereby defined to have no particular applicability to the work except as a general measurement of whether the Work complies with standards recognized in the construction industry.
- D. Reference standards and codes listed in these specifications may include, but are not necessarily limited to, standards or codes published by the following agencies and organizations:

1. AA Aluminum Association
 900 19th Street, NW, Washington, DC 20006
2. AAMA American Architectural Manufacturer's Association
 1827 Walden Office Square, Schaumburg, IL 60173
3. AASHTO American Association of State Highway & Transportation Officials
 444 North Capitol Street, NW, Washington, DC 20001
4. ACI American Concrete Institute
 38800 Country Club Drive, Farmington Hills, MI 48331
5. AI Asphalt Institute
 Research Park Drive, P.O. Box 14052, Lexington, KY 40512-4052
6. AISC American Institute of Steel Construction
 One East Wacker Drive, Suite 3100, Chicago, IL 60601-2001
7. AISI American Iron and Steel Institute
 1101 17th Street, NW, Suite 1300, Washington, DC 20036
8. ANSI American National Standards Institute
 11 West 42nd Street, New York, NY 10036
9. APA American Plywood Association
 7011 So. 19th, Tacoma, WA 98466
10. API American Petroleum Institute
 12201 L Street, NW, Washington, DC 20005-4070

11. ARI Air-Conditioning & Refrigeration Institute
4100 N. Fairfax Drive, Suite 200, Arlington, VA 22203
12. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning
Engineers
1791 Tullie Circle, NE; Atlanta, GA 30329
13. ASME American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990
14. ASSE American Society of Sanitary Engineering
901 Canterbury, Suite A, Westlake, OH 44145
15. ASTM American Society for Testing and Materials
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
16. AWI Architectural Woodwork Institute
1952 Isaac Newton Square West, Reston, VA 20190
17. AWWPA American Wood-Preserver's Association
P.O. Box 388, Selma, AL 36702-0388
18. AWS American Welding Society
550 N.W. LeJune Road, Miami, FL 33126
19. AWWA American Waterworks Association
6666 West Quincey Avenue, Denver, CO 80235
20. BHMA Builder's Hardware Manufacturers Association
355 Lexington Avenue, 17th floor; New York, NY 10017
21. BIA Brick Industry Association
11490 Commerce Park Drive, Reston, VA 20191-1525
22. CRSI Concrete Reinforcing Steel Institute
9333 N. Plum Grove Road, Schaumburg, IL 60173
23. EJMA Expansion Joint Manufacturers Association
25 North Broadway, Tarrytown, NY 10591
24. EJMA Factory Mutual System
FM Global Corporate Offices
1301 Atwood Avenue, PO Box 7500
Johnston, RI 02919
25. FS Federal Specification (General Services Admin.)
Bldg. 197, Washington Navy Yard; Washington, DC 20407
26. FTI Facing Tile Institute
Box 8880, Canton, OH 44711

- 27. GA Gypsum Association
810 1st St., NE, Washington, DC 20002
- 28. GANA Glass Association of North America
2945 SW Wanamaker Drive, Suite A, Topeka, KS 66614
- 29. IESNA Illuminating Engineering Society of North America
120 Wall Street, Floor 17, New York, NY 10005
- 30. MIL Military Specifications
Naval Publications and Forms Center
5801 Tabor Avenue, Philadelphia, PA 19120
- 31. NAAMM National Association of Architectural Metal Manufacturers
8 South Michigan Avenue, Suite 1000, Chicago, IL 60603
- 32. NCMA National Concrete Masonry Association
13750 Sunrise Valley Drive, Herndon, VA 20171-4662
- 33. NECA National Electrical Contractors Association
3 Bethesda Metro Center, Suite 1100, Bethesda, MD 20814
- 34. NEMA National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847, Rosslyn, VA 22209
- 35. NFPA National Fire Protection Association
1 Batterymarch Park, Quincy, MA 02169-7471
- 36. NIS National Institute of Standards
(U.S. Department of Commerce), 100 Bureau Drive, Stop 3460
Gaithersburg, MD 20899-3460
- 37. NRCA National Roofing Contractors Association
10255 W. Higgins Road, Suite 600, Rosemont, IL 60018
- 38. NSF National Sanitation Foundation International
P.O. Box 130140, 789 N. Dixboro Road, Ann Arbor, MI 48113-0140
- 39. OSHA Occupational Safety & Health Administration
200 Constitution Avenue, NW, Washington, DC 20210
- 40. PCA Portland Cement Association
5420 Old Orchard Road, Skokie, IL 60077
- 41. PCI Prestressed Concrete Institute
209 W. Jackson Blvd., Chicago, IL 60606-6938

- 42. SAE Society of Automotive Engineers
SAE World Headquarters
400 Commonwealth Drive, Warrendale, PA 15096-0001
- 43. SDI Steel Deck Institute
P.O. Box 25, Fox River Grove, IL 60021
- 44. SDI Steel Door Institute
30200 Detroit Rd., Cleveland, OH 44145-1987
- 45. SIGMA Sealed Insulating Glass Manufacturers Assoc.
401 N. Michigan Avenue, Chicago, IL 60611-4267
- 46. SJI Steel Joist Institute
3127 10th Ave. North Ext., Myrtle Beach, SC 29577-6760
- 47. SMACNA Sheet Metal and Air Conditioning
Contractor's National Association
4201 Lafayette Center Drive, Chantilly, VA 20151-1209
- 48. SSPC Society for Protective Coatings
40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656
- 49. TCA Tile Council of America
100 Clemson Research Blvd., Anderson, SC 29625
- 50. UBC Uniform Building Code
5360 Workman Mill Road; Whittier, CA 90601-2298
- 51. UL Underwriters' Laboratories
333 Pfingston Road; Northbrook, IL 60062

1.04 SUBMITTALS

- A. For OWNER's records, CONTRACTOR shall submit copies of permits, licenses, certifications, inspection reports, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

1.05 DEFINITIONS

- A. Indicated:
 - 1. The term "indicated" is a cross-reference to details, notes, or schedules on the drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in the Contract Documents.
 - 2. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated", it is for the purpose of helping the reader locate cross-reference, and no limitation is intended except as specifically noted.

- B. Approve (or Words of Similar Nature):
1. Where used in conjunction with ENGINEER's response to submittals, requests, applications, inquiries, reports, and claims by CONTRACTOR, the meaning of the term "approve" will be held to the limitation of ENGINEER's responsibilities and duties as specified in Paragraph 1.02.B.1. of the General Conditions.
 2. In no case will "approval" by ENGINEER be interpreted as a release of CONTRACTOR from responsibility to fulfill requirements of the Contract Documents.
- C. Minimum Requirements:
1. Indicated requirements are for a specific minimum acceptable level of quality or quantity, as recognized in the industry.
 2. Actual work must comply with (or within specified tolerances) or exceed minimums.
 3. CONTRACTOR shall refer uncertainties to ENGINEER before proceeding.
- D. Abbreviations: Abbreviations, where not defined in the Contract Documents, will be interpreted to mean the normal construction industry terminology.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number or by reference to recognized industry standards.
 - 2. To facilitate CONTRACTOR's understanding of the design intent, procedures have been established for advance submittal of design data and for its review or rejection by ENGINEER.
 - 3. The type of submittal requirements specified in this section include shop drawings, product data, samples, and other miscellaneous work related submittals.
- B. Related work described elsewhere: Additional requirements for submittals are described in other sections of these specifications. Submittals shall conform to Article 6 of the General Conditions.

1.02 IDENTIFICATION OF SUBMITTALS

- A. CONTRACTOR shall completely identify each submittal and re-submittal by showing at least the following information:
 - 1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
 - 2. Name and location of project and identification number.
 - 3. Drawing number and specifications section number to which the submittal applies.
 - 4. Include the date of each submittal or re-submittal.

1.03 GROUPING OF SUBMITTALS

- A. Unless otherwise specifically permitted by ENGINEER, CONTRACTOR shall make all submittals in groups containing all associated items so that information is available for checking each item when it is received.
- B. Partial submittals may be rejected as not complying with the provisions of the Contract Documents.

1.04 TIMING OF SUBMITTALS

- A. CONTRACTOR shall make all submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary approval, for possible revision and re-submittal and for placing orders and securing delivery.

1.05 SHOP DRAWINGS

- A. Shop drawings include specially-prepared technical data for this project including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to a range of similar projects. Shop drawings shall be submitted for all manufactured or fabricated items. See individual technical sections for special requirements.
- B. CONTRACTOR shall make all shop drawings accurately to scale and sufficiently large to show all pertinent aspects of the item and its method of connection to the work.
- C. Shop drawings shall be checked, approved, and stamped by CONTRACTOR in accordance with the General Conditions before transmittal to OWNER for ENGINEER review and approval.
- D. Complete shop drawings and descriptive data shall be submitted on all manufactured or fabricated items prior to 25% completion of the Work. Except as noted, six copies of shop drawings and descriptive data shall be submitted to OWNER for ENGINEER approval. Three copies of these will be returned to CONTRACTOR if approved. If shop drawings are not approved or if they are stamped "Approved as Noted-Resubmit," two corrected copies will be returned to CONTRACTOR for use in resubmittal. If CONTRACTOR desires more than three approved copies, submitted quantity shall be increased accordingly.
- E. Shop drawings shall be submitted in 3-ring binders or 3-tab report covers.
- F. Shop drawings submitted to OWNER will be reviewed by ENGINEER and stamped "Approved," "Approved as Noted," "Approved as Noted-Resubmit," or "Not Approved." CONTRACTOR shall resubmit the above number of corrected shop drawings for all shop drawings stamped "Approved as Noted-Resubmit" and "Not Approved" and will continue this process until shop drawings are stamped "Approved" or "Approved as Noted." If drawings are stamped "Approved as Noted-Resubmit," fabrication may proceed in accordance with the marked up shop drawings. Installation shall not proceed until shop drawings have been resubmitted and stamped "Approved" or "Approved as Noted."
- G. If shop drawings are stamped "Approved as Noted" or "Approved as Noted-Resubmit" and CONTRACTOR does not agree with revisions or cannot conform with revisions, fabrication shall not proceed and shop drawings shall be resubmitted with explanation of CONTRACTOR's position.
- H. All shop drawings used for construction site activities shall bear the "Approved" or "Approved as Noted" stamp of ENGINEER.
- I. Arrangements may be made between CONTRACTOR and ENGINEER to provide additional copies of "Approved" shop drawings for field activity purposes.

1.06 COLORS AND PATTERNS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, whenever a choice of color or pattern is available in a specified product CONTRACTOR shall submit accurate color charts and pattern charts to ENGINEER for OWNER's review and selection.
- B. Unless all available colors and patterns have identical wearing capabilities, and are identically suited for the installation, CONTRACTOR shall completely describe the relative capabilities of each.

1.07 SAMPLES AND FIELD MOCK-UPS

- A. CONTRACTOR shall provide samples and field mock-ups where noted or specified.
- B. Samples are physical examples which illustrate materials, equipment, or workmanship and establish standards by which the work will be judged.
- C. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product, and full range of color, texture, and pattern.
- D. Samples shall have labels firmly attached, bearing the following information:
 - 1. Name of project.
 - 2. Description of product and finish.
 - 3. Name of CONTRACTOR.
 - 4. Trade name and number of product.
 - 5. Standards met by the product.
- E. Approval of samples must be obtained prior to proceeding with any work affected by material requiring sample approval.
- F. Samples, unless otherwise noted, become the property of OWNER.
- G. In situations specifically approved by ENGINEER, the retained sample may be used in the construction as one of the installed items.
- H. Field mock-ups:
 - 1. CONTRACTOR shall erect field mock-ups at the project site in a location acceptable to ENGINEER and OWNER.
 - 2. When accepted by ENGINEER, the mock-up will become the basis for comparison of the actual work.
 - 3. Remove mock-up at conclusion of the work if it was not incorporated into the work.

1.08 PRODUCT DATA

- A. CONTRACTOR shall provide product data as required to supplement shop drawings.
- B. Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by CONTRACTOR to illustrate a material, product, or system for some portion of the work.
- C. CONTRACTOR shall collect required product data into one submittal for each unit of work or system.

- D. CONTRACTOR shall include manufacturer's standard printed recommendations for application and use, compliance with standards, performance characteristics, wiring and piping diagrams and controls, component parts, finishes, dimensions, required clearances, and other special coordination requirements.
- E. CONTRACTOR shall mark each copy of standard printed data to identify pertinent products, models, options, and other data.
- F. CONTRACTOR shall supplement manufacturer's standard data to provide information unique to the work.

1.09 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by ENGINEER.
- B. Shop Drawings and Product Data:
 - 1. Revise initial drawings or data and resubmit as specified for initial submittal.
 - 2. Itemize in a cover letter any changes which have been made other than those requested by ENGINEER.

1.10 MANUFACTURER'S DIRECTIONS

- A. Manufactured articles, materials and equipment shall be stored, commissioned, operated, applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer, unless specified to the contrary.
- B. Wherever specifications call for work to be performed, or materials to be installed in accordance with the manufacturer's printed instructions or directions, CONTRACTOR shall furnish copies as required for shop drawings of those instructions or directions to OWNER before installing the material or performing the work.

1.11 MAINTENANCE MANUAL

- A. Prior to 50% completion of the Contract, CONTRACTOR shall furnish to OWNER four complete copies of a maintenance manual for all equipment furnished.
- B. The manuals shall include manufacturer's instructions for maintenance and operation for each item of mechanical and electrical equipment. Manuals shall be specific for the equipment as installed; provide project specific inserts as required. Manuals shall contain: operation instructions, lubrication schedules, types and quantities, preventative maintenance program, spare parts list, parts lists, I.D. No. and exploded views, assembly instructions, parts supplier location, trouble shooting and startup procedures and, where applicable, test data and curves.
- C. All sheets have reduced dimensions as described for shop drawings, and shall be furnished in 3-ring binders or 3-tab report covers.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1—GENERAL

1.01 SUMMARY

- A. Work Includes:
 - 1. Quality assurance—control of installation.
 - 2. Tolerances
 - 3. Manufacturers' field services and reports.

1.02 QUALITY ASSURANCE—CONTROL OF INSTALLATION

- A. CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. CONTRACTOR shall comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.
- D. CONTRACTOR shall comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Work shall be performed by persons qualified to produce workmanship of specified quality.
- F. CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

- A. CONTRACTOR shall monitor tolerance control of installed products to produce acceptable work and shall not permit tolerances to accumulate.
- B. CONTRACTOR shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from ENGINEER before proceeding.
- C. CONTRACTOR shall adjust products to appropriate dimensions; position before securing products in place.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification sections or when requested by ENGINEER, CONTRACTOR shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship.

- B. CONTRACTOR shall submit qualifications of observer to ENGINEER 30 days in advance of required observations.
- C. CONTRACTOR shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. CONTRACTOR shall submit report in duplicate within 30 days of observation to ENGINEER for information.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Temporary utilities.
 - 2. Temporary stairs and access.
 - 3. Temporary support facilities.
 - 4. Construction sign.
 - 5. Removal of temporary facilities.
- B. CONTRACTOR shall arrange for and provide temporary facilities as required for proper and expeditious prosecution of the Work.
- C. CONTRACTOR shall pay all costs, except as otherwise specified, until final acceptance of the Work unless OWNER makes arrangements for use of completed portions of the Work after substantial completion in accordance with the provisions of the General Conditions.
- D. CONTRACTOR shall make all temporary connections to utilities and services in locations acceptable to OWNER and local authorities having appropriate jurisdiction.
 - 1. Furnish all necessary labor and materials.
 - 2. Make all installations in a manner subject to the acceptance of such authorities and OWNER.
 - 3. Maintain such connections.
 - 4. Remove temporary installation and connection when no longer required.
 - 5. Restore services and sources of supply to proper operating conditions.

1.02 TEMPORARY UTILITIES

- A. Temporary Toilets: CONTRACTOR shall provide and maintain sanitary temporary chemical toilets located where approved by OWNER and in sufficient number required for the work force employed by CONTRACTOR.
- B. Temporary Electrical Services:
 - 1. CONTRACTOR shall make all necessary arrangements, furnish, install, and maintain necessary temporary electrical services at the Site. Services shall be a minimum of 200 amperes, 1 phase, 3 wire, 120/240 volt temporary power and lighting system adequate for the construction of this Project and in accordance with OSHA Requirements for Construction Projects. Installation of the temporary power and lighting system is to begin upon notification to proceed and shall be installed and routed in a manner so as not to interfere with construction of the Project. CONTRACTOR shall remove all temporary services when Project is complete.
 - 2. The temporary light and power system shall include temporary service poles, metering facilities, driven ground, fused main disconnect switch, panelboards, branch circuits, outlets and lamps, and the maintenance thereof.

3. Construction areas, aisles, stairs, and ramps shall be illuminated to 5 fc. Construction shops, storerooms, mechanical, and electrical rooms shall be illuminated to 10 fc. Offices illuminated to 30 fc.
 4. Temporary lights shall be equipped with heavy-duty electric cords and lamp guards. They must not be suspended by the power supply cord unless it is designed for this use.
 5. Provide one general purpose, 20 ampere, 120 volt, single phase, grounding type receptacle outlet for every 1,000 feet of floor space and tank area. The maximum length of a 20 ampere, 120 volt lighting or power circuit shall not be greater than 200 feet from panelboard to farthest outlet. All single phase receptacle outlet circuits shall have approved ground-fault circuit interrupter protection.
 6. All utility charges for installation of the temporary services shall be paid for by CONTRACTOR. All metering installation charges and all energy charges for electric current used for temporary lighting and power are to be paid by CONTRACTOR.
 7. No permanent electrical equipment or wiring shall be used without express written permission of OWNER. Such approval, if given, shall not affect guarantee period. If OWNER authorizes use of permanent service facilities, CONTRACTOR shall pay all metering costs until acceptance or occupancy (whichever occurs first) of building by OWNER.
- C. Weather Protection and Temporary Heat:
1. CONTRACTOR shall provide weather protection to protect the Work from injury because of freezing, rain, snow, and other inclement weather.
 2. CONTRACTOR shall provide temporary heat within buildings, without cost to OWNER, from the time the buildings or portions thereof are enclosed until the Project is accepted or occupied by OWNER, whichever occurs first. The building work is to be heated during construction so a minimum temperature of 50°F is maintained at all times. The temporary heating equipment shall be of a type approved by ENGINEER.
 3. Tanks that are constructed and existing tanks taken out of service as part of the Work shall be protected by CONTRACTOR from damage because of frost by insulating, enclosure, heating, or a combination of methods as required.
 4. No permanent heating equipment shall be used on a temporary basis without express written permission by OWNER. Such approval, if given, shall not affect the guarantee period. If OWNER authorizes use of permanent heating equipment, CONTRACTOR shall pay all related energy costs until acceptance or occupancy (whichever occurs first) of the building by OWNER.
- D. Temporary Telephone Service: CONTRACTOR shall provide, without extra cost to OWNER, telephone services at the Site for phones and computed modem specified in Section 01590—Field Offices and Sheds for the duration of the Work at the Site. Also provide service as required for CONTRACTOR's use. Party making toll calls shall pay for same.
- E. Temporary Water: CONTRACTOR shall supply its own water during construction. CONTRACTOR shall also provide its own piping, valves, and appurtenances for its requirements. Connection to the existing water system shall be coordinated with OWNER and shall meet all code requirements including disinfection and backflow prevention.
- F. Temporary Fire Protection: CONTRACTOR and Subcontractor(s) who maintain or provide an enclosed shed or trailer shall provide and maintain in operating order in each shed or trailer a minimum of one fire extinguisher. More extinguishers shall be provided as

necessary. Fire extinguishers shall be minimum dry chemical, nonfreezing-type, UL rating 2A-30BC, with 10-pound capacity for Class A, B, and C fires.

1.03 TEMPORARY STAIRS AND ACCESS

- A. CONTRACTOR shall provide and maintain all equipment such as temporary stairs, ladders, ramps, runways, chutes, and so on as required for proper execution of the Work. CONTRACTOR shall be responsible for providing its own scaffolds, hoists, etc.
- B. All such apparatus, equipment, and construction shall meet all requirements of OSHA, the labor laws, and other applicable State and local laws. Provide stairs with handrails. As soon as possible and where applicable, permanent stairs shall be installed.
- C. As soon as permanent stairs are created, provide temporary protective treads, handrails, and shaft protection.
- D. Provide barricades at hazardous locations, complete with signs, temporary general lighting, warning lights, and similar devices as required.

1.04 TEMPORARY SUPPORT FACILITIES

- A. CONTRACTOR shall provide whatever facilities and services which may be needed to properly support primary construction process and meet compliance requirements and governing regulations.
- B. CONTRACTOR shall not use permanent facilities except as otherwise indicated, unless authorized by OWNER.

1.05 CONSTRUCTION SIGN

- A. Furnish and erect a construction sign to be maintained and kept in place until completion of the Contract.
- B. The sign shall be minimum 4-feet high by 8-feet wide, constructed by a professional sign painter, and shall show the name of the Project, OWNER, all prime contractors and ENGINEER. ENGINEER will furnish a sketch showing the printing. OWNER shall select colors of paint required. General sign layout shall be as shown on Drawing 01-975-158A attached at the end of these Specifications.

1.06 REMOVAL OF TEMPORARY FACILITIES

- A. Remove temporary materials, equipment, services, and construction as soon as practicable but no later than just prior to substantial final completion inspection.
- B. Clean and repair damage caused by installation or use of temporary facilities and restore existing facilities used during construction to specified, or to original, condition.
- C. Minor temporary facilities which interfere with OWNER's operations shall be removed at the end of each Work period.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01560

TEMPORARY CONTROLS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Dust control.
 - 2. Water, erosion and sediment control.
 - 3. Noise control.
 - 4. Traffic control.
 - 5. Site security.
 - 6. Daily cleanup.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 DUST CONTROL

- A. CONTRACTOR shall execute the Work by methods to minimize raising dust from construction operations.
- B. CONTRACTOR shall provide positive means to prevent air-borne dust from dispersing into atmosphere.
- C. CONTRACTOR shall provide partitions, enclosures, etc., within buildings as necessary to confine dust and protect adjacent areas.

3.02 WATER, EROSION AND SEDIMENT CONTROL

- A. CONTRACTOR shall grade site to drain and shall maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. CONTRACTOR shall protect Site from puddling or running water.
- C. CONTRACTOR shall provide erosion control measures as necessary to control discharge of sediment laden water to surface waters and wetlands.
- D. Except as provided for in the document, overland discharge of water from dewatering operations shall not be allowed. Depending on water quality, such water shall either be piped directly to the surface water or shall be directed to sedimentation basins or other such structures or features prior to discharge to surface waters so as not to cause damage to existing ground and improvements, erosion, or deposition in the discharge area.

- E. CONTRACTOR shall use jute or synthetic netting, silt fences, straw bales, dikes, channels, and other applicable measures to prevent erosion of soils disturbed by its construction operation.
- F. Restoration of the Site shall proceed concurrently with the construction operation. See Drawings and Specifications for erosion control measures in addition to that which may be required above.
- G. Erosion control measures shall comply with the following document: "Standard Specifications for Soil Erosion and Sediment Control," of the Illinois Environmental Protection Agency, IEPA/WPC 87-012.

3.03 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

3.04 TRAFFIC CONTROL

- A. CONTRACTOR shall be responsible for providing all signs, barricades, flagmen and other traffic control devices in the construction zone.
- B. All traffic control measures shall meet the requirements of Illinois Manual on Uniform Traffic Control Devices for Streets and Highways, Latest Edition, and the Standard Specifications for Traffic control Items, Latest Edition.
- C. Do not close or obstruct roadways without approval of OWNER.
- D. Maintain two-way traffic on streets at all times.
- E. Conduct operations with minimum interference to roadways.

3.05 SITE SECURITY

- A. CONTRACTOR shall have the sole responsibility of safeguarding the Site perimeter to prevent unauthorized entry to the Site throughout the duration of the Project. CONTRACTOR shall at all times provide such permanent and temporary fencing or barricades or other measures as may be necessary to restrict unauthorized entry to its construction area including construction in public rights-of-way or easements. Site security measures shall include safeguards against attractive nuisance hazards as a result of construction activity.
- B. CONTRACTOR shall at all times be responsible for the security of the Work including materials and equipment. OWNER will not take any responsibility for missing or damaged equipment, tools, or personal belongings. CONTRACTOR shall have the sole responsibility of safeguarding the Work and the Site throughout the duration of the Project.

3.06 DAILY CLEANUP

- A. CONTRACTOR shall clean up the Site and remove all rubbish on a daily basis.
- B. CONTRACTOR shall clean up public streets and highways and remove any dirt, mud or other materials due to project traffic on daily basis and shall comply with all local and state ordinances and permit requirements.

END OF SECTION

SECTION 01590

FIELD OFFICES AND SHEDS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Materials, equipment, furnishings.
 - 2. Construction.
 - 3. Environmental control.
 - 4. CONTRACTOR office and facilities.
 - 5. ENGINEER Office.
 - 6. Storage areas and sheds.
 - 7. Preparation.
 - 8. Installation.
 - 9. Maintenance and cleaning.
 - 10. Removal.

PART 2–PRODUCTS

2.01 MATERIALS, EQUIPMENT, FURNISHINGS

- A. Materials, equipment and furnishings shall be serviceable, new or used, and adequate for required purpose.

2.02 CONSTRUCTION

- A. Portable or mobile buildings, or buildings shall be constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. CONTRACTOR shall provide structurally sound, secure, weathertight enclosures for office and storage spaces.
- C. Temperature transmission resistance of floors, walls, and ceilings shall be compatible with occupancy and storage requirements.
- D. Exterior materials shall be weather resistant.
- E. Interior materials in offices shall consist of sheet type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.
- F. Lighting for offices shall be 50-foot candles minimum at desk top height, with exterior lighting at entrance doors.
- G. Provide appropriate type fire extinguisher at each office and each storage area.
- H. Interior materials in storage sheds shall be as required to provide specified conditions for storage of products.

2.03 ENVIRONMENTAL CONTROL

- A. Heating, cooling, and ventilating for offices shall consist of automatic equipment to maintain comfort conditions; 70°F heating and 78°F cooling.
- B. Heating and ventilation for storage spaces shall be as needed to maintain products in accordance with Contract Documents and to provide adequate lighting for maintenance and observation of products.

2.04 CONTRACTOR OFFICE AND FACILITIES

- A. CONTRACTOR shall provide facilities to meet CONTRACTOR's needs and to provide space for Project meetings.
- B. Provide telephone as required for CONTRACTOR's needs.
- C. Provide furnishings in meeting area. As a minimum, provide conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents.

2.05 ENGINEER OFFICE

- A. CONTRACTOR shall provide separate space for sole use of ENGINEER, with separate entrance door with new lock and two keys.
- B. Minimum area shall be 150 square feet, minimum dimension 8 feet.
- C. Minimum total area of windows shall be 10% of floor area, with operable sash and insect screens. Locate to provide views of construction area.
- D. Electrical distribution panel shall have two circuits minimum, 110 volt, 60 Hz service. Provide minimum four 110 volt duplex convenience outlets, one on each wall.
- E. Provide minimum single line touch tone phone and answering machine.
- F. Provide plain paper facsimile machine.
- G. Provide plain paper copier.
- H. Provide the following personal computer items:
 - 1. One desktop or laptop PC, IBM compatible, with minimum Intel Core 2 processor at minimum 2.6 GHz, minimum 2 GB RAM, minimum 200 GB hard drive, card reader, 16X CD/DVD Burner (DVD±RW), modem and related communications software, keyboard, mouse, and related software, Windows XP or newer, and network card.
 - 2. Color monitor, 17-inch minimum LCD.
 - 3. Hewlett-Packard LaserJet, or equal, laser printer or Ink-Jet.
 - 4. Microsoft Office 2007 software, compatible with supplied operating system and hardware.
 - 5. All necessary cables for system configurations.
 - 6. Separate telephone line dedicated to PC modem or high speed internet.
 - 7. PC to be set up, configured, and fully functional for use with communications and Microsoft Office software.
 - 8. An Internet Access service provider, Compu Serve, A-O-L, or equal.

9. Current version of antivirus software with subscription updates.
- I. Provide bottled drinking water dispenser and refill as necessary.
- J. Provide the following furnishings:
 1. One desk minimum 54-inch by 30-inch with three drawers.
 2. One drafting table 36-inch by 72-inch, with one equipment drawer.
 3. Plan rack to hold working drawings, shop drawings, and record documents.
 4. One standard four-drawer legal size metal filing cabinet.
 5. Six linear feet of metal bookshelves.
 6. One swivel arm chair.
 7. Six straight chairs.
 8. One drafting table stool.
 9. One tackboard 36-inch by 30-inch.
 10. One waste basket.

2.06 STORAGE AREAS AND SHEDS

- A. Provide storage areas and sheds of size to meet storage requirements for products of individual sections, allowing for access and orderly provision for maintenance and for observation of products to meet requirements of Section 01600–Materials and Equipment.

PART 3–EXECUTION

3.01 PREPARATION

- A. CONTRACTOR shall fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 INSTALLATION

- A. CONTRACTOR shall install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed or as agreed upon by ENGINEER.
- B. Provide two hard surfaced parking spaces for use by ENGINEER, connected to office by hard surfaced walk.

3.03 MAINTENANCE AND CLEANING

- A. CONTRACTOR shall maintain approach walks free of mud, water, and snow.

3.04 REMOVAL

- A. Upon final acceptance and completion of the Work, CONTRACTOR shall remove field offices, foundations, utility services, and debris, and shall restore areas.

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for the delivery, handling, storage and protection of all material and equipment required to complete the Work as specified herein.
- B. Related Sections and Divisions: Specific requirements for the handling and storage of material and equipment are described in other sections of these Specifications.

1.02 PRODUCTS

- A. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.
- B. CONTRACTOR shall not use materials and equipment removed from existing construction, except as specifically required, or allowed, by the Contract Documents.
- C. When any construction deviations from the Drawings and/or Specifications necessary to accommodate equipment supplied by CONTRACTOR, result in additional costs to CONTRACTOR or other contractors, such additional costs shall be borne by CONTRACTOR. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.
- D. Each major component of equipment shall bear a nameplate giving the name and address of the manufacturer and the catalogue number or designation.

1.03 TRANSPORTATION AND HANDLING

- A. Materials, products and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.
- B. CONTRACTOR shall not overload any portion of the structure in the transporting or storage of materials.
- C. CONTRACTOR shall not damage other construction by careless transportation, handling, spillage, staining or impact of materials.
- D. CONTRACTOR shall provide equipment and personnel to handle products, including those provided by OWNER, by methods to prevent soiling and damage.
- E. CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.
- F. CONTRACTOR shall handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

1.04 DELIVERY AND RECEIVING

- A. CONTRACTOR shall arrange deliveries of products in accordance with the Progress Schedule, allowing time for observation prior to installation.
- B. CONTRACTOR shall coordinate deliveries to avoid conflict with the Work and conditions at the Site; work activities of OWNER; limitations on storage space; availability of personnel and handling equipment and OWNER's use of premises.
- C. CONTRACTOR shall deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. CONTRACTOR shall clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.
- E. Immediately on delivery, CONTRACTOR shall inspect shipment to assure:
 - 1. Product complies with requirements of Contract Documents and reviewed submittals.
 - 2. Quantities are correct.
 - 3. Accessories, and installation hardware are correct.
 - 4. Containers and packages are intact and labels legible.
 - 5. Products are protected and undamaged.

1.05 STORAGE AND PROTECTION

- A. General:
 - 1. CONTRACTOR shall store products, immediately on delivery, in accordance with manufacturer's instructions, with all seals and labels intact and legible.
 - 2. Available storage space at the Site is limited. Any additional off-site space required shall be arranged by CONTRACTOR.
 - 3. CONTRACTOR shall allocate the available storage areas and coordinate their use by the trades on the job.
 - 4. CONTRACTOR shall arrange storage in a manner to provide access for maintenance of stored items and for observation.
- B. In enclosed storage, CONTRACTOR shall:
 - 1. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.
 - 2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
 - 3. Provide ventilation for sensitive products as required by manufacturer's instructions.
 - 4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.
 - 5. Store solid materials such as insulation, tile, mechanical and electrical equipment, fittings, and fixtures under shelter, in original packages, away from dampness and other hazards.
 - 6. Store liquid materials away from fire or intense heat and protect from freezing.
- C. At exterior storage, CONTRACTOR shall:
 - 1. Store unit materials such as concrete block, brick, steel, pipe, conduit, door frames, and lumber off ground, out of reach of dirt, water, mud and splashing.
 - 2. Store tools or equipment that carry dirt outside.
 - 3. Store large equipment so as not to damage the Work or present a fire hazard.

4. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet material and provide ventilation to avoid condensation.
5. Completely cover and protect any equipment or material which is prime coated or finish painted with secured plastic or cloth tarps. Store out of reach of dirt, water, mud and splashing.
6. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
7. Provide surface drainage to prevent erosion and ponding of water.
8. Prevent mixing of refuse or chemically injurious materials or liquids.
9. Cover aggregates such as sand and gravel in cold wet weather.
10. Remove all traces of piled bulk materials at completion of work and return site to original or indicated condition.

1.06 MAINTENANCE OF STORAGE

- A. CONTRACTOR shall periodically inspect stored products on a scheduled basis.
- B. CONTRACTOR shall verify that storage facilities comply with manufacturer's product storage requirements, and verify that manufacturer required environmental conditions are maintained continually.
- C. CONTRACTOR shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.
- D. CONTRACTOR shall perform scheduled maintenance of equipment in storage as recommended by the manufacturer. A record of the maintenance shall be kept and turned over to ENGINEER when the equipment is installed.

1.07 INSTALLATION REQUIREMENTS

- A. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respective manufacturers, unless otherwise specified.
- B. After installation, CONTRACTOR shall protect all materials and equipment against weather, dust, moisture, and mechanical damage.
- C. CONTRACTOR shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until completion and final acceptance of the Work by OWNER. Damaged material and equipment shall be immediately removed from the Site.

1.08 CONCRETE EQUIPMENT BASE

- A. Cast-in-place concrete equipment bases shall be provided for all new and relocated equipment including electrical control panels, motor control centers, switchgear, etc. Concrete equipment bases shall be provided by CONTRACTOR except where specifically noted to be provided by others. Bases shall be 3-1/2 inch minimum height and shall be a minimum of 3 inches larger than equipment being supported. Grouting of equipment bases shall be as recommended by equipment manufacturer.

- B. Concrete and grout shall meet applicable sections of the specifications.
- C. Provide all anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete for support of equipment.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01650

STARTING OF SYSTEMS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Starting equipment and systems.
 - 2. Demonstration and instructions.
 - 3. Start up and testing.
- B. CONTRACTOR shall perform the Work described in the following subsections.

1.02 STARTING EQUIPMENT AND SYSTEMS

- A. Coordinate schedule for start up of various equipment and systems.
- B. Notify ENGINEER and OWNER a minimum of seven days prior to start up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions which may cause damage.
- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start up under supervision of applicable manufacturer's representative and CONTRACTOR's personnel in accordance with manufacturers' instructions.
- G. Require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start up, and to supervise placing equipment or system in operation.
- H. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report.
- I. Provide lubricants as recommended by manufacturer appropriate for start up conditions.

1.03 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to OWNER's personnel.
- B. For all mechanical equipment or systems, demonstrate project equipment and instruct in a classroom environment at a location acceptable to the OWNER and instructed by a qualified manufacturers' representative who is knowledgeable about the Project.

- C. For equipment or systems requiring seasonal operation, perform demonstration for noncurrent season at start of noncurrent season.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with OWNER's personnel in detail to explain all aspects of operation and maintenance.
- E. Demonstrate start up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- G. Supervision and Start Up: Installation of all equipment furnished under this Contract shall be supervised as required by a qualified representative of equipment manufacturer. All equipment shall be placed in operation by a qualified representative of the equipment manufacturer and the staff shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to OWNER's satisfaction.
- H. Where items of equipment are placed into service at different times or sequence, manufacturer's services for start up, field testing, and supervision shall be provided for each time or sequence. Training shall be provided prior to or at the time the first similar item of equipment is placed in service.

1.04 START UP AND TESTING

- A. Prior to acceptance of any portion of the Work, start up and testing of all equipment and testing of all materials furnished on the Project by CONTRACTOR shall have been conducted in the presence of representatives of CONTRACTOR, OWNER and ENGINEER and also manufacturer if requested by OWNER or ENGINEER.
- B. CONTRACTOR shall provide whatever temporary installations and conditions are necessary in order to perform start up and testing operations on all equipment and materials furnished under the Contract. Temporary connections and equipment necessary during start up and testing operations shall include, but not be limited to, temporary piping and electrical equipment and devices, temporary connection from various parts of the systems and any other labor, materials, fuel, devices or items that may be required for start up and testing operations. Temporary conditions shall include filling with water, if necessary, to check equipment and materials.
- C. All temporary installations and conditions shall be removed by CONTRACTOR upon completion of start up and testing.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Closeout procedures.
 - 2. Final cleaning.
 - 3. Adjusting.
 - 4. Project record documents.
 - 5. Warranties.
 - 6. Spare parts and maintenance materials.

1.02 CLOSEOUT PROCEDURES

- A. CONTRACTOR shall provide submittals to ENGINEER that are required by governing or other authorities.
- B. CONTRACTOR shall comply with General Conditions and Supplementary Conditions and complete the following before requesting ENGINEER's observation of the Work, or designated portion thereof, for substantial completion.
 - 1. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, and similar required documentation for specific units of Work, enabling OWNER's unrestricted occupancy and use.
 - 2. Submit record documentation, maintenance manuals, tools, spare parts, keys, and similar operational items.
 - 3. Submit consent of surety (if surety required in Contract).
 - 4. Complete final cleaning, touch-up work of marred surfaces, and remove temporary facilities and tools.

1.03 FINAL CLEANING

- A. It is CONTRACTOR's responsibility to completely clean up the inside and outside of all buildings and the construction site at the completion of the Work.
- B. CONTRACTOR shall clean areas of the building in which painting and finishing work is to be performed just prior to the start of this work, and maintain these areas in satisfactory condition for painting and finishing. This cleaning includes:
 - 1. Removal of trash and rubbish from these areas.
 - 2. Broom cleaning of floors.
 - 3. Removal of any plaster, mortar, dust, and other extraneous materials from finish surfaces, including but not limited to exposed structural steel, miscellaneous metal, masonry, concrete, mechanical equipment, piping, and electrical equipment.

- C. In addition to the cleaning specified above and the more specific cleaning that may be required in various technical sections of the Specifications, CONTRACTOR shall prepare the Project for occupancy by a thorough cleaning throughout, which shall include the following:
 - 1. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
 - 2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
 - 3. Replace filters of operating equipment.
 - 4. Clean debris from roofs, gutters, downspouts, and drainage systems.
 - 5. Clean site; sweep paved areas, rake clean landscaped surfaces.
 - 6. Remove waste and surplus materials, rubbish, and construction facilities from the Site.

1.04 ADJUSTING

- A. CONTRACTOR shall adjust operating products and equipment to ensure smooth and unhindered operation.

1.05 PROJECT RECORD DOCUMENTS

- A. CONTRACTOR shall maintain on Site, one set of the following record documents to record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. CONTRACTOR shall ensure entries are complete and accurate, enabling future reference by OWNER.
- C. CONTRACTOR shall store record documents separate from documents used for construction.
- D. CONTRACTOR shall record information concurrent with construction progress.
- E. Specifications: CONTRACTOR shall legibly mark and record at each Product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by addenda and modifications.
- F. Record Documents and Shop Drawings: CONTRACTOR shall legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
 - 4. Field changes of dimension and detail.

5. Details not on original Contract drawings.

1.06 WARRANTIES

- A. CONTRACTOR shall provide warranties beyond project one year warranty as required by technical sections and as follows.
- B. Submit warranty information as follows:
 - 1. Provide notarized copies.
 - 2. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers, and provide Table of Contents and assemble in three ring binder with durable cover.
 - 3. Submit with request for certificate of Substantial Completion.
 - 4. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

- A. CONTRACTOR shall provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

**PROCEDURES FOR ISSUING LOANS FROM
THE WATER POLLUTION CONTROL LOAN PROGRAM**

**Construction Contracts of Loan Recipient and Other Sections From
"Procedures For Issuing Loans From the Water Pollution Control Loan Program"**

Section 369.620(c) Negotiations of Contract Amendments (Change Orders)

2) Changes in contract price or time

The contract price or time may be changed only by a change order. When negotiations are required, they shall be conducted in accordance with subsection (c) of this Section.

- 3) For each change order the contractor shall submit to the loan recipient for review sufficient cost and pricing data to enable the loan recipient to ascertain the necessity and reasonableness of costs and amounts proposed, and the allowability and eligibility of costs proposed.

Section 369.620(d) Required Construction Contract Provisions

Each construction contract shall include the following provisions:

1) Audit; access to records:

- A) The contractor shall maintain books, records, documents and other evidence directly pertinent to performance on loan work under this agreement consistent with generally accepted accounting standards in accordance with the American Institute of Certified Public Accountants Professional Standards. The contractor shall also maintain the financial information and data used by the contractor in the preparation or support of any cost submissions required under subsection (c), (Negotiation of Contract Amendments, Change Orders) and a copy of the cost summary submitted to the owner. The Illinois Auditor General, the owner, the Agency, or any of their duly authorized representatives shall have access to the books, records, documents, and other evidence for purposes of inspection, audit, and copying. The contractor will provide facilities for such access and inspection.
- B) For a formally advertised, competitively awarded, fixed price contract, the contractor shall include access to records as specified in subsection (d)(1)(A) for all negotiated change orders and contract amendments in excess of \$25,000, that affect the contract price. In the case of all other prime contracts, the contractor shall agree to include access to records as specified above in all his or her contracts and all tier subcontracts or change orders in excess of \$25,000 that are directly related to project performance.
- C) Audits shall be consistent with generally accepted auditing standards in accordance with the American Institute of Certified Public Accountants Professional Standards.
- D) The contractor shall agree to the disclosure of all information and reports resulting from access to records pursuant to subsection (d)(1)(A). Where the audit concerns the contractor, the auditing agency shall afford the contractor an opportunity for an audit exit conference and an opportunity to comment on the pertinent portions of the draft audit report. The final audit report shall include the written comments, if any, of the audited parties.

- E) The records required by subsection (d)(1)(A) above shall be maintained and made available during performance of the work under the loan agreement and for three years after the date of final loan audit. In addition, records that relate to any dispute or litigation or the settlement of claims arising out of any performance, costs or items to which an audit exception has been taken, shall be maintained and made available for three years after resolution of the dispute, appeal, litigation, claim, or exception.
- F) The right of access will generally be exercised with respect to financial records under:
 - i) Negotiated prime contractors;
 - ii) Negotiated change orders or contract amendments in excess of \$25,000 affecting the price of any formally advertised, competitively awarded, fixed price contract; and
 - iii) Subcontracts or purchase orders under any contract other than a formally advertised, competitively awarded, fixed price contract.
- G) This right of access will generally not be exercised with respect to a prime contract, subcontract, or purchase order awarded after effective price competition. In any event, the right of access shall be exercised under any type of contract or subcontract:
 - i) With respect to records pertaining directly to contract performance, excluding any financial records of the contractor; and
 - ii) If there is any indication that fraud, gross abuse, or corrupt practices may be involved in the award or performance of the contract or subcontract.

2) Covenant against contingent fees.

The contractor shall warrant that no person or selling agency has been employed or retained to solicit or secure the contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee. For breach or violation of this warranty, the owner shall have the right to annul the contract without liability or in its discretion to deduct from the contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

3) Wage provisions.

The Contractor shall pay prevailing wages in accordance with the Davis-Bacon Act (40 USC 276a through 276a-5) as defined by the U.S. Department of Labor.

4) Disadvantaged Business Enterprise Requirements.

The contractor shall provide evidence, including, but not limited to, a copy of the advertisement(s) and the record of negotiation, that the contractor has taken affirmative steps in accordance with 40 CFR Part 33 to assure disadvantaged business enterprises are used when possible as sources of supplies, equipment, construction and services consistent with the provisions of the Agency's Operating Agreement with USEPA.

5) American Iron, Steel and Manufactured Goods provisions.

The contract shall require the successful bidder(s) to certify compliance with Section 1605 of the ARRA, which specifies that all iron, steel and manufactured goods used in the project are produced in the United States.

6) Debarment and suspension provisions.

The contract shall require the successful bidder(s) to submit a "Certification Regarding Debarment, Suspension and Other Responsibility Matters" (EPA Form 5700-49) showing compliance with federal Executive Order 12549 (Appendix A, Exhibit A).

7) Nonsegregated facilities provisions.

The successful bidder shall be required to submit a certification of nonsegregated facilities as prescribed in 18 USC 1001.

Section 369.620(e) Subcontracts Under Construction Contracts

The award or execution of all subcontracts by a prime contractor and the procurement and negotiation procedures used by the prime contractor shall comply with:

- 1) All applicable provisions of federal, State and local law;
- 2) All provisions of this Part 369 regarding fraud and other unlawful or corrupt practices;
- 3) All provisions of this Part 369 with respect to access to facilities, records and audit of records; and,
- 4) All provisions of subsection (d)(6) that require a "Certification Regarding Debarment, Suspension, and Other Responsibility Matters" (EPA Form 5700-49) showing compliance with federal Executive Order 12549 (Appendix A, Exhibit A).

Section 369.620(f) Contractor Bankruptcy

In the event of a contractor bankruptcy, the loan recipient shall notify the Agency and shall keep the Agency advised of any negotiations with the bonding company, including any proposed settlement. The Agency may participate in those negotiations and will advise the loan recipient of the impact of any proposed settlement to the loan agreement. The loan recipient shall be responsible for assuring that every appropriate procedure and incidental legal requirement is observed in advertising for bids and re-awarding a construction contract.

Section 369.640(c) Remedies

All claims, counter-claims, disputes and other matters in question between the recipient and the contractor arising out of, or relating to a sub-agreement or the breach of it will be decided by arbitration if the parties mutually agree, or in a court of competent jurisdiction within the State.

Section 369.810(b) Access

Any contract entered into by the loan recipient for construction work, and any sub-agreement hereunder, shall provide the representatives of the Agency with access to the work. The contractor or subcontractor will provide facilities for such access and inspection. Such contract or sub-agreement must also provide that the Agency or any authorized representative shall have access to any books, documents, papers and records of the contractor or subcontractor which are pertinent to the project for the purpose of making audit, examination, excerpts and transcriptions thereof.

PERMITS

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
WATER POLLUTION CONTROL PERMIT

LOG NUMBERS: 2969-07

PERMIT NO.: 2007-AB-2969

FINAL PLANS, SPECIFICATIONS, APPLICATION
AND SUPPORTING DOCUMENTS

DATE ISSUED: July 16, 2007

PREPARED BY: Strand Associates, Inc.

SUBJECT: Washington-STP #2, Phase 1 Improvements L17-2756

PERMITTEE TO CONSTRUCT AND OWN

City of Washington
115 Jefferson Street
Washington, IL 61571

Permit is hereby granted to the above designated permittee to construct water pollution control facilities described as follows:

Provide a new raw sewage pump with a rated capacity of 1628 gpm at 43 feet of TDH and rebuild two existing pumps to achieve the ratings of 727 gpm at 55 feet of TDH and 1628 gpm at 43 feet of TDH respectively, a new mechanical bar screen assembly capable of handling a peak flow of 7.48 mgd and one 12 inch Parshall flume liner, an oxidation ditch with a volume of 79000 cubic feet, 2 final clarifier mechanisms to be installed in the new 65-foot diameter concrete clarifiers having a side water depth of 14 feet, 3 new return activated sludge pumps each with a rating of 250 gpm at 32 feet of TDH, one scum pump with a rating of 40 gpm at 70 feet of TDH, two stand alone chlorinators, two gas sulfonators, phosphorus removal equipment and sludge drying beds.

Upon completion of the above listed facilities, the above referenced treatment plant will be rated at the following capacities:

Design Average Flow (DAF) =	1.56	MGD
Design Maximum Flow (DMF) =	5.29	MGD
Organic Loading =	1693	Lbs/day
Solids Loading =	1631	Lbs/day

This Permit is issued subject to the following Special Condition(s). If such Special Condition(s) require(s) additional or revised facilities, satisfactory engineering plan documents must be submitted to this Agency for review and approval for issuance of a Supplemental Permit.

SPECIAL CONDITION 1: The operational portion of this permit shall be governed by NPDES Permit No. IL0042412.

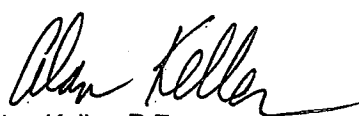
SPECIAL CONDITION 2: This permit also covers all necessary appurtenances not specifically mentioned herein but detailed in the specifications and/or the design drawings.

THE STANDARD CONDITIONS OF ISSUANCE INDICATED ON THE REVERSE SIDE MUST BE COMPLIED WITH IN FULL. READ ALL CONDITIONS CAREFULLY.


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DIVISION OF WATER POLLUTION CONTROL

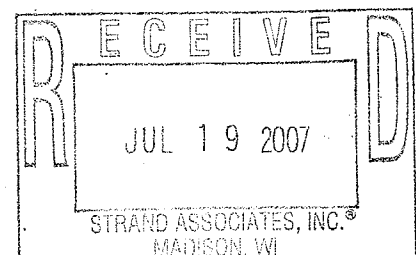
cc: EPA - Peoria FOS
Strand Associates, Inc.
Records - Municipal
Binds


Alan Keller, P.E.
Manager, Permit Section

**READ ALL CONDITIONS CAREFULLY:
STANDARD CONDITIONS**

The Illinois Environmental Protection Act (Illinois Revised Statutes Chapter 111-12, Section 1039) grants the Environmental Protection Agency authority to impose conditions on permits which it issues.

1. Unless the construction for which this permit is issued has been completed, this permit will expire (1) two years after the date of issuance for permits to construct sewers or wastewater sources or (2) three years after the date of issuance for permits to construct treatment works or pretreatment works.
2. The construction or development of facilities covered by this permit shall be done in compliance with applicable provisions of Federal laws and regulations, the Illinois Environmental Protection Act, and Rules and Regulations adopted by the Illinois Pollution Control Board.
3. There shall be no deviations from the approved plans and specifications unless a written request for modification of the project, along with plans and specifications as required, shall have been submitted to the Agency and a supplemental written permit issued.
4. The permittee shall allow any agent duly authorized by the Agency upon the presentations of credentials:
 - a. to enter at reasonable times, the permittee's premises where actual or potential effluent, emission or noise sources are located or where any activity is to be conducted pursuant to this permit;
 - b. to have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit;
 - c. to inspect at reasonable times, including during any hours of operation of equipment constructed or operated under this permit, such equipment or monitoring methodology or equipment required to be kept, used, operated, calibrated and maintained under this permit;
 - d. to obtain and remove at reasonable times samples of any discharge or emission of pollutants;
 - e. to enter at reasonable times and utilize any photographic, recording, testing, monitoring or other equipment for the purpose of preserving, testing, monitoring, or recording any activity, discharge, or emission authorized by this permit.
5. The issuance of this permit:
 - a. shall not be considered as in any manner affecting the title of the premises upon which the permitted facilities are to be located;
 - b. does not release the permittee from any liability for damage to person or property caused by or resulting from the construction, maintenance, or operation of the proposed facilities;
 - c. does not release the permittee from compliance with other applicable statutes and regulations of the United States, of the State of Illinois, or with applicable local laws, ordinances and regulations;
 - d. does not take into consideration or attest to the structural stability of any units or parts of the project;
 - e. in no manner implies or suggests that the Agency (or its officers, agents or employees) assumes any liability, directly or indirectly, for any loss due to damage, installation, maintenance, or operation of the proposed equipment or facility.
6. Unless a joint construction/operation permit has been issued, a permit for operating shall be obtained from the agency before the facility or equipment covered by this permit is placed into operation.
7. These standard conditions shall prevail unless modified by special conditions.
8. The Agency may file a complaint with the Board for suspension or revocation of a permit:
 - a. upon discovery that the permit application contained misrepresentations, misinformation or false statement or that all relevant facts were not disclosed; or
 - b. upon finding that any standard or special conditions have been violated; or
 - c. upon any violation of the Environmental Protection Act or any Rules or Regulation effective thereunder as a result of the construction or development authorized by this permit.





Illinois Department of Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
<http://dnr.state.il.us>

Pat Quinn, Governor

Marc Miller, Acting Director

March 10, 2009

SUBJECT: Permit No. DS2009031
Improvements to Sewage Treatment Plant No. 2
Farm Creek Floodplain - Tazewell County

City of Washington
115 West Jefferson Street
Washington, Illinois 61571

Gentlemen:

Enclosed is Illinois Department of Natural Resources, Office of Water Resources (IDNR/OWR) Permit No. DS2009031 authorizing the subject project. This permit authorizes the construction of additional sludge drying beds, a chlorine contact tank, a cascade aerator, clarifiers and effluent filters that are to be constructed in the floodplain. IDNR/OWR authorization is not required for the oxidation ditches that are to be constructed outside of the 100-year frequency floodplain. This approval is based on our determination that the increase in flood profiles resulting from the project will be contained on the permittee's property and within a flood easement on the neighboring upstream property.

This permit does not supersede any other federal, state or local authorizations that may be required for the project.

If any changes of the permitted work are found necessary, revised plans should be submitted promptly to this office for review and approval. Also, this permit expires on the date indicated in Condition (13). If unable to complete the work by that date, the permittee may make a written request for a time extension.

Please feel free to contact Wes Rust of my staff at 217/782-4376 if you have any questions concerning this authorization.

Sincerely,

Michael L. Diedrichsen, P.E.
Acting Manager, Downstate Regulatory Programs

MLD:PWR:crw

Enclosures

cc: Strand Associates, Inc.



PERMIT NO. DS2009031

DATE: March 10, 2009

State of Illinois
Department of Natural Resources, Office of Water Resources

Permission is hereby granted to:

CITY OF WASHINGTON
115 WEST JEFFERSON STREET
WASHINGTON, ILLINOIS 61571

to construct additional sludge drying beds, a chlorine contact tank, a cascade aerator, clarifiers and effluent filters for the City of Washington's Sewage Treatment Plant No. 2, in the floodplain of Farm Creek located in the Northwest ¼ of Section 28, Township 26 North, Range 3 West of the 3rd Principal Meridian in Tazewell County,

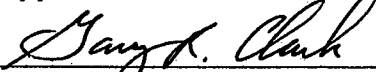
in accordance with an application dated December 6, 2006, and the plans and specifications entitled:

PRELIMINARY SITE PLAN
SEWAGE TREATMENT PLANT NO. 2
CITY OF WASHINGTON
TAZEWELL COUNTY, ILLINOIS
(Figure 1, Printed November 15, 2006).

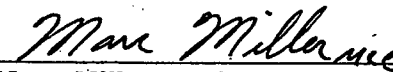
Examined and Recommended:


Michael L. Diedrichsen, Acting Manager
Downstate Regulatory Programs

Approval Recommended:


Gary R. Clark, Director
Office of Water Resources

Approved:


Marc Miller, Acting Director
Department of Natural Resources

THIS PERMIT IS SUBJECT TO THE FOLLOWING CONDITIONS:

- 1) This permit is granted in accordance with the Rivers, Lakes and Streams Act "615 ILCS 5."
- 2) This permit does not convey title to the permittee or recognize title of the permittee to any submerged or other lands, and furthermore, does not convey, lease or provide any right or rights of occupancy or use of the public or private property on which the activity or any part thereof will be located, or otherwise grant to the permittee any right or interest in or to the property, whether the property is owned or possessed by the State of Illinois or by any private or public party or parties.
- 3) This permit does not release the permittee from liability for damage to persons or property resulting from the work covered by this permit, and does not authorize any injury to private property or invasion of private rights.
- 4) This permit does not relieve the permittee of the responsibility to obtain other federal, state or local authorizations required for the construction of the permitted activity; and if the permittee is required by law to obtain approvals from any federal or other state agency to do the work, this permit is not effective until the federal and state approvals are obtained.
- 5) The permittee shall, at the permittee's own expense, remove all temporary piling, cofferdams, false work, and material incidental to the construction of the project. If the permittee fails to remove such structures or materials, the Department may have removal made at the expense of the permittee.
- 6) In public waters, if future need for public navigation or other public interest by the state or federal government necessitates changes in any part of the structure or structures, such changes shall be made by and at the expense of the permittee or the permittee's successors as required by the Department or other properly constituted agency, within sixty (60) days from receipt of written notice of the necessity from the Department or other agency, unless a longer period of time is specifically authorized.
- 7) The execution and details of the work authorized shall be subject to the review and approval of the Department. Department personnel shall have the right of access to accomplish this purpose.
- 8) Starting work on the activity authorized will be considered full acceptance by the permittee of the terms and conditions of the permit.
- 9) The Department in issuing this permit has relied upon the statements and representations made by the permittee; if any substantive statement or representation made by the permittee is found to be false, this permit will be revoked; and when revoked, all rights of the permittee under the permit are voided.
- 10) In public waters, the permittee and the permittee's successors shall make no claim whatsoever to any interest in any accretions caused by the activity.
- 11) In issuing this permit, the Department does not ensure the adequacy of the design or structural strength of the structure or improvement.
- 12) Noncompliance with the conditions of this permit will be considered grounds for revocation.
- 13) If the construction activity permitted is not completed on or before December 31, 2012, this permit shall cease and be null and void. When all work is constructed, the permittee shall notify the Department so that a final inspection can be completed.

SECTION 02050

DEMOLITION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: All demolition, removal, and salvage work as shown on the drawings or specified herein to include, but not necessarily limited to the following:
 - 1. RAS Pumping Building.
 - 2. Control Building.
 - 3. Gravity Thickeners.
 - 4. Aeration Tanks/Aerobic Digesters.
 - 5. Existing Roadways, Stairs, and Sidewalks.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. CONTRACTOR shall submit permits and notices, if required, authorizing building demolition.

1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform demolition, removal, and salvage in conformity with applicable federal, state, and local safety practices and code requirements.

1.04 SEQUENCE

- A. No demolition, removal, or salvage work shall commence until approval to proceed has been granted by OWNER. Such work shall be completed in accordance with the construction sequence included in Division 1 of these specifications and in accordance with the construction phases of this project and work to be done by other contractors.

PART 2–PRODUCTS

2.01 GENERAL

- A. Compacted fill shall meet the requirements of Section 02222–Excavation, Fill, Backfill and Grading.
- B. Pipe fittings and materials shall meet the requirements of Section 02600–Buried Piping and Appurtenances and Section 15050–Piping and Appurtenances.

PART 3-EXECUTION

3.01 BREAKING DOWN AND REMOVING STRUCTURES

- A. General:
 - 1. All existing structures, with all attached parts and connections, shown on the drawings or specified to be removed or that interfere with the new construction, shall be entirely removed within the limits shown or specified, unless otherwise provided.
 - 2. When a portion of an existing structure is to be retained, CONTRACTOR shall take care during construction operations so as not to impair the value of the retained portion.
 - a. Complete all operations necessary for the removal of any existing structure which might endanger the new construction prior to the construction of the new work.
 - b. Do not use any equipment or devices which might damage structures, facilities, or property which are to be preserved and retained.
- B. CONTRACTOR shall remove entirely the following major structures. The following list is not intended to be all inclusive. CONTRACTOR shall remove all structures indicated or specified to be removed.
 - 1. Excess Flow Inlet/Outlet Structure.
 - 2. Surge and First Flush Basin.
 - 3. Plane Effluent Structure.
- C. Pavement, Curb, Gutter, Sidewalk, Driveways, Crosswalk, and Similar Structures:
 - 1. Where portions of the existing structure are to be left in the surface of the finished work, CONTRACTOR shall remove the structure to an existing joint, or saw and chip the structure to a true line.
 - 2. Sufficient removal shall be made to provide for proper grades and connections in the new work.
- D. Walls, Piers, Surface Drains, Foundations, and Similar Masonry Structures:
 - 1. Remove entirely or break down to an elevation at least 2 feet below the earth subgrade within the areas of a road bed and elsewhere to 2 feet below the finished slopes or natural ground, as the case may be.
 - 2. Remove existing construction as required to clear new construction.

3.02 ABANDONING STRUCTURES

- A. Tanks, Manholes, Catch Basins, and Inlets:
 - 1. CONTRACTOR shall thoroughly clean structures to be abandoned.
 - 2. CONTRACTOR shall plug existing pipe connections with brick or concrete block masonry or with any grade of concrete having a 28-day compressive strength in excess of 2,000 psi.
 - 3. CONTRACTOR shall remove the walls of the structures to an elevation at least 2 feet below the finished grade line, or to such elevation that may be designated on the drawings or as necessary to clear new construction.

3.03 ABANDONING AND REMOVING UTILITIES AND UNDERGROUND PROCESS PIPING

- A. CONTRACTOR shall be responsible for the turning off or unhooking of all utilities and process piping before starting the demolition work. Remove all utility lines, including electrical services and process piping that are shown or specified to be removed. Remove utility lines that are to be abandoned as needed to clear new construction.
- B. The ends of utility lines and process piping shown or specified to be abandoned that are exposed by excavation shall be plugged with concrete to prevent soil infiltration into the pipes.

3.04 EQUIPMENT

- A. CONTRACTOR shall remove all equipment specified herein or indicated.
- B. CONTRACTOR shall remove associated exposed conduit, power wiring, controls, switches, instrumentation, control wiring, control boxes, appurtenances, and their supports serving equipment to be removed. Electrical items shall be removed to their junction with motor control center, control panel, or their junction with conduit serving other equipment that is to remain.
- C. CONTRACTOR shall remove all piping and appurtenances and their supports serving equipment indicated to be removed. Piping shall be removed to its junction with the main service header serving other equipment that is to remain or new equipment as indicated. Remaining piping and tubing shall be fitted with an appropriate blind flange or plug and insulated as required.
- D. CONTRACTOR shall remove equipment bases, anchor bolts, and other supports serving equipment to be removed. Concrete bases shall be removed to 1 inch below floor elevation and repaired with nonshrink grout plus surfacing to match existing.
- E. CONTRACTOR shall patch floors, walls, and ceilings as required to match existing or as indicated where equipment, piping, electrical, bases, or supports are removed.
- F. CONTRACTOR shall remove the following major equipment items or systems. The following list is not intended to be all-inclusive. CONTRACTOR shall remove all items indicated or specified to be removed.
 - 1. Tertiary Filter Building No. 2: Pressure filters and appurtenances, NPW pumps, hydropneumatic tank, pressure filter controls and console (except PLC—returned to OWNER), HVAC equipment, and grating.

3.05 INTERIOR PIPING AND APPURTENANCES

- A. CONTRACTOR shall remove all piping and appurtenances as indicated. The location and elevations of existing piping are approximate.
- B. CONTRACTOR shall remove all supports for piping and appurtenances indicated to be removed. Repiping and connections to new piping shall be as specified for new piping. Remaining piping and tubing, not reconnected for new piping, shall be fitted with an appropriate blind flange or plugged and insulated as required.

- C. CONTRACTOR shall patch all holes resulting from removal of piping, appurtenances, and their supports. Patching of concrete shall be with nonshrink grout and as indicated. Patching of masonry shall be with matching material toothed in. Patch other material as indicated.

3.06 SALVAGE

- A. OWNER has first right of refusal to all material, piping, and equipment removed.
- B. All equipment, material, and piping, except as specified hereinafter, within the buildings and structures to be demolished and additional items as noted shall be removed by CONTRACTOR. CONTRACTOR shall inspect each structure and determine the type and amount of equipment, materials, and piping to be removed.
- C. All equipment, material, and piping, except as specified hereinafter, within the limits of the demolition and additional items noted to be removed, will become the property of CONTRACTOR if OWNER does not claim under first right of refusal and shall be removed from the project site.
- D. The following equipment and materials shall be removed and reused in the new facilities:
 - 1. Grit Tank: Influent sampler.
 - 2. Plant Effluent Structure: Effluent sampler.
- E. The following equipment and materials shall be removed and turned over to OWNER:
 - 1. Plant Effluent Structure: Ultrasonic level transducer.
 - 2. Tertiary Filter Building No. 2: Dehumidifiers, PLC from pressure filter console, air compressor, and backwash pumps.
- F. Surge and First Flush Basin: CONTRACTOR shall clean and dispose of existing contents in the basin prior to demolition.

3.07 BACKFILL

- A. CONTRACTOR shall fill all abandoned structures and excavations resulting from removal of structures and utilities with compacted fill. See Section 02222–Excavation, Fill, Backfill and Grading for required degree of compaction.
- B. Prior to filling, CONTRACTOR shall break one opening in the floor or wall near the base of each compartment to allow groundwater to freely migrate through the structure.

END OF SECTION

SECTION 02110

SITE CLEARING AND STRIPPING

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Removal of surface debris.
 - 2. Removal of paving, curbs, and sidewalks.
 - 3. Removal of trees, shrubs, and other plant life.
 - 4. Strip and stockpile topsoil.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Payment: Topsoil removal and stockpiling shall be considered unclassified excavation.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 PREPARATION

- A. CONTRACTOR shall identify existing plant life to remain and shall tag accordingly.

3.02 PROTECTION

- A. CONTRACTOR shall protect from damage utilities and structures that are to remain.
- B. CONTRACTOR shall protect trees, plant growth, and features designated to remain as final landscaping.
- C. See Division 1 for protection of survey monumentation.

3.03 CLEARING AND GRUBBING

- A. Clearing and grubbing shall consist of cutting and disposing of trees, brush, windfalls, logs, and other vegetation, and the removing and disposing of roots, stumps, stubs, grubs, logs, and other timber from within the clearing limits as defined on the drawings, designated to be removed on the drawings or in the specifications, or fall within the excavation, embankment, or improved areas of the site.
- B. All roots and stumps shall be removed to a depth of not less than 12 inches below the original ground surface in embankment areas. In cut areas, such material shall be removed to a depth of not less than 12 inches below the subgrade.

3.04 REMOVALS

- A. CONTRACTOR shall remove from the site all trees, brush, and other vegetation, debris, and rocks that fall within the excavation and grading limits, as well as any paving, curb and gutter, and sidewalks shown on the drawings to be removed.

3.05 STRIPPING

- A. Excavate topsoil from areas to be built upon, cut or filled, or to have surface improvements, including roadways and walks.
- B. Stockpile topsoil on site and protect from erosion. CONTRACTOR shall provide additional topsoil as required.
- C. Excess topsoil, if any, shall be removed from the site and disposed of at CONTRACTOR's expense.

END OF SECTION

SECTION 02140

DEWATERING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Removal of groundwater to allow below grade construction.
 - 2. Site grading to prevent surface water from entering the excavation.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Payment:
 - 1. The expense for making all extra excavations necessary to prevent water from interfering with the proper construction of the work and for forming all dams or diversions, digging of sumps or pump wells, bailing, and installation and pumping of wells shall be borne by CONTRACTOR.
 - 2. The cost for removal of groundwater and surface water shall be included in the prices bid for the work. No separate payment will be made for dewatering whether accomplished by use of sumps and pumps, well point systems, deep wells, or any other method.

1.02 REFERENCES

- A. See Division 1, Regulatory Requirements for permit requirements and water, erosion, and sediment control.

1.03 SYSTEM REQUIREMENTS

- A. CONTRACTOR shall, at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or under water. No water shall flow over the work until the joints are complete or the concrete has set.
- B. Dewatering shall be sufficient to lower the piezometric level to at least 2 feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.
- C. In areas where rock is encountered, the water level shall be kept at or below top of rock, but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.
- D. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented.
- E. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

1.04 QUALITY ASSURANCE

- A. All dewatering shall be done in accordance with applicable federal, state, and local code requirements.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 DEWATERING

- A. Dewatering shall be started, and the water level shall be lowered as specified herein prior to beginning excavation and shall be continued until structure, main, or appurtenance has been completed and fill has been placed and compacted to final grade.
- B. CONTRACTOR shall provide at least two groundwater observation wells near each area to be excavated to aid CONTRACTOR in determining whether the minimum specified requirements have been met prior to excavation. The observation well shall be a minimum 2-inch-diameter slotted PVC pipe. The observation well shall be installed and backfilled in such a way as to allow an accurate determination of actual groundwater levels. The observation well shall be properly abandoned after use unless specified otherwise.
- C. CONTRACTOR shall provide all necessary materials and equipment to keep the excavation free from water during construction. CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages, and shall have available at all times competent workers for the operation of the pumping equipment. The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during the work stoppages.
- D. CONTRACTOR shall meet all requirements of applicable IEPA permits for construction pit or trench dewatering.
- E. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill, and prevent floatation or movement of all structures and pipelines.

3.02 PROTECTION

- A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding, or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner.

- B. Prior to dewatering, CONTRACTOR shall take into account the effect of its proposed dewatering operation on existing private water supply systems and shall make arrangements with property owners for protecting their supplies or providing alternative means of supply.
- C. In the event that CONTRACTOR's dewatering operation adversely affects private water supply systems, CONTRACTOR shall provide property owners with alternative potable and nonpotable supplies until dewatering operations are ceased and groundwater levels return to normal. If the water in private water supply wells is contaminated, through no fault of CONTRACTOR, after restoration of original groundwater levels, OWNER will provide measures to restore water potability. CONTRACTOR is responsible for restoration of the water supply, not its potability after restoration.
- D. In areas where continuous operation of dewatering pumps is required, CONTRACTOR shall avoid noise disturbance to nearby residences to the greatest extent possible by using electric-driven pumps, or intake and exhaust silencers or housing to minimize noise from engine-driven generators or engine-driven pumps.

END OF SECTION

SECTION 02222

EXCAVATION, FILL, BACKFILL, AND GRADING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Excavating, filling, backfilling, and grading for this work includes, but is not necessarily limited to:
 - 1. Excavating for footings, foundations, roads, and utilities.
 - 2. Placing and compacting all fill and backfill.
 - 3. Placement of granular mat vapor barrier and granular cushion below interior slabs on grade.
 - 4. Placement of crushed stone mat below tank slabs and manhole/vault slabs, basement floors, or other structures where required.
 - 5. Rough and finish grading prior to paving, seeding, etc.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Allowances:
 - 1. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 500 cubic yards of unsuitable foundation material for structures and roads as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for structures and roads will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 500 cubic yards) and the Supplemental Unit Price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting and filling or gravel bedding material required for placing concrete above water level as required under the concrete specifications. The Bid shall include any removal and replacement of excavated material so indicated on the drawings or specified herein.
 - 2. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 500 cubic yards of unsuitable foundation material for utility trenches as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for utility trenches will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 500 cubic yards) and the Supplemental Unit Price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting, filling, or bedding. The Bid shall include any removal and replacement of excavated material so indicated on the drawings or specified herein.
- D. Payment:
 - 1. General excavation shall include all excavation specified, undercutting, fill, backfill and grading, including rock excavation but not including unsuitable foundation material, as hereinafter described.
 - 2. All general excavation shall be included in the Lump Sum Bid. Changes which require additions to or deductions from the excavation will be adjusted on the basis of the unit price for changes contained in the Contract.

1.02 REFERENCES

- A. ASTM D1557–Test Methods for Moisture Density Relations of Soils and Soil–Aggregate Mixtures using 10 pound Rammer and 18-inch drop.
- B. Standard Specifications: Unless otherwise indicated, Standard Specifications within this section shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.

1.03 SUBMITTALS

- A. CONTRACTOR shall submit samples of materials proposed for use as fill to soils testing laboratory for analysis of their suitability and for recommendations on moisture content during compaction, compaction methods, or other appropriate information.
- B. CONTRACTOR shall submit sufficient samples of each different type or classification of soil to obtain representative values.

1.04 JOB CONDITIONS

- A. The elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. No extras will be allowed because of variations between drawings and actual grades.
- B. Soil borings were made and the soils information is included in an Appendix to these Specifications. The information contained is not guaranteed to be indicative of conditions to be encountered during construction. It is CONTRACTOR's responsibility to make its own investigations to determine physical conditions at the site, which may affect the work.

PART 2–PRODUCTS

2.01 COMPACTED FILL

- A. All fill and backfill material designated to be compacted fill shall be granular with no stones larger than 4 inches and shall be reasonably well graded throughout the particle size range. Of that portion of the material passing the No. 4 sieve, not more than 25% shall pass the No. 200 sieve, and material shall have less than 5% clay content. When placing fill during wet weather or in wet areas, this requirement shall be modified to not more than 5% passing the No. 200 sieve. Adequately dewatered areas are not defined as wet areas.
- B. Native material may be used as compacted fill if it meets the above specification. CONTRACTOR shall determine whether native material meets the above specification. CONTRACTOR shall provide all needed fill material whether from on-site or off-site at no additional cost to OWNER.

2.02 CRUSHED STONE MAT

- A. Crushed stone mat below tank slabs, manholes, vault slabs and basement floors shall be 3/4-inch clear crushed stone and shall meet all requirements of Illinois DOT Article 351, gradation CA7/11.

2.03 GRANULAR CUSHION

- A. Granular cushion beneath floor slabs-on-grade shall meet requirements of Illinois DOT Article 351, gradation CA6.

2.04 EMBANKMENT FILL

- A. Embankment fill shall contain no stumps, brush, rubbish, or other perishable material. The top 12 inches of the earth embankment shall be earthy material free from large stones.

2.05 CONCRETE FILL

- A. Concrete fill shall be Class X concrete as defined in Section 03300 Cast-In-Place Concrete, or flowable fill as defined in this section.

2.06 CLAY FILL

- A. Clay fill shall contain at least 25% clay minerals (material finer than 0.002 mm).

2.07 FLOWABLE FILL

- A. Flowable fill shall be a self-compacting, self-leveling, material consisting of a mixture of fine aggregate and filler (as needed), water, and cementitious materials (Portland cement, fly ash, granulated blast furnace slag) that is in a flowable state at the time of placement meeting the requirements of the National Ready Mixed Concrete Association Guide Specification for Controlled Low Strength Materials (CLSM). The flowable fill shall be proportioned by the ready mixed concrete supplier on the basis of field experience and/or laboratory trial mixtures to produce a cohesive and non-segregating mixture which has the following properties:
 - 1. Minimum compressive strength: 50 psi.
 - 2. Maximum compressive strength: 150 psi.
 - 3. Maximum unit weight where flowable fill is provided adjacent to basement walls: 85 pcf.
- B. CONTRACTOR shall submit the following information well in advance of fill placement to avoid any delay in construction:
 - 1. Gradation of fine aggregate.
 - 2. Design mix.
 - 3. Previous test results with 7- and 28-day compressive strengths.
 - 4. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
 - 5. Brand, type, principle ingredient, and amount of each admixture if used.

PART 3-EXECUTION

3.01 GENERAL

- A. Prior to all excavating, CONTRACTOR shall become thoroughly familiar with the site and site conditions.

3.02 PROTECTION

- A. CONTRACTOR shall provide all necessary sheeting and shoring including all labor, material, equipment, and tools required or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of Contract work, and to protect adjacent property, structures, and roads. CONTRACTOR shall be held liable for any damage which may result to property from excavation or construction operations. Sheet piling and timbers in excavations shall be withdrawn in a manner so as to prevent subsequent settlement of structures.
- B. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

3.03 UTILITIES

- A. Before starting excavations, CONTRACTOR shall locate existing underground utilities in all areas of the work.
- B. If utilities are to remain in place, CONTRACTOR shall provide adequate means of protection during earthwork operations.
- C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions.
- D. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation, and repair any damaged utilities to satisfaction of utility owner.
- E. CONTRACTOR shall not interrupt existing utilities serving facilities occupied and used by OWNER or others except when permitted in writing by OWNER.
- F. CONTRACTOR shall demolish and completely remove from the site existing underground utilities indicated to be removed after utility has been capped and sealed.
- G. CONTRACTOR shall accurately locate and record abandoned and active utility lines rerouted or extended on project record drawings.

3.04 FINISH ELEVATIONS AND LINES

- A. CONTRACTOR is responsible for setting and establishing finish elevations and lines.

3.05 EXCAVATION

- A. After the site has been cleared and stripped, the site shall be cut and filled to the indicated subgrade as shown or specified.

- B. All excavated material that does not meet the specification for compacted fill or embankment fill or meets the specification but is not required for backfill or fill shall be placed on site as fill material to the limits shown in area indicated on the plans located west of the excess flow lagoon. Any material in excess of that required to fill this area to the limits shown shall be classified as excess material and shall be removed from the site and disposed of at CONTRACTOR's expense.
- C. All material other than suitable bearing soil or bedrock, as determined by the Project Soils Engineer, shall be removed from under concrete to be poured on ground.
- D. Excavation for all footings, foundation walls, pits, etc., shall be large enough to provide adequate clearance for the proper execution for the work within them.
- E. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered. See Section 02140–Dewatering.
- F. No footings or slabs shall bear on the top 2 feet of existing soil. Where planned subgrade is within 2 feet of existing grade, remove soils to 2 feet below existing grade and backfill with compacted fill up to subgrade elevation.
- G. When excavations reach subgrade elevations as shown on the drawings, or as specified herein, the Project Soils Engineer will observe the bottom material. Where, in the opinion of the Project Soils Engineer, unsuitable foundation material is found at the level of the subgrade, original material below the excavation necessary for construction according to grades shown or specified, shall be removed and replaced with material and placing methods as specified under compacted fill and backfill.
- H. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation one foot plus a distance at least equal to the depth of undercut below footing grade.
- I. CONTRACTOR shall backfill and compact all overexcavated areas.
- J. The subsurface soils at the Chlorine Contact Tank (60) shall be overexcavated to the glacial fill soils at approximate elevation 630 and extending a minimum of 5 feet beyond the limits of the tank base slab. The overexcavated area shall be backfilled to required subgrade elevation in 12-inch lifts adequately compacted with clear crushed stone as specified in Paragraph 2.02.A of this specification.

3.06 PREPARATION OF SUBGRADE

- A. After the site has been cleared, stripped, and excavated to subgrade, thoroughly compact subgrade to the requirements specified for compacted fill below. Scarify and moisture condition the subgrade as recommended by the Project Soils Engineer.
- B. Remove all ruts, hummocks, and other uneven surfaces by surface grading prior to placement of fill.
- C. All slab-on-grade and road subgrades shall be proofrolled with a heavy rubber-tired construction vehicle (such as a fully loaded tandem-axle dump truck) in the presence of the Project Soils Engineer.

- D. Road subgrade shall be compacted to a minimum of 98% of Standard Proctor maximum dry density (ASTM D-698).

3.07 COMPACTED FILL AND BACKFILL

- A. All fill and backfill, except as otherwise specified, shall be compacted fill placed to within 4 inches of the bottom of the topsoil or to the bottom of the structure or other improvement.
- B. Unless otherwise noted, structures with a top slab shall not be backfilled until the slab is in place and has reached its specified 28-day strength.
- C. In fill areas above existing grade around structures, compacted fill shall be placed within a minimum of 10 feet from the structure.
- D. No fill shall be placed under water or over unsuitable subgrade conditions. Existing topsoil shall be removed prior to placement of fill material.
- E. All fill and backfill, except embankment fill and clay fill, shall be compacted as follows:
 - 1. Class 1 Compaction: This class of compaction shall apply to all fill areas under buildings, structures, piping, bituminous roadway and parking areas, curb and gutter, and backfill within ten feet of structure walls. All compacted material shall be placed in uniform layers not exceeding 8 inches in loose thickness prior to compaction. Each layer shall be uniformly compacted to a dry density at least 98% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D698). Compaction shall be obtained by compaction equipment appropriate for the conditions.
 - 2. Class 2 Compaction: This class of compaction shall be used in excavated areas beyond 10 feet of structures without any piping or adjacent foundations. Material for backfill shall be granular material as specified above. The material shall be deposited, spread, and leveled in layers generally not exceeding 8 inches in thickness before compaction. Each layer of the fill shall be compacted to at least 95% of the maximum dry density (testing same as Class 1). Compaction shall be obtained by compaction equipment appropriate for the conditions.
- F. No frozen material shall be placed nor shall any material be placed on frozen ground.
- G. Four inches of clay fill shall be placed and compacted to at least a firm consistency in areas to be seeded or sodded prior to placement of topsoil.

3.08 EMBANKMENT FILL

- A. Embankment fill may be placed in fill areas to be seeded or sodded if no piping exists in the fill and the areas are at least 10 feet from any structure.
- B. Embankment fill shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be obtained for each layer before any material for a succeeding layer is placed thereon. Compaction shall be obtained using the hauling and leveling equipment, and in addition, tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment required to produce the desired results.

3.09 CONCRETE FILL

- A. In areas where there is inadequate room for compaction equipment and in other areas as shown or specified, Class X concrete or flowable fill shall be used as fill material.

3.10 GRADING

- A. CONTRACTOR shall perform all rough and finish grading required to attain the elevations shown on the drawings.
- B. Grading Tolerances:
 - 1. Rough Grade: Buildings, parking areas, and sidewalks— ± 0.1 feet.
 - 2. Finish Grade: Granular cushion or crushed stone mat under concrete slabs— ± 0.03 feet.
 - 3. Lawn areas away from buildings, parking areas, and sidewalks— ± 0.25 feet.

3.11 PLACING GRANULAR CUSHION AND VAPOR BARRIER

- A. When subgrade is prepared for slab-on-grade areas, CONTRACTOR shall place the vapor barrier.
- B. A 6-inch layer of granular cushion shall then be placed, compacted, and finish graded.

3.12 PLACING CRUSHED STONE AND GEOTEXTILE FABRIC

- A. The same day that the subgrade is exposed, place geotextile fabric on subgrade, and place 12 inches of crushed stone mat below tank slabs, manholes, vault slabs, and basement floors. Compact in place.

3.13 COMPACTION TESTING

- A. Compaction tests shall be done by the Project Soils Engineer. Location and frequency of the tests shall be as recommended by the Project Soils Engineer and paid for by OWNER.

END OF SECTION

SECTION 02231

AGGREGATE BASE COURSE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Aggregate base course for roads and parking areas.
 - 2. Gravel roads.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Repair or replacement of aggregate base course shall be considered incidental and included in the price bid.
- D. CONTRACTOR is cautioned that existing private and public roads and shoulders may not hold up to typical construction traffic or activities. CONTRACTOR shall repair all roads, shoulders, and gravel areas damaged in accordance with this section. All paved areas shall also be repaired in accordance with Section 02510–Asphaltic Concrete Paving.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.

1.03 DEFINITIONS

- A. Street or road shall include streets, roads, driveways, and parking lots.

1.04 SUBMITTALS

- A. Submit sieve analysis for proposed materials in accordance with Section 01300–Submittals.

1.05 DRAINAGE DURING CONSTRUCTION

- A. CONTRACTOR shall comply with the provisions of Article 280 of the Standard Specifications.

PART 2–PRODUCTS

2.01 AGGREGATES

- A. Aggregate for base course shall meet the requirements of Article 351 of the Standard Specifications.

- B. Base course shall be uniformly graded and shall conform to the requirements of No. CA/CM-6.

PART 3—EXECUTION

3.01 PREPARATION

- A. The subgrade shall be graded and rolled to provide uniform density and shall comply with the profile and cross sections contained in the drawings. All street subgrade in cut areas and all areas to receive fill shall be proof-rolled in the presence of OWNER or ENGINEER with a heavily loaded tri-axle dump truck or similar equipment prior to the placement of any fill materials or base course. The subgrade shall be prepared in accordance with Article 301 of the Standard Specifications. Subgrade shall be compacted to a minimum of 98% of Standard Proctor maximum dry density (ASTM D-698).

3.02 CONSTRUCTION

- A. Base course grade shall be set to allow placement of thickness of asphaltic pavement shown or specified.
- B. Depth of base course shall be provided according to the standard cross sections provided on the drawings.
- C. Each layer of base course shall be wetted and rolled to provide maximum compaction in accordance with Article 351.05 of the Standard Specifications.
- D. The finished base course shall be fine graded in preparation for paving.
- E. After final grading, CONTRACTOR shall maintain the base course until asphaltic paving work has been completed.
- F. All gravel surfaces damaged during construction shall be replaced. The depth of aggregate shall match existing or 8 inches, whichever is greater.

END OF SECTION

SECTION 02240

GEOTEXTILES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Geotextiles for areas below structures, at perforated drain pipe trenches, pressure relief valves, below base course, and below riprap.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Geotextile for areas below structures, for use at perforated drain pipe trenches and pressure relief valves, and as specified elsewhere, shall be Mirafi 140N, or equal.
- B. Geotextile below riprap shall be Mirafi 600X, or equal.
- C. Geotextile below base course, if required, shall be Mirafi 500X, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Geotextile shall be installed in accordance with manufacturer's recommendations.
- B. Geotextile shall be lapped a minimum of 24 inches.
- C. If extensive areas of unstable subgrade are encountered on street areas, ENGINEER may request the furnishing and installation of construction fabric to obtain the necessary subgrade support for the roadway structure. Vibratory compaction shall not be used in the compaction of base course in areas where construction fabrics are used.
- D. CONTRACTOR shall protect the construction fabric from exposure to the sun until installation. Construction fabric shall be covered with stone or soil immediately upon placement.

END OF SECTION

SECTION 02270

SLOPE PROTECTION AND EROSION CONTROL

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Erosion control devices.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 PAYMENT

- A. All costs associated with slope protection and erosion control shall be included in CONTRACTOR's Bid. This work shall include, but is not limited to, erecting fence, excavation, placing posts, backfilling, attaching woven wire and geotextile fabric; placing ditch checks; installing sediment traps; removing the fence at completion of project; cleaning and repairing; removing or spreading accumulated sediment to form a surface suitable for seeding; replacing silt fence and damages caused by overloading of sediment material or ponding of water adjacent to silt fence; and furnishing labor, tools, equipment, and incidentals necessary to complete the work in accordance with the Contract.

1.03 REFERENCES

- A. Illinois Urban Manual and Procedures and Standards for Urban Soil Erosion and Sediment Control in Illinois "Green Book."

1.04 REGULATORY REQUIREMENTS

- A. OWNER has prepared a Stormwater Pollution Prevention Plan in conjunction with development of construction documents and submitted a "Notice of Intent" (NOI) for General Permit to Discharge Storm Water Construction Site Activities. CONTRACTOR, as designated operator of activities at the construction site, will be responsible for compliance with all permit conditions. This includes, but is not limited to the following:
 - 1. Implementation of erosion and sediment control practices necessary to meet federal, state, and local performance standards.
 - 2. Receiving required approvals from OWNER and regulatory agencies for any modifications to the pollution prevention plan necessitated by site conditions or operations.
 - 3. Performance of all inspection, maintenance, and record-keeping activities required by the permit.
 - 4. Payment of any fines or other fees resulting from failure of CONTRACTOR to comply with permit requirements.
- B. Comply with laws prohibiting pollution of any lake, stream, river, or wetland.

1.05 QUALITY CONTROL

- A. Construct and maintain erosion sediment control measures in accordance with the Illinois Urban Manual and Procedures and Standards for Urban Soil Erosion and Sediment Control in Illinois "Green Book."
- B. Check facilities weekly and after any rainfall event, and make needed repairs within 24 hours.

PART 2-PRODUCTS

2.01 EROSION MATS

- A. Uniform web of interlocking wood excelsior fibers, with a net backing on one side. The wood from which the blanket is produced shall have been properly cured to achieve adequately curled and barbed fibers. The blanket shall be of uniform thickness with the wood fibers evenly distributed over the entire area of the blanket. The blanket shall be furnished in rolled strips. The width of the strips shall be 48 inches, ± 1 -inch. Weight of blanket measured under average atmospheric conditions shall be 78 pounds per 80 square yards, $\pm 10\%$. Net backing shall have mesh size not exceeding 1 1/2 by 3 inches and may be woven from twisted paper, cotton cord, a biodegradable plastic, or other alternate approved by ENGINEER. The blanket shall be nontoxic to vegetation.

2.02 SILT FENCE

- A. Use geotextile fabric consisting of either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride with the following requirements. Fabric shall have the minimum strength values in the weakest principal direction. Nonwoven fabric may be needle punched, heat bonded, resin bonded, or combination thereof.

VALUE MINIMUM REQUIREMENTS (1)			
Test	Method	Silty Soils ⁽⁴⁾	Sandy Soils ⁽⁵⁾
Grab Tensile-strength	ASTM D-1682 ⁽²⁾	100	100
Mullen Burst strength (psi)	ASTM D-3786	200	200
Equivalent Opening Size	CW-02215-77	50-140	20-50
U.S. Standard sieve	Corps of Engineers		
Water Flow Rate (gal/min/ft. ² at 50 MM Constant head	ASTM D-4491 ⁽³⁾	10	10
Ultra Violet Radiation Stability (percent)	ASTM D-4355	90	90

- (1) All numerical values represent minimum average roll values (i.e., the average of test results on any roll in a lot should meet or exceed the minimum values in the table).
- (2) ASTM D-1682 Grab Test, Method 16, using a 4-inch by 8-inch sample, 3-inch gauge length clamped in 1-inch by 2-inch long grip, tested at a strain rate of 12-inch/min.

- (3) Water Flow Rate in gal/min/ft shall be determined by multiplying Permittivity in sec. as determined by ASTM D-4491 by a conversion factor of 74.
- (4) Silty Soil: More than 15% by weight passing No. 200 sieve.
- (5) Sandy Soil: Less than 15% by weight passing No. 200 sieve.

- B. Furnish geotextile fabric in a wrapping which will protect the fabric from ultraviolet radiation and from abrasion because of shipping and handling. Keep geotextile dry until installed.

2.03 GEOTEXTILE FABRIC

- A. See Section 02240—Geotextiles for fabric under riprap.

2.04 RIPRAP

- A. See Section 02275—Riprap.

PART 3—EXECUTION

3.01 GENERAL

- A. Install devices before construction activities begin.
- B. Proceed carefully with construction adjacent to stream channels to avoid washing, sloughing, or deposition of materials into the stream. If possible, the work area should be diked off and the volume and velocity of water that crosses disturbed areas be reduced by means of planned engineering works (diversion, detention basins, berms).
- C. Unless noted on drawings, do not remove trees and surface vegetation.
- D. Expose the smallest practical area of soil at any given time through construction scheduling. Make the duration of such exposure before application of temporary erosion control measures or final revegetation as short as practicable.

3.02 EROSION MAT INSTALLATION

- A. Place erosion mat immediately after seeding or sodding operations have been completed. Before mat placement, remove all material or clods over 1 1/2 inches in diameter and all organic material or other foreign material which interfere with the mat bearing completely on the soil or sod.
- B. Any small stones or clods which prevent contact of the mats with the soil shall be pressed in the soil with a small lawn-type roller or by other effective means. The mat shall have its lateral edge so impressed in the soil as to permit runoff water to flow over it.
- C. The matting strips shall be rolled on or laid in direction of flow. Spread mat evenly, smoothly, in a natural position without stretching and with all parts bearing on soil, and place blanket with netting on top. Overlap adjacent strips at least 4 inches. Overlap strip ends at least 10 inches. Make overlaps with the upgrade section on top.
- D. Bury upgrade end of each strip of fabric or blanket at least 6 inches in a vertical slot cut in the soil and press soil firmly against the embedded fabric or blanket.

- E. Anchor mats in place with vertically driven staples, driven until their tops are flush with the soil. Space staples at 3-foot centers along mat edges and stagger space at 3-foot centers through the center. Place staples at 10-inch centers at end or junction slots.
- F. Reseed areas damaged or destroyed during erosion mat placing operations as specified for original seeding.
- G. Dispose of surplus excavated materials and all stones, clods, or other foreign material removed in the preparation of the seeded soil or sodded surface before placing mat.
- H. Following mat placement, uniformly apply water to the area to moisten seedbed to 2-inch depth and in a manner to avoid erosion.
- I. Maintain erosion mat and make satisfactory repairs of damage from erosion, traffic, fires or other causes until work acceptance.

3.03 GEOTEXTILE FABRIC

- A. Before placing fabric, grade area smooth and remove stones, organic matter, or other foreign material which would interfere with fabric being completely in contact with soil.
- B. Place fabric loosely and lay parallel to direction of water movement. Pinning or stapling is acceptable to hold geotextile in place. Overlap or sew together separate pieces of fabric. Overlap joints a minimum 24 inches in the flow direction. After placement, do not expose fabric more than 48 hours before covering.
- C. Cover damaged areas with a patch of fabric using a 3-foot overlap in all directions.

3.04 SILT FENCE INSTALLATION

- A. Erect silt fence before starting construction operations which might cause sedimentation or siltation at site of proposed silt fence.
- B. Construct silt fence in an arc or horseshoe shape with ends pointing up slope. Construct silt fence to the dimensions and details shown on drawings. Remove silt fences after slopes and ditches have been stabilized and turf developed to the extent that future erosion is unlikely. Dispose of materials remaining after removal.
- C. Inspect all silt fences immediately after each rainfall and at least daily. Correct deficiencies immediately. Where construction activity changes the earth contour and drainage runoff, make a daily review to ensure that silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences.
- D. Remove and dispose of sediment deposits. Sediment deposits remaining in place after the silt fence is no longer required shall be dressed to conform with the existing grade and the area topsoiled, fertilized, and seeded as required.

END OF SECTION

SECTION 02275

RIPRAP

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Furnishing and placing riprap.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Payment: Riprap will be paid for by the cubic yard at the unit price bid.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.

PART 2—PRODUCTS

2.01 MATERIALS

- A. Stone for riprap shall be durable quarry stone of approved quality. It shall be sound, hard, dense, resistant to the action of air and water, and free from seams, cracks, or other structural defects.
- B. Stone for riprap shall be in accordance with Standard Specifications, Article 1005.01, Gradation 4, Class A.

PART 3—EXECUTION

3.01 PREPARATION

- A. The bed for the riprap shall be properly trimmed and shaped before geotextile and stone is placed. Bed shall be minimum 6 inches thick.
- B. Geotextile shall be placed below riprap. See Section 02240—Geotextile.

3.02 INSTALLATION

- A. Riprap shall be provided in areas as designated on the drawings and in accordance with Drawing 01-975-149A.
- B. Stone placed above the water line shall be placed by hand. It shall be laid with close, broken joints and shall be firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope with ends in contact.

- C. The riprap shall be thoroughly compacted as construction progresses, and the finished surface shall present an even, tight surface.
- D. The large stone shall be placed in the lower courses. Interstices between stones shall be chinked with spalls firmly rammed into place.
- E. Unless otherwise shown or specified, riprap shall be at least 18 inches in thickness, measured perpendicular to the slope.

END OF SECTION

SECTION 02276

MODULAR RETAINING WALL

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Interlocking modular concrete retaining wall units and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C1372—Specification for Segmental Retaining Wall Units.
- B. ASTM D4595—Tensile Properties of Geotextiles—Wide Width Strip.
- C. ASTM D5262—Unconfined Tension Creep Behavior of Geosynthetics.
- D. GRI-GG1—Standard Test Method for Geogrid Rib Tensile Strength.
- E. GRI-GG2—Standard Test Method for Geogrid Junction Strength.
- F. GRI-GG4—Determination of Long Term Design Strength of Geogrids.
- G. GRI-GG5—Determination of Geogrid (Soil) Pullout.
- H. NCMA SRWU-1—Test Method for Determining Connection Strength of SRW.
- I. NCMA SRWU-2—Test Method for Determining Shear Strength of SRW.
- J. ASTM D4475—Apparent Horizontal Shear Strength of Pultruded Reinforced Plastic Rods by the Short-Beam Method.
- K. ASTM D2339—Strength Properties of Adhesives in Two-Ply Wood Construction in Shear by Tension Loading.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Masonry units, when delivered to the site, shall be thoroughly cured and shall be dry. When stored on the site, they shall not be in contact with the ground and shall be kept clean.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01300—Submittals.
- B. CONTRACTOR shall submit construction drawings and design calculations for the retaining wall system prepared and stamped by a professional engineer registered in the

State of Illinois. The engineering designs, techniques, and material evaluations shall be in accordance with the manufacturer's requirements. Construction drawings shall include all details necessary for construction of the retaining wall, including elevations and steps in top and bottom of wall, locations, sizes, types, and lengths of geogrid, and any other required information.

- C. Submit gradation of base leveling pad material and unit fill material.
- D. Submit color samples for OWNER's selection.

PART 2-PRODUCTS

2.01 MODULAR CONCRETE MASONRY UNITS

- A. Masonry units shall be Keystone Rockwood, Allan Block, Mesa Block, or equal. Specification is written based on the Keystone System.
- B. Masonry units shall conform to ASTM C1372 and have a minimum 28-day compressive strength of 3,000 psi. The concrete shall have a maximum moisture absorption of 8%.
- C. Units shall have angled sides capable of concave and convex alignment curves with a minimum radius of 3.5 feet. For straight walls, cap units shall have nonangled straight sides.
- D. Standard units shall be 8 inches high by 18 inches wide with sculptured rock face texture.

2.02 STRUCTURAL GEOGRID

- A. Geogrid shall be a product with a regular grid structure of a select high density polyethylene or polypropylene resin, UX 1500HP, as manufactured by Tensar Corporation, or equal.
- B. Minimum allowable junction strength of the geogrid, per G.R.I. GG2, shall be equal to or greater than 90% of the ultimate strength of the geogrid, as per G.R.I. GG1.

2.03 CONNECTING PINS

- A. Units shall be interlocked with noncorrosive fiberglass pins.
- B. Connecting pins shall be 1/2-inch diameter thermoset isophthalic polyester resin-pultruded fiberglass reinforcement rods.
- C. Pins shall have a minimum flexural strength of 128,000 psi and short beam shear of 6,400 pounds per ASTM D4475.
- D. Connecting pins are not required for masonry units with integral keys or lips that provide mechanical interlock between adjacent units.

2.04 ADHESIVE

- A. Construction adhesive shall be Keystone Kapseal, or equal, and shall meet requirements of ASTM D2339.

2.05 BASE LEVELING PAD

- A. Base leveling pad material shall be 6 inches of compacted crushed stone, 3/8-inch to 3/4-inch. Pea gravel shall not be allowed.

2.06 UNIT FILL

- A. Unit fill shall be free-draining, well-graded crushed stone, 3/8-inch to 3/4-inch, with no more than 5% passing the No. 200 sieve.

2.07 BACKFILL

- A. Backfill for use beyond drainage zone behind units shall be as specified in Section 02222-Excavation, Fill, Backfill and Grading.

PART 3-EXECUTION

3.01 EXCAVATION

- A. Foundation soil shall be excavated as required for leveling pad dimensions shown on the drawings.
- B. Subgrade shall be approved by the Project Soils Engineer to confirm that the actual foundation soil conditions meet or exceed assumed design strength. Soils not meeting required strength shall be removed and replaced with acceptable material.

3.02 BASE LEVELING PAD

- A. Leveling pad materials shall be placed as shown on the drawings to a minimum thickness of 6 inches.
- B. Materials shall be compacted so as to provide a level surface on which to place the first course of units. Compaction shall be to 95% of standard proctor for sand or gravel-type materials. For crushed rock, material shall be densely compacted.
- C. Leveling pad shall be prepared to ensure complete contact of retaining wall unit with base.

3.03 INSTALLATION

- A. Units shall be installed to conform to elevations shown on the drawings.
- B. Place first course of concrete wall units on the base leveling pad. The units shall be checked for level and alignment. Ensure that units are in full contact with base. Bottom of wall shall be minimum 8 inches below finished grade and shall be lower if required by design.

- C. Units are placed side by side for full length of wall alignment. Alignment may be done by a string line or offset from base line.
- D. Units shall be interlocked with fiberglass pins or lips cast integrally with each masonry unit. Pins shall protrude into adjoining courses above a minimum of 1 inch. Two pins required per unit.
- E. Fill all voids inside and between units and drainage zone behind units with unit fill material. Tamp fill. Do not use automated compaction equipment directly over the units. Walk behind mechanical compaction equipment may be used to compact soils that are placed beyond the drainage zone behind the unit. Mobile mechanical compaction equipment shall not be used within 5 feet of the wall face.
- F. While placing material behind first course of units, replace the passive soil wedge at the front of these units.
- G. Sweep all excess material from top of units and install next course. Ensure each course is completely unit filled, backfilled, and compacted prior to proceeding to next course.
- H. Geogrid reinforcement shall be placed at the elevation(s) and to the extent required by design. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignments.
- I. The geogrid soil reinforcement shall be laid horizontally on compacted backfill. Place the next course of modular concrete facing units over geogrid. The geogrid shall be pulled taut and anchored prior to backfill placement on the geogrid.
- J. Geogrid reinforcements shall be continuous throughout their embedment length(s). Spliced connections between shorter pieces of geogrid will not be allowed.
- K. Place next course, pull each unit forward away from the embankment against pins in the previous course, and backfill as the course is completed. Repeat procedure to the extent of wall height.
- L. Provide permanent mechanical connection of cap units to wall units with construction adhesive. Apply adhesive to top surface of unit below, and place cap unit into position. Place cap units over projecting pin from units below. Pull forward to setback position. Backfill and compact to finished grade.
- M. As appropriate where the wall changes elevation, units shall be stepped with grade or turned into the embankment with a convex return end. Minimum of three units shall be installed into the grade on compacted leveling pad in area of convex return end. Units shall be laid to create the minimum radius possible.

END OF SECTION

SECTION 02510

HOT MIX ASPHALT PAVING

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes Hot Mix Asphalt (HMA) paving, tack coat, and casting adjustments.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. CONTRACTOR is cautioned that existing private and public roads and shoulders may not hold up to typical construction traffic or activities. CONTRACTOR shall repair all roads, shoulders, and paved areas damaged during the project in accordance with this section. Gravel shoulders, gravel roads, and parking areas shall be repaired in accordance with Section 02231–Aggregate Base Course.
- D. Payment: Payment for HMA paving shall be considered incidental to the project and included in the lump sum bid.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.

1.03 DEFINITIONS

- A. Street or road shall include streets, roads, driveways, and parking lots.

1.04 SUBMITTALS

- A. Prior to the commencement of paving, mix designs and aggregate sieve analysis shall be submitted to ENGINEER for approval in accordance with Section 01300–Submittals.

PART 2–PRODUCTS

2.01 HMA PAVEMENT

- A. Asphaltic pavement shall be Class 1 per Section 406. Asphaltic material for binder course and surface course shall be asphaltic material 10-20.
- B. Aggregate shall conform to the requirements of Article 406.13 of the Standard Specifications. Aggregate for the binder course shall be Binder Mixture B. Aggregate for the surface course shall be Surface Mixture C.

- C. Replacement of paved surfaces shall be 3 inches in thickness or existing thickness, whichever is greater. Lower layer shall be 1 1/2 inches minimum. Upper layer shall be 1 1/2 inches minimum.
- D. Materials for tack coat shall conform to the requirements of Article 406.02.
- E. Pavement markings shall conform to Section 646 for white markings, except without the reflective additive.

PART 3-EXECUTION

3.01 ALLOWABLE REMOVAL OF PAVEMENT

- A. CONTRACTOR shall remove asphalt pavement and road surface as a part of the general excavation. The width of pavement removed shall be the minimum possible and acceptable for convenient and safe installation of structures, utilities, and appurtenances.
- B. All asphalt pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the excavation. Should the cut edge be damaged, a new cut shall be made in neat, straight lines parallel to the original cut encompassing all damaged areas. Pavement removal shall be extended to a seam or joint if seam or joint is within 3 feet of damaged pavement.

3.02 CASTING ADJUSTMENTS

- A. All new and existing manhole castings and valve boxes within the paving limits of the street, which require adjustment, shall be adjusted to match the finished asphaltic surface. Adjustments shall not be made greater than 48 hours prior to the anticipated time of paving. Adjustments shall be performed as called for in Section 02600–Buried Piping and Appurtenances Section 02700–Water Main, Storm and Sanitary Sewers. CONTRACTOR shall furnish Class 1 barricades with flashers on all adjusted castings until paving has been completed. Tops of castings and valve boxes shall be oiled or protected by other methods to prevent sealing of lids and filling of lift holes during paving. Upon completion of paving operations, CONTRACTOR shall check all castings and valve boxes to insure that the lids are clean and operational. Manhole casting adjustment shall be included in the cost of other items of work, and no further compensation will be made. Valve box adjustment shall be considered an incidental item of work.

3.03 TACK COAT

- A. All work shall be in accordance with the Standard Specifications.
- B. If asphaltic surface course is applied to an existing street or is not applied the same day as binder course, the existing street or binder surface shall be tack coated prior to surface paving. Prior to placement of tack coat, the streets shall be thoroughly cleaned and broomed. Tack coat shall be applied at a rate of 0.10 gallons per square yard immediately prior to placement of asphaltic surface course.
- C. In situations where traffic must be maintained, tack coat shall not be placed on the traveled half of the street until traffic can be switched to the new pavement.

3.04 JOINTS

- A. Joints between old and new pavements or between successive day's work shall be constructed and treated as to insure thorough and continuous bond between the old and new mixtures. Transverse construction joints shall be constructed by cutting the material back for its full depth so as to expose the full depth of the course. Where a header is used, the cutting may be omitted provided the joint conforms to the specified thickness. These joints shall be treated with tack coat material applied with a hose and spray nozzle attachment to fully coat the joint surface.
- B. The longitudinal joint shall be made by overlapping the screed on the previously laid material for a width of not more than 2 inches and depositing a sufficient amount of asphaltic mixture so that the finished joint will be smooth and tight. Longitudinal joints in the surface course shall at no time be placed immediately over similar joints in the binder course beneath. A minimum distance of 12 inches shall be permitted between the location of the joints in the binder course and the location of similar joints in the surface course above.
- C. All costs for furnishing and applying tack coat to butt joints as specified above shall be considered incidental.

3.05 FINISHING ROADWAY

- A. The finished base course shall be fine-graded in preparation for HMA paving. Base course ramps at all existing pavement shall be removed to provide a full depth butt joint. Base course around manhole castings and valve boxes shall be hand-trimmed and compacted with a vibratory plate compactor.
- B. This item shall include all of the following preparatory and finishing items and any other incidental items of work required for construction. Asphaltic ramps around manholes on existing binder course to receive surface course shall be removed. Asphaltic ramps shall be installed on all manholes and at all butt joints in areas to receive binder course only.
- C. Finishing roadway shall be considered incidental to HMA paving.
- D. Paint all markings as shown on drawings with lines not less than 4 inches wide.

3.06 TESTING HOT MIX ASPHALT

- A. ENGINEER may require samples of HMA pavement for testing. CONTRACTOR shall cut samples from the finished pavement where marked by ENGINEER and patch the sample area. Samples for sieve analysis and asphalt content will be taken by ENGINEER prior to placement.

3.07 HOT MIX ASPHALT PAVING

- A. HMA paving work shall include the construction of plant-mixed hot mix asphalt pavement in the areas shown on the drawings. All work shall be performed in accordance with Article 406 of the Standard Specifications.
- B. Prior to commencement of paving operations, CONTRACTOR shall examine the finished road bed. CONTRACTOR shall notify ENGINEER of any areas of suspected instability.

- C. The pavement structure for new roads shall be determined from the standard cross sections provided on the drawings.

END OF SECTION

SECTION 02521

CONCRETE SIDEWALKS AND DRIVEWAY APRONS

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes concrete sidewalks and driveway aprons as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Supplemental Unit Price: CONTRACTOR shall fill in a unit price for “Concrete Sidewalks” in the blank space provided in the Bid to apply in the event of any deletions from or additions to the work.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.
- B. AASHTO M148 Standard Specifications for Liquid Membrane–Forming Compounds for Curing Concrete.

1.03 QUALITY ASSURANCE

- A. Unless otherwise specified, all curb and gutter, sidewalks, and driveway apron construction shall meet the requirements of the Standard Specifications.

PART 2–PRODUCTS

2.01 CONCRETE

- A. All concrete shall be Class A or A-FA as specified in Section 03300–Cast-in-Place Concrete.

2.02 CURING COMPOUND

- A. Liquid curing compounds shall conform to the requirements of the Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete, AASHTO Designation M148, Type 2, White Pigmented.

PART 3–EXECUTION

3.01 BASE PREPARATION–SIDEWALKS AND DRIVEWAYS

- A. The subgrade shall be thoroughly compacted and finished to a trim, firm surface. All soft or unsuitable material shall be removed and replaced with suitable material.
- B. A minimum 2-inch-thick layer of sand, sand and gravel, or base course shall be placed under all sidewalks. This material shall be thoroughly moistened and compacted before the concrete is placed.

3.02 FORMS

- A. Forms shall be of metal and of sufficient strength to resist distortion or displacement. Metal forms shall be used to construct a curb and gutter cross section as shown on Drawing 01-975-82A. Forms shall be full depth of the required work. Facing boards, if used, shall be built so as to obtain the cross section called for on the drawings. Forms shall be securely staked and held firmly to line and grade. Forms shall be cleaned thoroughly and oiled before reuse.

3.03 PLACING AND FINISHING CONCRETE

- A. Unless otherwise specified, concrete shall be placed in accordance with Section 03300-Cast-in-Place Concrete.
- B. Concrete for sidewalk shall be placed to a minimum thickness of 5 inches, except at driveways and alleys, which shall have a minimum thickness equal to that of the driveway. Driveways shall have a minimum thickness of 8 inches. The concrete shall be thoroughly spaded and tamped to remove all voids. The surface of the driveway or sidewalk shall be thoroughly troweled and finished with a brush at right angles to the driveways or sidewalk line.

3.04 JOINTING–SIDEWALKS AND DRIVEWAYS

- A. Concrete sidewalk shall be cut into rectangular blocks approximately 5 feet long. The cut must extend at least 1/5 of the total thickness of concrete. The edges of the sidewalk along forms and joints shall be rounded with an edging tool of 1/4-inch radius. All joints shall be at right angles to the centerline of the sidewalk.
- B. Concrete driveways shall be jointed in approximately square sections. The depth of the joint and the finishing of the edges shall be the same as for concrete sidewalk.

3.05 EXPANSION JOINTS

- A. A 3/4-inch-thick expansion joint shall be placed at all sidewalk corners, between sidewalks and buildings, and between back of curb and sidewalk.

3.06 SLOPE

- A. Sidewalk cross slope shall be 1/4-inch per foot unless otherwise noted in the drawings or requested by ENGINEER.

3.07 CURING

- A. As soon after finishing operations as the free water has disappeared, the concrete surface shall be sealed by spraying on it a uniform coating of curing material in such a manner as to provide a continuous water impermeable film on the entire concrete surface.
- B. The material shall be applied to form a uniform coverage at the rate of not less than one-half gallon per 100 square feet of surface area.
- C. Within 30 minutes after the forms have been removed, the edges of the concrete shall be coated with the curing compound applied at the same rate as on the finished surface.

3.08 PROTECTION OF CONCRETE

- A. CONTRACTOR shall erect and maintain suitable barricades to protect the new concrete. Where it is necessary to provide for pedestrian traffic, CONTRACTOR shall, at his own cost, construct adequate crossings. Crossing construction shall be such that no load is transmitted to the new concrete.
- B. Any part of the work damaged or vandalized prior to final acceptance shall be repaired or replaced at the expense of CONTRACTOR in a manner satisfactory to ENGINEER.
- C. Pedestrian traffic shall not be permitted over new concrete prior to 72 hours after application of curing material. Vehicular traffic shall not be permitted over newly placed concrete within seven days after completion when temperatures are 70°F or higher, 10 days when temperatures are not lower than 60°F and up to a maximum of 21 days when the temperatures are generally lower than 60°F.

END OF SECTION

SECTION 02600

BURIED PIPING AND APPURTENANCES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All underground piping and valves of every description.
 - 2. Excavation, dewatering, and backfilling for all work under this section unless otherwise noted.
 - 3. Concrete foundations and anchor bolts for all equipment furnished under this section.
 - 4. Underground piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01300–Submittals for shop drawing submittal procedures.
 - 2. General arrangement drawings of 3 inch or larger exterior (below ground) ductile iron piping shall be submitted to ENGINEER for approval. Drawings shall include proposed length, location and elevation of pipe, fittings, valves and appurtenances.

PART 2–PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials in contact with water to be used for potable water supplies shall be National Sanitation Foundation (NSF)-approved.
- B. Size and Type:
 - 1. All materials shall conform to the size and type shown on the drawings or called for in the specifications.
 - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be standard selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be selected by CONTRACTOR and submitted for review by ENGINEER.

2.02 MANHOLES

- A. General: All provisions of Drawing 01-975-43A, enclosed in these specifications, except those contrary to provisions delineated herein or on the drawings shall apply.
- B. Unless otherwise specified or shown on the drawings for special manholes, all manholes shall be reinforced concrete precast manholes. Reinforced concrete manhole base sections, riser sections, cones, and flat slabs shall conform to the requirements of ASTM C-478. Solid precast manhole bottoms shall be provided except where shown on the drawings. Manholes shall be provided with minimum diameters as shown on Drawing 01-975-43A. Diameters shall be increased from the minimum for the following:
 - 1. To provide between adjacent pipe a minimum distance equal to 1/2 the outside diameter of the largest pipe measured circumferentially along the inside face of the manhole.
 - 2. To accommodate flexible manhole connections used.
 - 3. To accommodate multiple valves or valve assemblies.
- C. Manhole top sections shall be precast reinforced eccentric cones unless precast reinforced flat slabs are specifically required or shown on the drawings or are necessary because of shallow depth. Flat slabs shall have opening offset unless otherwise required or shown. Flat slabs shall be designed for HS20 loadings.
- D. Manhole sections shall be provided in such combinations as to conveniently make up the required depth of the manholes. A maximum of two handling holes per length of pipe will be permitted. All joints shall be tongue and groove and shall be sealed with rubber o-ring gaskets of circular cross section or mastic compounds. Gaskets shall conform to ASTM C-443. Mastic compounds shall be Ram-nek, Kent-Seal, Mas-stik, or equal.
- E. Except as otherwise specified, connection of pipes to manholes shall be with KOR-N-SEAL, A LOK, Interpace, PS-X, or equal joint. The joint shall provide a flexible, watertight connection between pipe and manhole. Manhole connections for storm sewer mains and leads may be made with poured-in-place concrete during completion of manhole interior in lieu of above.
- F. Manhole Steps:
 - 1. Manhole steps shall be provided as shown on the drawings by manhole manufacturer, except that steps shall not be installed in the wet well. Manhole steps shall be M.A. Industries, Inc. PS1-PF with 1/2-inch-diameter steel reinforcing rod, conforming to ASTM A-615, Grade 60, with molded co-polymer polypropylene covering conforming to ASTM D4101 Type PP200B33450Z02, or equal.
 - 2. Manhole steps shall be inserted in manhole riser, cone, and flat slab sections prior to the initial set of the concrete in accordance with ASTM C478 and shall have maximum embedment and pull-out resistance in accordance with ASTM C478.
 - 3. The top step shall be located 10 inches or less from the top of the cone section. Steps shall be a maximum 16 inches apart.
- G. Manhole Frames and Covers:
 - 1. Manhole frames and covers shall be provided for the openings indicated on the drawings.
 - 2. For standard manholes, frames shall be Neenah R-1550, or equal, with Type B lid, with two concealed pickholes equipped with self-sealing gaskets. Frames for valve manholes shall be Neenah R-6065 with Type B lid with two concealed pickholes equipped with self-sealing gaskets, or equal. Catch basin grates in paved areas shall

be Neenah R-2668, catch basin frame, and Type C grate, or equal. Catch basin grates in other areas shall be Neenah R4340-B, or equal.

- H. Manhole Chimney Seals:
 - 1. External manhole chimney seals shall be provided for all new manholes. Chimney seal shall be Cretex, or equal.
 - 2. Existing manholes exposed during the construction period shall have the adjustment rings replaced and a new chimney seal installed. Existing castings shall be reused.
- I. Valve boxes shall be provided for all buried valves. Valve boxes shall be Tyler/Union 6850 Series, 4 inch through 12 inch, or equal. Extension heights shall be provided as required. Lids shall be marked for appropriate use. CONTRACTOR shall verify that all valve boxes are large enough to accommodate all operating nuts and wrenches. Provide one "Tee" valve key operator for each valve manhole and one for each tank with tank or channel drain.
- J. Floor boxes shall conform to Section 15050-Piping and Appurtenances.
- K. Storm sewer manholes and curb inlets shall be constructed as shown on Drawing 01-975-41A. Except as otherwise specified, manhole covers shall be Neenah R-1550, or equal, with Type B lid with two concealed pickholes and self-sealing gaskets.
- L. Area drains as shown on the drawings shall be constructed using a section of 24-inch-diameter RCP bell and spigot joint pipe. Castings for area drains shall be Neenah R-4353 beehive grate with frames. The pipe bell I.D. shall be greater than the casting O.D. so that the casting will fit within the bell without becoming wedged against the side of the pipe.

2.03 BURIED PIPING

- A. Ductile Iron Piping and Ductile Iron Fittings:
 - 1. Unless otherwise shown or specified, all underground piping 3 inches in diameter or larger shall be ductile iron conforming to AWWA C151/A21.51 with mechanical joints or push-on joints. Unless otherwise shown or specified, all piping shall be minimum Special Thickness Class 53 with a minimum rated working pressure of 250 psi. Pipe wall thickness shall be furnished as required by: AWWA C150 for buried piping with the depth of cover as shown on the drawings for laying condition 4; Special Thickness Class 53 minimum unless otherwise shown or specified.
 - 2. Except as otherwise specified, underground pipe shall have mechanical joints or push-on joints conforming to AWWA C110 and C111 with vulcanized styrene butadiene rubber gaskets conforming to AWWA C111. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe and provide joint restraint are not acceptable. Underground hot water and aeration piping shall have EPDM gaskets designed for a minimum 225°F (mechanical joints) or a minimum 250°F (push-on joint). Bolts on exterior joints shall be high-strength low-alloy steel (Corten, or equal) conforming to AWWA C111. Certificate to that effect shall be provided.
 - 3. Mechanical joints shall be restrained with MEGALUG® Series 1100 or 1100SD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1400 by Ford Meter Box Co., Inc., or equal, restraint. Push-on joints for ductile iron piping shall be restrained with MEGALUG®, Series 1100HD or 1700, by EBAA Iron Sales, Inc., UNIFLANGE Series 1450 by Ford Meter Box Co., Inc., Flex-Ring or Lok-Ring by American Cast Iron Pipe Company, TR Flex by U.S. Pipe Company, or equal.

4. Joint restraint is not required for gravity sewers, drains, and those pipes designated in Paragraph 1 of 3.02 Infiltration/Exfiltration Tests.
5. Underground pipe shall have mechanical joint or push-on joint ductile iron fittings conforming to AWWA C110 and C111 or AWWA C153 compact fittings with a minimum rated working pressure of 150 psi. Gaskets for fittings shall be as specified for underground piping.
6. All ductile iron fittings shall be American, Clow, Griffin, Tyler, U.S. Pipe, or equal.
7. Ductile iron wall pipes shall be provided as shown on the drawings. For piping over 24 inch that do not require restraints, wall pipes shall be provided with push-on joint connection at exterior end of wall pipe. For piping over 24 inch that requires restraint, wall pipes shall be provided with Lok-Ring by American Ductile Iron Pipe Company, TR-Flex by US Pipe Company, or equal, connection. For piping over 24 inch, wall pipes may also be provided with mechanical joint connection at exterior end of wall pipe. For piping that requires restraint, mechanical joint connections at exterior end of wall pipe shall be restrained as specified for mechanical joints.
8. The words "Ductile Iron" and the weight and class of pipe shall be plainly marked on each piece of pipe.
9. Unless otherwise specified, all ductile iron piping and fittings shall be cement-mortar-lined and asphaltic-coated inside. Unless otherwise specified, underground piping and fittings shall be asphaltic-coated outside. Cement-mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
10. Drainage Piping: All process drain piping and all underground piping designated as drain (D) and waste (W) shall be ductile iron. All underground drainage piping more than 2 feet from building walls shall be ductile iron as specified. Connections to drainage piping from buildings shall be made within 2 feet from the building wall and shall be made with a Fernco, or equal, flexible coupling.
11. All ductile iron piping and fittings designated A (Air) shall be unlined, and shall receive exterior coating as specified above.
12. All buried ductile iron piping and appurtenances shall be polyethylene encased in accordance with AWWA C105. Polyethylene encasement shall be Class C (black) and shall be minimum 8 mil thickness.
13. All ductile iron piping and fittings designated SCM (Scum), and all piping conveying a combination of these sludges such as SCM/WAS, etc., shall be glass-lined, and shall receive exterior coating as specified above. The glass lining shall be fused to the inside metal base prepared by blasting by placing the pipe or fitting into a furnace at the appropriate maturing temperature above 1,400°F. The entire coating shall be from 0.008-inch- to 0.012-inch-thick. It shall have a hardness of from 5 to 6 on the Mohs Scale, and a density of from 2.5 to 3.0 grams per cubic centimeter. The glass lining shall be capable of withstanding a thermal shock of 350°F without crazing, blistering, or spalling. It shall be resistant to corrosion by solutions of between pH-3 and pH-10 at 125°F. There shall be no visible loss of surface gloss on the glass lining after immersion of a normal production run sample in an 8% sulfuric acid solution at 148°F for a period of ten minutes. In addition, when tested according to ASTM Designation C283-54, it shall show a weight loss of not more than 3 milligrams per square inch.
14. Piping and fittings for installation in manholes and wet wells shall be flanged and provided as specified in Section 15050—Piping and Accessories.

- B. Reinforced Concrete Sewer Pipe:
1. Reinforced concrete pipe for storm sewer (STS) shall meet the requirements of ASTM C76 for circular pipe and ASTM C507 for elliptical pipe. Strength and class of the pipe shall conform to the drawings and as specified herein. All reinforced concrete pipe used in the work shall be of adequate strength to support the trench loads applied.
 2. Standard and special fittings shall be of approved manufacture and shall conform to requirements of the trade and these specifications. All fittings shall be of a strength at least equal to that of the sewer main and shall be jointed with the same type of joint as used in the sewer main.
 3. Not more than one lift hole per length of pipe shall be used in storm sewer.
 4. Reinforced concrete pipe and fittings shall be joined with joints which meet the requirements of the ASTM C443. All pipe shall be specifically built to fit the gasket used. Gaskets for sanitary sewer shall be continuous O-ring of circular cross section. Gaskets for storm sewer shall be Tylox, or equal. Provide precast concrete endwalls on all storm sewers.
- C. Perforated Pipe: Foundation drain piping shall be perforated corrugated polyethylene tubing with integral filter fabric. Size shall be as shown on drawings, minimum 4-inch-diameter. Piping shall meet requirements of ASTM F-405. Provide all required bends, adapters, couplings, risers, cleanout covers, etc. Piping shall be as furnished by Wisconsin Tubing, Inc. of Omro, Wisconsin, or equal. See detail on drawings for laying conditions. Fabric shall be installed in accordance with manufacturer's instructions. Minimum lap shall be 18 inches. All laps shall be tacked or pinned to prevent separation during installation.
- D. Copper Piping:
1. Copper piping shall conform to the requirements of the "Specifications for Seamless Copper Water Tube," ASTM B88.
 2. All underground water supply piping 2 inches and smaller shall be Type K soft copper with compression fittings. Joints shall not be used under floor slabs.
 3. Shutoff valves shall be placed on each branch for all underground piping.
- E. Galvanized Iron Piping: Unless otherwise shown or specified, all piping smaller than 3 inches shall be extra strong galvanized iron pipe, with galvanized malleable iron fittings. Pipe shall conform to the "Specifications for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses," ASTM A-53.
- F. PVC Piping:
1. Chemical Feed and Chemical Solution Piping: Except as otherwise specified, all chemical feed and chemical solution piping including PRC, CS, SDS, etc. shall be constructed of PVC. PVC chemical feed and chemical solution piping shall be as specified in Section 15050-Piping and Accessories.
 2. Sewer and Plant Drain Piping:
 - a. PVC sewer pipe and fittings 4 inches to 15 inches shall be solid wall PVC and shall meet the requirements of ASTM D3034. The standard dimension ratio (SDR) of PVC sewer pipe and fittings shall be 26.
 - b. PVC sewer pipe and fittings 18 inch to 36 inch shall meet the requirements of ASTM F679. The SDR of PVC sewer pipe and fittings shall not exceed 35. The wall thickness shall conform to requirements for a T-1 wall.
 - c. PVC material shall have cell classification 12454-B or 12454-C as defined in ASTM D1784 with minimum modulus of elasticity of 400,000 psi in tension. Pipe stiffness shall be minimum 46 psi when tested in accordance with ASTM D2412.

- d. Pipe and fittings shall be the product of one manufacturer, and the manufacturer shall have an experience record substantiating acceptable performance of the pipe to be furnished. Fittings shall be injection-molded.
- e. All joints shall be of the flexible elastomeric type with bells and spigots conforming to ASTM D3212. Gaskets shall conform to ASTM F477. All bells shall be formed integrally with the pipe and shall contain a factory-installed elastomeric gasket which is positively restrained.

G. Cast Iron Soil Pipe: Cast iron soil pipe shall be as specified in Section 15050.

H. CPVC Piping: CPVC pipe shall be as specified in Section 15050–Piping and Accessories.

2.04 VALVES (VALVES FOR UNDERGROUND SERVICE ARE SPECIFIED IN DIVISION 15)

A. Valves shall conform to Section 15050–Piping and Appurtenances.

2.05 HYDRANTS

A. Yard Hydrants:

1. Yard hydrants shall be Mueller A-411, or equal, with one 2 1/2-inch hose nozzle and threaded lead to accept copper pipe. Provide one operating wrench for each hydrant. Provide all yard hydrants with 1 1/2-inch hose adaptor from 2 1/2-inch hose nozzle and four adaptors to 3/4-inch hose from 1 1/2-inch hose nozzle. Hydrant cover depths of 6 feet shall be provided.
2. Yard hydrants shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the pressure relief valves and yard hydrants once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all valves, hydrants, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9.

2.06 CONCRETE

A. All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 3.

PART 3–EXECUTION

3.01 INSTALLATION

A. Underground Piping:

1. Except where noted or specified, all ductile iron underground piping shall be laid in accordance with AWWA C600 with the conditions that a) blocking shall not be used to support pipe, and b) either all joints on bends and fittings shall be anchored with poured concrete to resist thrust, or all joints on bends and fittings shall be restrained as specified below, and pipe joints shall be restrained in all directions from all bends

and fittings to the length as specified below. If adequate support against undisturbed soil cannot be obtained with poured concrete thrust blocks, restrained joints shall be used.

2. For restrained pipe joints, all underground ductile iron pipe joints (except for the branch of tees and dead ends) shall be restrained to the length listed below in all directions from all bends and fittings. The branch of tees and all dead ends shall be restrained to two times the length listed below. All joints on yard and fire hydrant leads shall be restrained. Where wall penetrations occur at less than the length indicated below, the wall fittings shall also be restrained. Additional restraint shall be provided inside of structures as required.

MINIMUM LENGTH (IN FEET) RESTRAINED PIPE FROM BENDS OR FITTINGS (POLY-WRAPPED AND MINIMUM 6 FEET BURY DEPTH					
Pipe Size, Inches	Test Pressure, psi				
	10	25	50	100	150
3-12	5	18	18	36	36
14-18	5	18	18	36	54
20-24	5	18	36	54	72
30	10	18	36	72	90
36	10	18	36	72	
42	10	36	54	90	
48	10	36	54	90	

3. PVC sewer and plant drain piping shall be installed in accordance with ASTM D2321. Except where noted or specified, PVC or other thermoplastic pressure piping shall be installed in accordance with ASTM D2774.
4. Except where noted or specified, reinforced concrete pipe shall be installed in accordance with Standard Specifications for Water and Sewer Main Construction in Illinois, latest edition.
5. Plumbing system shall be installed and tested in accordance with local and state plumbing code requirements and applicable portions of the Illinois plumbing code. Where requirements conflict, the stricter standard shall apply.
6. CONTRACTOR shall excavate and lay all pipe to the line and grade shown on the drawings with bell ends uphill wherever possible. If not possible, CONTRACTOR shall excavate and lay pipe to the line and grade shown on the drawings with bell ends in the direction of laying. Grade stakes will be required for all lines. Water piping and chemical solution piping shall have a minimum of 5.5 feet of cover. Unless shown otherwise, drainage piping shall clear floor slabs or footings by a minimum of 6 inches.
7. Where piping is laid in native soil, the width of trench below the top of the pipe shall not exceed the nominal diameter of the pipe plus 2 feet for all pipelines. Where the maximum trench width is exceeded, the pipe shall be placed in a concrete cradle or a stronger pipe used. If the maximum trench width is exceeded for any reason other than as otherwise specified, the concrete cradle or the stronger pipe shall be placed at CONTRACTOR's expense.
8. Except as otherwise specified, all underground pipe shall be bedded in crushed stone or crushed gravel aggregate. Polyethylene encased piping shall be bedded in compacted sand, unless polyethylene encased pipe and fittings are wrapped in a nonwoven geotextile fabric. Geotextile fabric shall be a minimum of 4.0 ounce/square yard. Copper piping shall be bedded in compacted sand. PVC or other thermoplastic

pressure piping may be bedded in compacted sand. Perforated piping shall be bedded with washed stone material as shown on the drawings. Ductile iron piping, except as otherwise specified, shall be placed using Class "C" Bedding Details as shown on Drawing 01-975-43A. All other piping shall be placed using Class "B" Bedding Details as shown on Drawing 01-975-43A. CONTRACTOR shall perform all necessary excavation and shall provide all required materials to provide this bedding. Bedding material shall conform to the requirements of ASTM C-33. The material shall be hard, tough, and durable, and shall meet the following gradation requirements:

	Percentage by Weight Passing			
	Crushed Stone Aggregate	Crushed Stone Chips	Crushed Gravel Aggregate	Bedding Sand
1 inch	100	--	100	--
3/4 inch	90 to 100	--	90 to 100	--
1/2 inch	--	100	--	--
3/8 inch	20 to 55	90 to 100	20 to 55	100
No. 4	0 to 10	--	0 to 10	95 to 100
No. 8	0 to 5	0 to 15	0 to 5	80 to 100
No. 30	--	0 to 5	--	25 to 60
No. 100	--	--	--	5 to 20
Passing No. 200	--	--	--	2 to 10

9. CONTRACTOR shall furnish ENGINEER with a sieve analysis of the bedding material for approval prior to construction.
10. No materials native to the trench shall be used as bedding material unless they meet the above specifications.
11. Immediately prior to placing the pipe, bedding shall be shaped by hand to fit the entire bottom quadrant of the pipe between bell holes. Bell holes shall be large enough to permit proper making of the joint but not larger than necessary to make the joint. All adjustments to line and grade must be done by scraping away or filling in bedding under the body of the pipe. Bedding must be tamped into place. If necessary to obtain uniform contact of the pipe with the bedding, a template shall be used.
12. All bends, plugs, and caps on pipes under pressure shall be securely blocked and wedged to solid earth and poured concrete. If adequate support cannot be obtained, CONTRACTOR shall provide tie rods or restraining joints. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used. Pipe must be kept clean of mortar, cement, clay, sand, or other material. When PVC piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.
13. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.
14. Material which is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified,
 - a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank run sand and crushed bank run gravel will be considered generally acceptable for cover material, c) no stones larger than 3/4 inch in their greatest dimension shall be allowed in the

cover material and d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be sand. Cover material for PVC pressure or other thermoplastic piping may be sand. Cover material for perforated piping shall be washed stone material as shown on the drawings.

15. Cover material for polyethylene encased piping shall be sand, unwashed bank run sand, or river gravel. Crushed stone or crushed gravel or other bedding or cover material that will damage polyethylene encasement will not be acceptable and shall not be used unless polyethylene encased pipe and fittings are wrapped with a nonwoven geotextile fabric. Geotextile fabric shall be minimum of 4.0 ounce/square yards.
16. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously. Cover material shall be placed over the top of the pipe to the height as shown on Drawing 01-975-43A for Class "B" (minimum 12 inches) or Class "C" (minimum 6 inches) Bedding. This backfill shall be placed by hand in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers. If bedding material conforming to any of the above three crushed stone or crushed gravel gradations is used as cover material, it need not be tamped. The remaining 6 inches to make up the required 1 foot of select cover material for Class "C" Bedding shall be granular material specified previously with no stones larger than 3/4 inch.
17. All cover material shall be placed in maximum 6-inch layers and compacted by hand tamping. Compaction shall be equivalent to that described under "Compacted Fill and Backfill" as specified in Section 02222–Excavation, Fill, Backfill and Grading.
18. No trenches shall be backfilled until the piping has been observed by ENGINEER prior to closing the ditch. Except as otherwise specified, all backfill above 1 foot above the pipe shall be "Compacted Fill and Backfill" as specified in Section 02222–Excavation, Fill, Backfill and Grading.
19. The locations and elevations of existing piping and manholes are approximate. Where necessary, existing piping shall be exposed by CONTRACTOR to confirm location and elevation prior to installing new piping. Any changes in pipe location or elevation shall be approved by OWNER.
20. Polyethylene encasement of ductile iron pipe and appurtenances shall be in accordance with AWWA C105. Use Method A for pipe and Method C at valves. All tapping locations shall be taped, and copper pipe shall be polyethylene encased within 3 feet from connection to ductile iron pipe. Repair any rips or punctures prior to backfilling pipe.
21. General Excavation:
 - a. CONTRACTOR shall do all excavation, undercutting, dewatering, and backfilling necessary for work under this contract unless otherwise noted. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.
 - b. Work shall conform to other sections of Division 2, except where modified by this section.
 - c. Pipe shall be placed only on dry foundations. No extra payment will be made to CONTRACTOR for dewatering.
 - d. Excavation shall include all necessary clearing of excavated areas, tree removal, all grubbing, all wet, dry, fill, and rock excavation, the removal of pavement, filling, and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling. All above work shall be included in the Lump Sum Bid.
 - e. CONTRACTOR shall excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown. The bottom of the excavation shall be leveled off,

all loose and disturbed soil shall be removed, and it shall be hand-tamped prior to pipe, manhole, etc., installation. Where requested by ENGINEER, original material below the excavation necessary for construction according to grades shown or specified shall be removed and replaced in accordance with Section 02222–Excavation, Fill, Backfill and Grading. Payment will also be in accordance with Section 02222–Excavation, Fill, Backfill and Grading.

- f. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present underground services shown on the drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.
 - g. Excavated native material that is unsuitable or not required for filling shall be removed from the site. Materials to be used for fill and suitable for this purpose shall be deposited where required except that no fill shall be placed where trenches for sewers, water lines, or other services will be located until after the trench work is completed.
 - h. CONTRACTOR shall provide adequate shoring, sheet piling, and bracing to prevent earth from caving or washing into the excavation and shall do all shoring and underpinning necessary to properly support adjacent or adjoining structures. All shoring, sheet piling, and underpinning must be maintained until permanent support is provided.
 - i. Any water, drainage, gas, sewer, or electric lines encountered in the excavation which are not to be disturbed shall be properly underpinned and supported. Any service connections encountered which are to be removed shall be cut off at limits of the excavation and capped in accordance with the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.
22. Valve Boxes: The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.
23. Yard Hydrants: Yard hydrants shall be set on a slab of concrete at least 1 cubic foot in size and against a 3-cubic foot minimum concrete brace laying against undisturbed earth. Backfill at base of hydrant shall be 1 cubic yard of coarse gravel. It shall be the responsibility of CONTRACTOR to ensure that the hydrants are set to the proper grade. Extensions or fittings shall be provided as required.

3.02 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price Bid.
- B. All work shall be inspected, tested, and approved in accordance with federal, state, and local rules and regulations. All work shall also be tested as specified in this section. Unless indicated in writing before testing begins, all tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.

- C. All new piping shall be tested. All underground piping shall be backfilled or properly secured to avoid damage during testing. Should underground piping fail test, CONTRACTOR shall be responsible for removal and replacement of backfill. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks. Manholes and precast reinforced concrete wet wells and appurtenances shall be free of any visible leaks. Any leakage shall be sealed by methods approved by OWNER, from the exterior of the manhole or structure. Precast reinforced concrete manhole risers and tops shall be tested in accordance with ASTM C497.
- D. All piping shall be flushed or blown out after installation prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Pressure Tests:
1. Pressure tests shall be performed as required by AWWA C600 unless otherwise noted herein.
 2. When test medium for piping is water, all air shall be removed from piping by flushing, opening vents, loosening flanges, utilizing equipment vents, and/or installation of corporations at high points in system. Presence or absence of air will be determined during pressurization of the piping system.
 3. The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids, such as SMC/WAS, shall be tested at the higher test pressure.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
A	15, 25	Air	"B" ⁽²⁾
CLS	150	Water	"A" ⁽¹⁾
ML, PI, SCM, SE, RAS (Gravity Flow), FE, PE, D	10	Water	"A"
DS, RAS (Pump Discharge) SPD, WAS, EF	50	Water	"A"
NPW, PE, SWS	150	Water	"A"

⁽¹⁾ Leakage allowance designation "A" shall mean not more than 0.002 gallon per hour per inch-diameter per 100 feet of buried pipe for all piping except buried mechanical joint or push-on joint pipe. Buried mechanical and push-on joint pipe shall meet the leakage specifications of AWWA C600.

⁽²⁾ Leakage allowance Designation "B" shall mean a loss of pressure of not more than 5% during the test period.

- F. Prior to making final connection between new and existing piping, new piping shall be tested as specified above.

G. Infiltration/Exfiltration Tests:

1. Infiltration/exfiltration tests for all gravity sewers, drains, and those pipes designated as W and D (other than building drains) will be as follows: If groundwater is above the pipe, measurements shall be taken to determine the rate of infiltration into the pipe. If groundwater is below the pipe, the stretch of pipe shall be plugged at its downstream end and water shall be placed inside the pipe to fill the pipe. Measurements shall then be taken to determine the rate of leakage out of the pipe by filling the pipe. Concrete pipe shall be filled with water at least 8 hours before measurements are taken. CONTRACTOR shall furnish all labor, water, and materials necessary for making the tests. The rate of infiltration or leakage shall not exceed 200 gallons per inch-diameter per mile per day for any stretch of pipe measured. CONTRACTOR shall immediately make all necessary repairs to bring infiltration or leakage within the above acceptable limits.
2. Air test procedure may be used, when allowed by ENGINEER, for the above-listed pipe designations and shall be conducted as follows:
 - a. Clean pipe to be tested.
 - b. Plug all pipe outlets with suitable test plugs. Brace each plug securely. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
 - c. After an internal pressure of 4.0 psig is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
 - d. When pressure decreases to 3.5 psig, start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding times for runs of single pipe diameter and for systems of 4-inch, 6-inch, or 8-inch laterals in combination with trunk lines shall be as recommended by National Clay Pipe Institute.
 - e. If the pipe to be tested is submerged in groundwater, determine the height of groundwater above the crown of the sewer. This is the back pressure due to groundwater submergence over the sewer. All gauge pressures in the test should be increased by the pressure head of water above the pipe.
 - f. ENGINEER may elect to test sewers in groundwater by measuring the infiltration through the use of a weir provided in the manhole at the downstream end of the sewer being tested.
 - g. The air test may be dangerous if a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Inasmuch as a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.
 - h. As a safety precaution, pressurizing equipment should include a regulator set at 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

3.03 CLEANING AND DISINFECTION

- A. All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the potable water system before it is put on-line. Water main shall be disinfected according to AWWA C651.

3.04 REPAIR AND RESTORATION

- A. Tree Removal: Tree removal and grubbing necessary for installing sewer, water, and other work shown shall be included in the Lump Sum Bid.
- B. Pavement Repair: Unless otherwise specified, CONTRACTOR shall replace all bituminous and concrete pavement removed or damaged during performance of the work. Concrete pavement replacement shall conform to Division 3. Bituminous pavement replacement shall conform to Division 2.
- C. Cleanup:
 - 1. Upon completion of the work, all improvements disturbed by CONTRACTOR's operations shall be repaired or replaced. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
 - 2. All areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off and cleaned up. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.
 - 3. All pipes and manholes shall be flushed until clean, and all debris and mud shall be removed.

3.05 DEMOLITION

- A. All exterior piping removals, including manholes and appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Where necessary, existing piping shall be exposed prior to installing new piping. Any changes in pipe location or elevation shall be approved by ENGINEER.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal. Unless otherwise shown or specified, piping shown or specified to be abandoned shall have each end plugged with nonshrink grout. Nonshrink grout shall be as specified in Division 3. Wherever excavations cross piping to be abandoned, piping shall be removed to the limits of the excavation and the ends shall be filled as specified above.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.
- D. It is the responsibility of CONTRACTOR to remove the following, including piping and appurtenances, as specified, and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner. All costs shall be included in the Lump Sum Bid.

END OF SECTION

SECTION 02936

SEEDING AND SODDING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Preparation of subsoil.
 - 2. Placing topsoil.
 - 3. Seeding, sodding, mulching and fertilizing.
 - 4. Maintenance.
- B. Except for paved, riprapped, or built-up areas, all areas of the site which are disturbed and areas noted on the drawings shall be seeded or sodded. Surfaces on 3 to 1 slope or less may either be seeded or sodded but surfaces on greater than 3 to 1 slope shall be sodded.
- C. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. FS O-F-241—Fertilizers, Mixed, Commercial.
- B. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.

1.03 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Sod: Minimum age of 18 months, with root development that will support its own weight without tearing when suspended vertically by holding the upper two corners. Submit sod certification for grass species and location of sod source.

1.04 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver sod on pallets or in rolls. Protect exposed roots from dehydration. Do not deliver more sod than can be laid within 24 hours.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2–PRODUCTS

2.01 SEED MIXTURE

- A. Seed mix Class 1–Lawn Mixture per Standard Specifications. Use blue tag certified seed. Do NOT use bent or Poa Annua. Each seed lot will be subject to sampling and testing by the state seed laboratory.
- B. Weed content shall not exceed 0.5% in mixture.

2.02 SOD

- A. Follow Section 252 of the Standard Specifications.
- B. Netting or fabric for sod reinforcement shall be in accordance with Section 253 of the Standard Specifications.
- C. Anchorage staples shall be in accordance with Section 257 of the Standard Specifications.

2.03 SOIL MATERIALS

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay, or impurities, plants, weeds, roots and rocks; pH value of minimum 5.4 and maximum 7.0.
- B. Topsoil from the site may be used if it meets the above requirements. Additional topsoil shall be provided as required by drawings and specifications.

2.04 ACCESSORIES

- A. Mulching material shall be oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Fertilizer shall be FS O-F-241, Type I, Grade A; recommended for grass, with 50% of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil to the following proportions: Nitrogen 10%, phosphoric acid 10%, soluble potash 10%. Submit composition deviations to suit site conditions for ENGINEER's approval.
- C. Water shall be clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

PART 3–EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds, and undesirable plants and their roots. Remove contaminated subsoil in accordance with local, state, and federal regulations.
- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.03 PLACING TOPSOIL

- A. Spread topsoil to a minimum depth of 4 inches over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign nonorganic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Manually spread topsoil around trees, plants, and buildings to prevent damage.
- F. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.04 FERTILIZING

- A. Apply fertilizer at a rate of 17 pounds per 1,000 square feet.
- B. Apply after smooth raking of topsoil and prior to installation of seed or sod, no more than 18 hours before seeding or 48 hours before sodding.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.05 SEEDING

- A. Apply seed at a total rate of 3-1/2 pounds per 1,000 square feet. Apply evenly in two intersecting directions. Rake in lightly or roll the seeded area after seeding.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting season shall be between April 15 and June 15 or between August 15 and October 15.
- D. Do not sow immediately following rain, when ground is too dry, or during windy periods.

- E. Immediately following seeding, apply mulch.
 - 1. Minimum Spread Rate: 1-1/2 tons per acre.
 - 2. Maximum Depth: 1-1/2 inches to 2 inches.
- F. Apply water with a fine spray immediately after each area has been mulched and on a daily basis to keep straw in place.
- G. Seeding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.
- H. Place erosion control mats per Section 02270—Slope Protection and Erosion Control.

3.06 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod immediately after delivery to site to prevent deterioration.
- C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Lay smooth. Align with adjoining grass areas.
- E. Place top elevation of sod 1/2-inch below adjoining edging, paving, or curbs.
- F. On slopes 4 to 1 and steeper, sod will be secured with wooden pegs at a maximum of 24 inches on center.
- G. On slopes 2 to 1 and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- H. All sod placed in ditches, flumes, or other appurtenances where a concentrated flow of water may be expected shall be staked regardless of the slope.
- I. Water sodded areas immediately after installation. Saturate sod to 4-inch depth of soil.

3.07 MAINTENANCE

- A. Seeding shall proceed concurrently with the main construction. Seeding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches. All costs for this work shall be included in the price bid for the work. An amount up to 5% of each bid item may be withheld for areas where seeding is not proceeding concurrently with the main installation.
- B. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than one-third of grass blade at any one mowing.
- C. Immediately remove clippings after mowing.
- D. Water to prevent grass and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.

- F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas which fail to show adequate catch. Bare spots shall not exceed 5 square feet in area and not exceed 3% of the total seeded areas. Immediately replace sod in areas which show bare spots or deterioration.
- H. Protect seeded areas with warning signs during maintenance period.
- I. Immediately reseed areas which do not show a satisfactory stand of established grass, and resod areas that do not show satisfactory establishment.
- J. Correct damage resulting from erosion, gullies, rills, or other causes by filling with topsoil, tamping, refertilizing, and reseeding if damage occurs prior to acceptance of work.
- K. Maintain seeded lawns for not less than 60 days after substantial completion.
- L. If seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.
- M. Maintain sodded lawns for not less than 30 days after substantial completion.
- N. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth acceptable lawn free of eroded or bare areas.

END OF SECTION

SECTION 02950

STONE MULCH AND EDGING

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Stone mulch.
 - 2. Plastic and aluminum edging.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2-PRODUCTS

2.01 MULCH MATERIALS

- A. Stone: Stone mulch shall be 3/4-inch washed crushed limestone.

2.02 ACCESSORIES

- A. Membrane: 20 mil thick, water permeable polyolefin fabric.
- B. Edging: Black Diamond Bed Divider by Valley View Specialty Co.; Ezy-Lok Edging by Ryerson Steel Co., or equal. Aluminum edging shall be 1/8-inch by 4 inches. Plastic edging shall have a minimum 5-inch side wall and 1-inch diameter head. Edging shall have a v-lip configuration for added stiffness and anchor-holding power.

PART 3-EXECUTION

3.01 INSTALLATION OF ACCESSORIES

- A. Place edging around mulched areas where shown on the drawings. Install edging using stakes at approximately 4 feet on center.
- B. Place mulch over membrane to 4-inch depth where indicated on drawings.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Forms for cast-in-place concrete.
 - 2. Form accessories.
 - 3. Openings for other work.
 - 4. Form stripping.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Supplemental Unit Price: CONTRACTOR shall fill in a unit price for "Forming" in the blank space provided in the Bid to apply in the event of any deductions from or additions to the work. The unit prices shall include all elements of work specified in this section.

1.02 REFERENCES

- A. ACI 301—Structural Concrete for Buildings.
- B. ACI 318—Building Code Requirements for Reinforced Concrete.
- C. ACI 347—Recommended Practice for Concrete Formwork.
- D. PS1—Construction and Industrial Plywood.

1.03 DESIGN

- A. All formwork shall comply with ACI 347 and ACI 301.
- B. CONTRACTOR shall assume the responsibility for the complete design and construction of the formwork.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300—Submittals for form ties, form coatings, form liners (if any), and any other form accessories.
- B. Submit geometry of forms for circular structures.

PART 2–PRODUCTS

2.01 FORMS

- A. Forms shall be of wood, plywood, steel, fiberboard lined, or other approved materials which will produce concrete which meets the specified requirements. The type, size, quality, and shape of all materials of which the forms are made are subject to the review of ENGINEER.
- B. Caution shall be exercised in the use of wood or composition forms or form liner to be certain that no chemical reaction will take place which causes a damaging effect on the concrete surface.

2.02 FORM TIES–NONREMOVABLE

- A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the tie shall be adjustable in length. Ties shall have cones on the water side of water-containing structures. Ties shall also have cones on the exterior side of all structures which have PVC water-stopped construction joints. Ties shall provide a positive disconnection on both ends 1 to 1 1/2 inches inside the finished face of the concrete.
- B. All wall ties used in the placement of structures which have water-stopped construction joints shall contain integral waterstops. All such ties shall be crimped or deformed in such a manner that the bond between concrete and tie cannot be broken in removal of the outer units. This portion of the tie shall not be removed prior to 24 hours after completion of the concrete placement.
- C. The use of wood spacers and wire ties will not be approved.

2.03 FORM TIES–REMOVABLE

- A. Taper ties which are designed to be removed entirely from the wall may be used with forms designed for this tie type and spacing.
- B. Tie holes shall be plugged with a neoprene plug, Dayton Superior, Inc., Sure-Plug, or equal.
- C. Cementitious waterproofing for patching taper tie holes shall be Hey Di K-11, Xypex Patch-N-Plug, or equal.

2.04 FORM COATINGS

- A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

2.05 CHAMFER STRIPS

- A. Provide 3/4-inch by 3/4-inch wood or plastic chamfer strips at all exposed corners, except as noted.

2.06 KEYWAYS

- A. Keyways shall be formed with wood inserts.

PART 3-EXECUTION

3.01 CONSTRUCTION

- A. Forms shall conform to the shape, line, grade, and dimensions as shown on the drawings. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall support the loads and pressures without deflection from the prescribed lines. They shall be properly braced or tied together so as to maintain position and shape and insure safety to workmen and passersby. Spacing of ties shall be recommended by the tie manufacturer.
- B. Formwork shall be constructed to meet the tolerances and intentions specified below for the indicated applications:
 - 1. Flat surfaces shall be formed in accordance with tolerances indicated in ACI 347 for buildings.
 - 2. Curved surfaces shall also meet ACI 347 for buildings. All exposed curved surfaces shall be formed to the continuous surface of the radius specified. Where segmented forms are proposed, a form system which deviates more than 3/8-inch from a circle through pan edges will not be allowed.
 - 3. Architectural surfaces and surfaces to be fitted with equipment shall be formed to match the shape intended. Where indicated on the drawings, the form shall be lined with minimum 3/8-inch masonite and shimmed as required.
 - 4. Variation from plumb shall not exceed 1/4-inch in 10 feet, and variation in linear lines shall not exceed 1/2-inch in 20 feet. These and other tolerance specified in ACI-347 shall be considered a part of this specification.
- C. When forms are placed for successive concrete placement, thoroughly clean concrete surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.
- D. At the request of ENGINEER, temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before depositing concrete.
- E. Provide inserts and provide openings in concrete form work to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Securely support items to be built into forms.
- F. Provide top forms for inclined surfaces where the slope is too steep to place and vibrate concrete.
- G. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to assure ease of removal. Inserts shall be securely held in place prior to concrete placement. Unless otherwise shown, chamfer strips shall be placed in the angles of the forms to provide 3/4-inch bevels at exterior edges and corners of all exposed concrete.

- H. The forms shall be oiled with a field-applied commercial form oil or a factory-applied nonabsorptive liner. Oil shall not stain or impede the wetting of surfaces to be cured with water or curing compounds. The forms shall be coated prior to placing reinforcing steel. Oil on reinforcement will not be permitted.
- I. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to the approval of ENGINEER.

3.02 FORM REMOVAL

- A. Supporting forms and shoring shall not be removed until the member has acquired sufficient strength to support its own weight and the construction live loads on it.
- B. All form removal shall be accomplished in such a manner that will prevent injury to the concrete and will ensure complete safety of the structure.
- C. Forms shall not be removed before the expiration of the minimum times as stated below unless specifically authorized by ENGINEER. These times may be increased by ENGINEER.
 - 1. Wall and vertical faces: 24 hours
 - 2. Columns: 24 hours
 - 3. Beams and slabs: 14 days

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes providing complete, in-place, all steel and fibers required for reinforcement of cast-in-place concrete as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Supplemental Unit Price: CONTRACTOR shall fill in a unit price for "Reinforcing," including all elements of work in this section, in the blank space provided in the Bid to apply in the event of any deductions from or additions to the work. All reinforcement shown or specified shall be included in the Lump Sum Bid.

1.02 REFERENCES

- A. Applicable standards listed in this section include, but are not necessarily limited to the following:
 - 1. ACI 315—Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - 2. ACI 318—Building Code Requirements for Reinforced Concrete.
 - 3. ASTM A82—Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement.
 - 4. ASTM A185—Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement.
 - 5. ASTM A615—Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 6. CRSI—Manual of Standard Practice.

1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01300—Submittals.
- B. Provide complete shop drawings of all material to be furnished and installed under this section:
 - 1. Before fabrication of the reinforcement is begun, CONTRACTOR shall obtain the approval of ENGINEER on reinforcing bar lists and placing drawings.
 - 2. These drawings and lists shall show in detail the number, size, length, bending, and arrangement of the reinforcing. Reinforcing supports shall also be located on the shop drawings.
 - 3. Shop drawings shall be in accordance with ACI 315.

1.04 PRODUCT HANDLING

- A. Delivery:
 - 1. Deliver reinforcement to the job site bundled, tagged, and marked.
 - 2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Storage: Store reinforcement at the job site on blocks and in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2-PRODUCTS

2.01 MATERIALS

- A. Reinforcing bars shall comply with ASTM A615, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.
- B. Steel wire shall comply with ASTM A82.
- C. Welded wire fabric shall comply with ASTM A185. Fabric shall be provided in flat sheets. Rolled fabric shall not be used.
- D. Reinforcement supports including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be:
 - 1. Wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.
 - 2. For slabs on grade, supports with sand plates, or horizontal runners where base material will not support chair legs.
 - 3. For exposed-to-view concrete surfaces or where the concrete surface will be exposed to weather or moisture, where legs of supports are in contact with forms, supports with either hot-dipped galvanized or plastic protected legs.
 - 4. When supports bear directly on the ground and it is not practical to use steel bar supports, precast concrete blocks may be used to support only the bottom lift of reinforcement. The precast blocks must be solid, be of an equal or higher strength than the concrete being placed, must provide adequate support to the reinforcement, and be of proper height to provide specified reinforcing cover. The use of face bricks, hollow concrete blocks, rocks, wood blocks, or other unapproved objects will not be permitted.
- E. Fibrous Reinforcing:
 - 1. Fibrous concrete reinforcement shall be Fibermesh 300, manufactured by Tapex Concrete Fibres Division, or equal.
 - 2. Reinforcement shall be 100% virgin polypropylene fibrillated, multi-length graded fiber containing no reprocessed olefin materials and specifically manufactured for use on concrete secondary reinforcement.
 - 3. Physical Characteristics:
 - a. Specific Gravity: 0.91.
 - b. Fiber Length: Multidesign gradation.

2.02 FABRICATION

- A. General:
 - 1. Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances which comply with CRSI Manual.
 - 2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
 - 3. Unless otherwise shown on the drawings, all end hook dimensions shall conform with "ACI Standard Hooks."
- B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work:
 - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
 - 2. Bend or kinks not indicated on drawings or final shop drawings.
 - 3. Bar with reduced cross section because of excessive rusting or other cause.

PART 3—EXECUTION

3.01 INSPECTION

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed.
- B. Correct conditions detrimental to the proper and timely completion of the work.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Comply with the specified standards for details and methods of placing reinforcement and supports.
 - 2. Clean reinforcement to remove loose rust, mill scale, earth, and other materials which reduce or destroy bond with concrete.
- B. Placing Reinforcement:
 - 1. All reinforcing shall be placed in accordance with Contract drawings and with shop drawings stamped and approved by ENGINEER.
 - 2. Position, support, and secure reinforcing against displacement by formwork, construction, or concrete placement operations.
 - 3. Support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as needed.
 - 4. Unless otherwise shown on the plans, the reinforcement is to be so detailed and placed as to allow the following concrete protection:
 - a. Three inches of cover where the concrete is placed directly against ground.
 - b. Two inches of cover where the concrete is placed in forms but is to be exposed to weather, liquid, or the ground.
 - c. One-inch cover in slabs and walls not exposed to weather, liquid, or the ground.
 - d. One and one-half-inch cover in beams, girders, and columns not exposed to weather, liquid, or the ground. This cover applies to beam stirrups and column ties where applicable.

5. Reinforcement shall be positioned within $\pm 3/8$ -inch for members with depth to tension reinforcing from compression face less than or equal to 8 inches. Tolerance shall be $\pm 1/2$ -inch for members with depth to tension reinforcing from compression face greater than 8 inches. Tolerance on dimension between adjacent bars in slab and wall reinforcing mats shall be 1 inch. Secure against displacement by anchoring at the supports and bar intersections with wire or clips.
6. Bars shall be securely tied at all intersections except where spacing is less than 1 foot in each direction when alternate intersections shall be tied. To avoid interference with embedded items, bar spacing may be varied slightly as approved by ENGINEER. Tack welding of reinforcing will not be permitted.
7. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
8. If reinforcing must be cut because of openings or embedded items in the concrete, additional reinforcing must be provided adjacent to the opening at least equal in cross sectional area to that reinforcing which was cut, and it shall extend a minimum of 36 bars diameters beyond the opening on each side or as shown on the drawings. At sumps or depressions in slabs, bars shall be bent and/or extended under sumps or depressions.
9. Wall reinforcing mats shall be secured in a vertical plane by providing clearance from forms with bar supports and by using Z-shaped bars at ± 4 feet on center wired between two mats of steel, spacing and staying both of them. Nails shall not be driven into the forms to support reinforcement and neither shall wire for this purpose come in contact with the forms. Alternate top transverse bars in slab shall be supported by individual bar chairs at approximately 3-foot 0-inch centers. Bottom longitudinal bars shall be supported by continuous bar chairs at approximately 4-foot 0-inch centers.
10. If carrier bars are to be used, CONTRACTOR shall provide reinforcing bars for this purpose in addition to the reinforcing called for by the drawings and specifications.

C. Reinforcement Supports:

1. Strength and number of supports shall be sufficient to carry reinforcement.
2. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support.
3. Do not use supports as bases for runways for concrete-conveying equipment and similar construction loads.

D. Welded Wire Fabric:

1. Install welded wire fabric in as long of lengths as practicable.
2. Lap adjoining pieces at least one full mesh.
3. Fabric shall be supported with bar supports.

E. Splices:

1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
2. Lap splices in reinforcing shall be avoided wherever possible. Lap splices shall be Class B, Category 1 in accordance with ACI 318 and adjacent splices shall be staggered a minimum of one full lap splice length or 3 feet, whichever is greater, unless otherwise shown. Stagger dimension shall be measured from center to center of the lap splice.
3. For circular walls, horizontal reinforcement laps shall not coincide in vertical arrays more frequently than every third bar.
4. Mechanical splices and threaded dowel bar inserts may be used where approved by ENGINEER. Splices shall be capable of developing at least 125% of the yield strength of the reinforcing bar.

- F. Embedded Items:
 - 1. Allow other trades to install embedded items as necessary.
 - 2. Particularly after bottom layer of reinforcing is placed in slabs, allow electrical contractors to install conduit scheduled for encasement in slabs prior to placing upper layer of reinforcing.
- G. Minimum Reinforcing: Where reinforcing is not shown, provide a minimum of #4 at 8-inch centers each way in members 10 inches or less in thickness and #5 at 12-inch centers each way in each face in members greater than 10 inches thick.
- H. Fibrous Reinforcing:
 - 1. Fibrous concrete reinforcing shall be used in all slab-on-grade concrete and all precast concrete topping.
 - 2. Add fibers at a minimum rate of 1.5 pounds per cubic yard.
 - 3. Mix concrete in strict accordance with reinforcement manufacturer's recommendations.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All cast-in-place concrete as shown except as noted otherwise.
 - 2. PVC and bentonite waterstops, expansion joint fillers, bonding agents, patching mortars, curing compounds, nonshrink grout, grout topping, and other related items and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Supplemental Unit Price: CONTRACTOR shall fill in a unit price for "Concrete" in the blank space provided in the Bid to apply in the event of any deductions from or additions to the work. All concrete shown or specified shall be included in the Lump Sum Bid.

1.02 REFERENCES

- A. ACI 211.1—Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301—Structural Concrete for Buildings.
- C. ACI 304—Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 305R—Hot Weather Concreting.
- E. ACI 306R—Cold Weather Concreting.
- F. ACI 308—Standard Practice for Curing Concrete.
- G. ACI 309—Guide for Consolidation of Concrete.
- H. ACI 318—Building Code Requirements for Reinforced Concrete.
- I. ASTM C31—Making and Curing Concrete Test Specimens in the Field.
- J. ASTM C33—Concrete Aggregates.
- K. ASTM C39—Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C40—Organic Impurities in Fine Aggregates for Concrete.
- M. ASTM C94—Ready-Mixed Concrete.
- N. ASTM C143—Slump of Portland Cement Concrete.
- O. ASTM C150—Portland Cement.

- P. ASTM C156–Test for Water Retention by Concrete Curing Materials.
- Q. ASTM C231–Air Content of Freshly Mixed Concrete by the Pressure Method.
- R. ASTM C260–Air-Entraining Admixtures for Concrete.
- S. ASTM C309–Liquid Membrane Forming Compounds for Curing Concrete.
- T. ASTM C494–Chemical Admixtures for Concrete.
- U. ASTM C618–Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- V. ASTM D994–Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- W. ASTM D1752–Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300–Submittals.
- B. Submit the following information:
 - 1. Gradation of fine and coarse aggregate–ASTM C33.
 - 2. Specific gravity and dry rodded density of each aggregate.
 - 3. Test of deleterious substances in fine and coarse aggregate–ASTM C33.
 - 4. Design mix of each individual concrete mix to be used.
 - 5. Previous test results or trial batch results with 7- and 28-day compressive strengths for each concrete mix proposed.
 - 6. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
 - 7. Brand, type, principal ingredient, and amount of each admixture to be used.
- C. It is important that the above data be submitted to ENGINEER well in advance of anticipated concreting operations to avoid any delay in construction.

PART 2–PRODUCTS

2.01 CEMENT

- A. All cement used shall be Portland Cement and shall conform to ASTM C150 and shall be Type I or Type III. Type III shall be used only when permitted by ENGINEER. All cement shall be the product of one reputable manufacturer and mill.
- B. Cement shall be stored in a dry, weather-tight, properly ventilated structure with the floor raised not less than 1 foot above the ground.

2.02 FLY ASH

- A. All fly ash used as an admixture in Portland cement concrete shall be Class C or F conforming to the requirements of ASTM C618.

2.03 AGGREGATE

- A. All aggregates shall be washed and shall consist of natural sand, gravel, or crushed rock and shall have clean, hard, durable, uncoated grains of strong minerals. The amounts of deleterious substances present in the fine and coarse aggregate expressed in percentages by weight shall not exceed the following:

Deleterious Substance	Aggregate	
	Fine	Coarse
Clay Lumps and Friable Particles	3.0	3.0
Coal and Lignite	0.5	0.5
Mineral finer than No. 200 sieve	3.0	
Soft Fragments	3.0	3.0
Chert*	---	5.0
Sum of Chert and Clay Lumps		5.0

* Material classified as chert and having a bulk specific gravity of less than 2.45. The percentage of chert shall be determined on the basis of the weight of chert in the sample retained on a 3/8-inch sieve divided by the weight of the total sample.

- B. The combined amount of all deleterious substances in an aggregate shall not exceed 5 percent of the weight of the aggregate.
- C. If required by ENGINEER, sodium sulfate soundness tests (ASTM Designation C88) shall be performed on the aggregate. When the aggregate is subjected to 5 cycles, the weight loss shall not exceed 12%. Samples of proposed aggregates shall be submitted to an independent laboratory for testing in advance of concrete work. All testing shall be performed in accordance with ASTM Designation C33. Certified test results shall be submitted to ENGINEER confirming that aggregate complies with all stated specifications. Report shall identify source of aggregate and absorbed water.
- D. Fine aggregate shall be well graded from coarse to fine and shall conform to the following requirements:

Percentage by Weight	
Passing 3/8-inch sieve	100
Passing No. 4 sieve	95-100
Passing No. 8 sieve	80-100
Passing No. 16 sieve	50-85
Passing No. 30 sieve	25-60
Passing No. 50 sieve	10-30
Passing No. 100 sieve	2-10

- E. Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. The fineness modulus shall be not less than 2.3 or more than 3.1, nor shall the fineness modulus of any sample vary by more than +0.20 from the fineness modulus of the representative sample used in proportioning the concrete.
- F. If required by ENGINEER, fine aggregate shall be subjected to the color-metric test for organic impurities (ASTM C40) and shall not produce a color darker than Figure 1, unless

they pass the mortar strength test. Aggregate producing color darker than Figure 2 shall not be used in any event.

- G. Coarse aggregate shall be well graded from coarse to fine, and when tested by laboratory sieves having square openings shall conform to the following requirements:

	Percentage by Weight Aggregate	
	3/4-inch Stone	1 1/2-inch Stone
Passing 2-inch sieve	---	100
Passing 1-1/2 inch sieve	---	90-100
Passing 1-inch sieve	100	20-55
Passing 3/4-inch sieve	90-100	0-15
Passing 3/8-inch sieve	20-55	0-5
Passing No. 4 sieve	0-10	---
Passing No. 8 sieve	0-5	---

- H. The 3/4-inch aggregate shall be used in concrete members no thinner than 4 inches and less than 10 inches thick. A blend of 3/4-inch and 1 1/2-inch aggregate shall be used in members 10 inches thick and thicker with the 3/4-inch aggregate compressing between 35% and 65% of the total aggregate. When members thinner than 10 inches are placed monolithically with members thicker than 10 inches, the aggregate requirements for the thinner member shall apply.
- I. Aggregates must be allowed to drain for at least 12 hours before being used. The ground upon which aggregates are stored must be hard, firm, well-drained and free from all vegetable matter. Various sizes of aggregates must be stored separately, and if they have become contaminated or merged with each other, they shall not be used.

2.04 WATER

- A. Water used in mixing concrete shall be clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious substances.

2.05 ADMIXTURES

- A. Water Reducing Admixture shall be Pozzolith 220N by BASF Admixtures, Inc., Daracem 19 by Grace or equal. Water reducing admixture shall conform to ASTM C494, Type A and Type F. Water reducing admixture shall not reduce durability, shall increase strength 10%, and shall not affect bleeding characteristics over reference mix.
- B. Air-Entraining Admixture shall be equal to MB AE90 Standard by BASF Admixtures, Inc., Darex by Grace Construction Products, or equal. Air-entraining admixture shall conform to ASTM C260.
- C. No other admixture will be allowed without written approval of ENGINEER. All admixture shall be compatible with cement, aggregate, and water used.

2.06 PROPORTIONING

- A. The proportions of aggregate to cement shall be such as to produce a workable mixture which can be thoroughly compacted and which will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the surfaces. The combined aggregates shall be such that when separated on the No. 4 sieve, the weight passing the sieve shall not be less than 30% nor greater than 50%.
- B. Concrete of various classes shall have the following maximum water/cement or water/(cement + fly ash) ratio minimum compressive strengths at 28 days and minimum cement and fly ash contents:

Class	Maximum Water/Cement or Water/ (Cement+Fly Ash)	Minimum 28 Day Strength-Pounds per Square Inch	Cement Content-Pounds per Cubic Yard	Fly Ash-Pounds per Cubic Yard	
				Type C	Type F
A	0.45	4,000	564	---	---
A-FA	0.45	4,000	480	110	125
B	0.53	3,500	517	---	---
C	0.53	3,000	517	---	---
X	---	2,000	376	---	---

- C. Except as otherwise indicated on the drawings or specified, all concrete shall be Class A or Class A-FA concrete.
- D. All concrete mixes shall be designed for a strength of 15% above that specified to allow for job variations. All mixes shall be designed in accordance with ACI 211.1 by a competent concrete engineer or competent laboratory technician. Required materials test data shall be submitted with design mixes for review and approval by ENGINEER. Mix computations shall be submitted if requested by ENGINEER.
- E. The slump for all concrete shall be 3 inches and concrete with a slump within the range of 2 to 3 1/2 inches will be acceptable unless otherwise stated.
- F. A water-reducing admixture shall be used in all concrete. A qualified representative of the manufacturer shall be available to assist in proportioning the concrete, advise on the proper addition of the admixture to the concrete, and advise on adjustments of concrete proportions to suit job conditions.
- G. An air-entraining admixture shall be used in all concrete except at patches. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between four to seven percent by volume.
- H. CONTRACTOR shall submit to ENGINEER compressive strength of concrete cylinder test results for the same concrete mixes proposed on a previous project. If this information is not available, one cubic yard trial batches of each individual mix proposed for use shall be made prior to use in the work. Four test cylinders shall be made for each trial batch, two to be tested at 7 days and two at 28 days. The trial batches shall be made preceding actual placement operations so that the results of the 7-day tests can be obtained. All costs for material, equipment, and labor incurred during design of concrete mixes shall be borne by CONTRACTOR.

- I. All aggregates shall be measured by weight. The concrete mixer is to be equipped with an automatic water-measuring device which can be adjusted to deliver the desired amount of water. All measuring, mixing, and proportioning equipment is subject to the approval of ENGINEER.

2.07 WATERSTOPS

- A. PVC waterstops shall be as manufactured by Greenstreak, Inc., W.R. Meadows, Grace Construction Products, or equal. Provide serrated center bulb-type, nontapered 3/8-inch minimum thickness waterstops manufactured from virgin polyvinyl chloride with no reclaimed/scrapped material or pigment whatsoever conforming to Corps of Engineers CRD-C-572. The waterstop shall have an integral fastening system consisting of hogrings or grommets. For 6-inch PVC waterstops in construction joints, use Greenstreak, Inc. Profile No. 732 or equal. For expansion joints, use Greenstreak, Inc. Profile No. 735 or equal. Where 4-inch PVC waterstops are called for in the drawings, use Greenstreak, Inc. Profile No. 702, or equal.
- B. Bentonite waterstop shall be flexible strip of bentonite waterproofing compound equal to Waterstop-RX as manufactured by the Colloid Environmental Technologies Company (CETCO), Swellstop by Greenstreak, Inc., or equal. The strip shall be 1-inch by 3/4-inch for walls with a double mat of reinforcing and 3/4-inch by 3/8-inch for walls with a single mat of reinforcing.

2.08 JOINT FILLER

- A. Expansion joints shall have standard 1/2-inch-thick cork expansion joint filler; W. R. Meadows or equal; meeting ASTM D1752–Type II. Exceptions to this are expansion joints in exterior concrete walks and between concrete walks and other structures which shall be asphalt expansion joint filler, 1/2-inch-thick; Grace, W.R. Meadows, or equal; meeting ASTM D994.

2.09 BONDING AGENT

- A. Acceptable manufacturers include Thorobond by Harris Specialty Chemicals, Inc., Sonocrete by Sonneborn Contech Co., Sonoprep by Sonneborn Contech Co., or equal.

2.10 PATCHING ADDITIVE

- A. Acceptable manufacturers include ACRYL 60 by Harris Specialty Chemicals, Inc., Sonocrete by Sonneborn Contech Co., or equal.

2.11 NONSHRINK GROUT

- A. Acceptable manufacturers include Dayton Superior, Master Builders, or equal. Grout shall be nonshrink, nonmetallic and shall achieve a strength of 7,500 psi in 28 days.

2.12 CURE–SEAL–HARDENER

- A. Penetrating sealer for interior building floors shall be Ashford Formula by Curecrete Chemical Company, Inc., or equal. See finish schedule for locations to be used.

PART 3-EXECUTION

3.01 MIXING

- A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304 from an approved batching plant. In general, concrete shall be mixed 50 revolutions at plant, 20 upon arrival at site, and 20 each time water is added; maximum of 110 revolutions at mixing speed. Concrete shall be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates or the cement to the aggregates. Truck mixers shall be equipped with drum revolution counters. In no event shall concrete which has taken its initial set be allowed to be used. Retempering of concrete is not permitted.
- B. A representative of ENGINEER may be at the batching plant periodically to observe the batching and mixing.
- C. No water shall be added on the job unless authorized by ENGINEER; the amount of water, if added, shall be recorded on all copies of the delivery tickets.
- D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the job site.
- E. With each load of concrete CONTRACTOR shall obtain delivery tickets and shall make these tickets available for review by ENGINEER. Delivery tickets shall provide the following information:
 - 1. Date.
 - 2. Name of ready-mix concrete plant, job location, and CONTRACTOR.
 - 3. Type of cement and admixtures, if any.
 - 4. Specified cement content in sacks per cubic yard of concrete and approved concrete mix number or designation.
 - 5. Amount of concrete in load, in cubic yards.
 - 6. Water added at job, if any.
 - 7. Truck number and time dispatched.
 - 8. Number of mixing drum revolutions.
- F. For job mixed concrete, all concrete materials shall be mixed in a machine batch mixer for at least 1 1/2 minutes after all ingredients are in the mixer and shall continue until there is a uniform distribution of the materials, and the mass is uniform in color and homogeneous. The mixer shall not be loaded beyond the capacity given by the manufacturer and shall be rotated at the speed recommended by the manufacturer. The mixer is to be provided with positive timing device which will positively prevent discharging the mixture until the specified mixing time has elapsed.

3.02 JOINTS

- A. CONTRACTOR shall place all joints as shown on the drawings or specified herein. If approved by ENGINEER, CONTRACTOR may, at his own expense, place construction joints in addition to and at places other than those shown on the drawings. Unless otherwise shown, all joints shall be straight, truly vertical or horizontal, and proper methods shall be employed to obtain this result.

- B. Where joints are not shown on the drawings or specified elsewhere, CONTRACTOR shall provide joints as follows:
 - 1. Walls shall have vertical joints at 30 feet on center maximum but not more than 15 feet from corners or intersections and shall have horizontal joints at 15 feet on center maximum.
 - 2. Slabs shall have joints at 20 feet on center maximum in each direction.
- C. Immediately after completion of the first pour at a joint, the concrete surface, reinforcement, and waterstop projecting beyond the joint shall be thoroughly cleaned and laitance removed. The waterstops shall not be disturbed after the concrete in the first pour at a joint has set. Concrete around waterstops shall be thoroughly compacted by hand spading and vibrating. Immediately before the second pour, all extraneous matter shall be removed from the joint, the waterstop and steel cleaned, and the surface thoroughly wetted.
- D. Concrete at all joints shall have been in place at least 24 hours before abutting concrete is placed. At least two hours must elapse after depositing concrete in columns or walls before depositing in beams, girders, or slab supported thereon. Beams, girders, brackets, column capital, and haunches shall be considered as part of the floor system and shall be placed integrally therewith.

3.03 WATERSTOPS

- A. Unless noted otherwise, PVC waterstops shall be provided at all expansion joints and at construction joints in floors and walls of structures exposed to ground or liquid on one side and occupied by personnel or nonsubmerged equipment on the other side.
- B. PVC waterstops shall be made continuous by splicing. Waterstops shall be spliced using a corner, tee, or cross splice, as applicable, at intersections. Waterstops shall be mitered to maintain the continuity of the ribs and center bulb. Splices shall be made using a hot metal plate or an electric splicer and full butt weld. Direct flame will not be allowed. Sample field-splices shall be submitted to ENGINEER for approval prior to construction.
- C. PVC waterstops placed in all joints shall be securely held in place by an approved method or as shown on the drawings. PVC waterstops shall be installed and secured prior to concrete placement. PVC waterstops shall not be inserted into wet concrete. No nails will be permitted through the waterstop. Great care shall be taken when concrete is placed to insure that the waterstop remains erect and is not bent over.
- D. Unless noted otherwise, bentonite waterstop shall be provided at all construction joints in liquid holding tanks and channels which are not adjacent to areas occupied by personnel and at joints between new and existing concrete. Waterstop shall be placed as shown on drawings.

3.04 BONDING TO EXISTING CONCRETE

- A. When placing new concrete adjacent to existing concrete, the existing concrete shall be thoroughly roughened, cleaned, and saturated with water 24 hours before pouring new concrete. Existing concrete is defined as concrete more than six months old. At time of new pour, remove any standing water and apply bonding agent. Bonding agent shall be applied in accordance with manufacturer's recommendations.

- B. When patching existing concrete, remove poor concrete until firm hard concrete is exposed; roughen and clean surface of the existing concrete, clean any exposed reinforcing bars, and pour new concrete. Concrete finish to match existing concrete. New concrete shall be 4,000 psi 28-day strength mixed with patching additive, mixed according to manufacturer's instructions. Concrete shall not be air-entrained.

3.05 EMBEDDED ITEMS IN CONCRETE

- A. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.
- B. All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.
- C. Embedded items shall be positioned accurately and supported against displacement. Reinforcing bars shall clear embedded items a minimum of 2 inches.

3.06 PLACING CONCRETE

- A. Before placing concrete, all equipment, forms, ground, reinforcements, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned of all debris, ice, and water. Ground shall be wetted prior to placement of concrete on it.
- B. After reinforcement is placed and before concrete is placed over it, ENGINEER shall be allowed sufficient time to observe the reinforcing.
- C. Unless otherwise authorized by ENGINEER, all concrete shall be placed in the presence of ENGINEER.
- D. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent the segregation or loss of materials. Chuting concrete directly into the form will not be allowed. Chuting for conveying purposes will be allowed only upon approval by ENGINEER and must be accomplished in such a manner as to prevent segregation or loss of materials. Receiving hoppers shall be installed at the chute discharge and at no point in its travel from the mixer to place of final deposit shall the concrete pass through a free vertical drop of more than 3 feet. Elephant trunks or tremies shall be used in all wall pours to prevent coating of forms and reinforcing bars.
- E. Care shall be taken to avoid an excess of water on the concrete surface. Excess water shall be drained or otherwise removed from the surface. Dry cement or a mixture of cement and sand shall not be sprinkled directly on the surface to absorb water.
- F. Concrete in wall and beam pours shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness. Each layer shall be well worked into the preceding layer while both layers are still soft.
- G. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. When concreting is once started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.

- H. All concrete shall be placed with the aid of mechanical vibrating equipment in accordance with ACI 309. In congested areas vibration shall be supplemented by hand spading adjacent to the forms. Vibration should secure the desired results within 5 to 15 seconds at intervals of 18 inches apart maximum. The vibrator shall penetrate the preceding layer of concrete. Vibrators shall have a frequency of not less than 10,000 impulses per minute when in operation submerged in concrete.
- I. A sufficient number of spare vibrators shall be kept in ready reserve to assure adequate vibration in case of breakdown of those in use.
- J. In placing concrete in beams where it is intended to be continuous and monolithic with the slab above, a delay to provide for settlement of the deep concrete shall be scheduled before placing the upper concrete in the slab. The length of delay shall be as long as possible and still permit the revibration of the deep concrete.
- K. Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete pour has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- L. No extra payment will be allowed for dewatering, undercutting, and gravel fill.

3.07 MOIST CURING

- A. All concrete shall be maintained in a moist condition for at least 7 days after being deposited except that for high-early strength concrete, a 3-day period will be sufficient. Moist curing shall be accomplished by one of the following methods:
 - 1. Wood forms left in place and kept wet at all times. If the forms are not going to be kept wet, they shall be removed as soon as practicable and other methods of moist curing shall be started without delay.
 - 2. Use of a curing compound conforming to ASTM C309, Type I as approved by ENGINEER. Curing compound shall be applied at a uniform rate as indicated by the manufacturer sufficient to comply with the requirements of the test water retention of ASTM C156. Curing compound applied to vertical concrete surfaces after forms are removed shall be specially adapted to provide required coverage on the vertical surface. On nonformed surfaces, the curing compound shall be applied immediately after the disappearance of the water sheen after finishing of the concrete. Curing compound shall not be used on concrete surfaces which are to be painted, receive ceramic tile or resilient flooring, or be waterproofed unless approved by ENGINEER. Care shall be taken not to get curing compound on construction joints, reinforcing steel, and other surfaces against which new concrete will be poured.
 - 3. Use of plastic film. Plastic film shall have a minimum thickness of 4 mils. It shall be placed over the wet surface of the fresh concrete as soon as possible without marring the surface and shall be weighted so that it remains in contact with all exposed surfaces of the concrete. All joints and edges shall be lapped and weighted. Any tears in the film shall be immediately repaired.
 - 4. Application of wet coverings weighing 9 ounces per square yard such as burlap, cotton mats, or other moisture-retaining fabrics. The covering system shall include two layers and shall be kept continuously moist so that a film of water remains on the concrete surface throughout the curing period.
 - 5. Use of an approved waterproof curing paper. Edges of adjacent sheets shall be overlapped several inches and tightly sealed.

6. Ponding of water or continuous sprinkling of water is permitted. Sprinkling at intervals will not be permitted.
 7. Construction joints shall be moist cured by one of the methods listed above except by Method "2."
- B. The use of moist earth, sand, hay, or another method that may discolor hardened concrete will not be permitted.

3.08 HOT WEATHER CONCRETING

- A. When the atmospheric temperature exceeds 80°F during concrete placement, this section and ACI 305 shall apply in addition to all other sections of the specifications.
- B. The temperature of the delivered concrete shall not exceed 85°F.
- C. Care shall be exercised to keep mixing time and elapsed time between mixing and placement at a minimum. Ready-mix trucks shall be dispatched so as to avoid delay in concrete placement, and the work shall be organized to use the concrete promptly after arrival at the job site.
- D. The subgrade, forms, and reinforcing shall be sprinkled with cool water just prior to placement of concrete. Prior to placing concrete, there shall be no standing water or puddles on the subgrade.
- E. If approved by ENGINEER, an admixture for retarding the setting of the concrete may be used.
- F. Exposed concrete surfaces shall be carefully protected from drying. Continuous water curing is preferred. Curing compounds shall be white pigmented.

3.09 COLD WEATHER CONCRETING

- A. Conditions of this section shall apply, in addition to all other sections of the specifications, when placing concrete in cold weather. Cold weather is defined as a period when, for more than three successive days, the average daily temperature drops below 40°F. When temperatures above 50°F occur during more than half of any 24-hour period, the period will no longer be regarded as cold weather. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. Cold weather concreting shall conform to all requirements of ACI 306.1, Standard Specification for Cold Weather Concreting, published by the American Concrete Institute, Detroit, Michigan, except as modified by the requirements of these specifications.
- B. Detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather shall be submitted to ENGINEER. Cold weather concreting shall not begin until these procedures have been accepted.
- C. All concrete materials, forms, ground, mixing equipment, and other surfaces with which the concrete is to come in contact shall be free from frost, and the temperature of contact surfaces shall be 35°F or above. Ground upon which concrete is to be placed shall not be frozen at any depth.

- D. The mixing water and aggregates shall be heated and when entering the mixer shall have temperatures not exceeding 175°F and 80°F, respectively. Concrete temperature as mixed shall not exceed 80°F and shall typically be between 55°F and 70°F. Concrete, when placed in the forms, shall have a temperature of not less than 50°F.
- E. Freshly placed concrete shall be protected by adequate covering, insulating, or housing and heating. If heating is used, ambient temperature inside the housing shall be maintained at a minimum of 70°F for 3 days or 50°F for 5 days. The maximum ambient temperature during curing shall not exceed 80°F. If insulating methods are used, recommendations contained in ACI 306R-78 shall be followed. Surface temperature shall be maintained at 50°F for 7 days. After the curing period, the temperature of the concrete shall be reduced uniformly at a rate not to exceed 40°F per 24 hours until outside air temperature is reached. Heating of enclosure shall continue if it is anticipated that the outside air temperature will drop more than 20°F in the next 24 hours. The concrete temperature shall be obtained by attaching a thermometer provided by CONTRACTOR to the concrete surface. Concrete shall be kept moist.
- F. If heating is used, the housing shall be constructed weather-tight and shall be constructed in a manner that will provide uniform air circulation and air temperatures over the complete concrete area that is being cured. Special attention shall be given to the edges and ends of a concrete pour with the housing extending at least 5 feet beyond any concrete surface being protected. The housing shall be in place and heat applied within two hours after concrete placement.
- G. Heating may be by steam or hot air. Heaters shall be vented to outside of the housing. Open burning salamanders will not be permitted. Heating devices shall not be placed so close to the concrete as to cause rapid drying or discoloration from smoke.
- H. If heating is used, CONTRACTOR shall provide sufficient 24-hour inspection of the heaters to insure compliance with the above-specified temperature requirements during the curing period. CONTRACTOR shall provide maximum-minimum thermometers for ENGINEER's use.
- I. The use of calcium chloride, salts, or other chemical admixtures for the prevention of freezing is prohibited.
- J. Salts or other deleterious materials shall not be used on temporary or permanent structures above concrete surfaces that are being placed, finished, or cured.

3.10 FINISHING

- A. Flat Work:
 - 1. Floated Finish: Place, consolidate, strike off, and level concrete eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Immediately refloat the slab to a uniform texture.
 - 2. Light Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks.
 - 3. Hard Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
 - 4. Tolerance for concrete floors shall be 1/4-inch within 10 feet in any direction. Straight edge shall be furnished by CONTRACTOR.

5. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.
 6. The above finishes shall be used in the following locations:
 - a. Float Finish: Surface to receive roofing, waterproofing, or sand bed terrazzo.
 - b. Light Troweled Finish: Submerged tank slabs.
 - c. Hard Troweled Finish: Building floors.
 - d. Broom or Belt Finish: Exterior slabs, sidewalks, tops of walls, and tank slabs to receive grout topping.
- B. Formed Surfaces:
1. Within two days after removing forms and prior to application of a curing compound, all concrete surfaces shall be observed and any poor joints, voids, stone pockets, or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to remove all loose and partially bonded aggregate. The area shall be thoroughly wetted and filled with as dry as practical mortar mix placed to slightly overfill the recess. Mortar shall include a bonding agent. After partial set has taken place, the excess mortar shall be removed flush with the surface on the concrete using a wood float. All patching shall be cured, protected, and covered as specified for concrete. All cracks, leaks, or moist spots which appear shall be repaired to the satisfaction of ENGINEER. No extra compensation will be allowed CONTRACTOR for such work.
 2. The exterior or removal portion of nonremovable ties shall be removed with the use of a special tool designed for this purpose. Cutting or chipping of concrete to permit removal of exterior portion will not be permitted.
 3. For nonremovable ties, tie rod holes left by the removal of the exterior portion of the tie and cone shall be thoroughly wetted and filled by ramming with as dry as practical mortar mix in such a manner as to insure complete filling of the hole. Mortar shall include a bonding agent. All patching shall be cured, protected, and covered as specified for concrete. The holes are to be filled immediately after removal of the exterior portion of the tie.
 4. Holes left by removable ties shall be filled by installing a neoprene plug near the center of the wall. The balance of the hole shall be filled with mortar as specified above to within 1 inch of the face of the wall. The remainder of the hole shall be filled with a waterproofing compound.
 5. All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections as shown or prescribed by ENGINEER. All surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness. All sharp angles, where required, shall be rounded or beveled. Any formed surface to be painted shall be free of any material that will be detrimental to the paint. The surface of the concrete shall be given one of the following finishes immediately after form stripping:
 - a. Finish A shall be referred to as a sack finish. Surfaces shall be free of contaminants prior to sacking. After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a continuous, hard, dust-free and uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all painted surfaces, interior surfaces of equipment rooms, operation areas, and permanently exposed vertical surfaces. Where steel faced forms are used to form walls, the portion of wall to receive the sack finish shall first be roughened by brush blasting or other approved method to achieve a texture similar to 40-60 grit sandpaper.
 - b. Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the

surface. Finish B shall be provided for waterproof and moistureproof coated surfaces.

- c. Finish C shall be referred to as a finish which has surface imperfections less than 3/8-inch in any dimension. Surface imperfections greater than 3/8-inch shall be repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.
- d. Finish D shall be the finish for surfaces which may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2-inch in any dimension shall be repaired. Finish D shall be provided for surfaces to be buried or covered by other construction such as masonry veneer.

- C. All precautions shall be taken to protect the concrete from stains or abrasions, and any such damage shall be removed or repaired under this Contract.

3.11 LOADING OF CONCRETE STRUCTURES

- A. No concrete structure or portion thereof shall be loaded with its design load until the concrete has obtained its specified 28-day compressive strength. This shall include but not be limited to vertical live load, equipment loading, water loading, groundwater loading, and backfill load. Concrete strength at time of loading shall be determined by testing field-cured concrete cylinders.
- B. Extreme care shall be taken to insure that construction loads do not exceed design loading of the structure.

3.12 WATER TEST

- A. When requested by ENGINEER, liquid-retaining structures shall be water tested by CONTRACTOR before being faced with masonry or backfilled. Generally, concrete structures separating liquid from occupied spaces and above grade tanks with veneer cladding or exposed to weather shall be tested. ENGINEER reserves the right to request CONTRACTOR to water test any liquid-retaining structure. The structure shall be filled with water, kept full for at least 24 hours, leaks or moist areas marked, and the structure or surrounding area drained. Repairs shall be made from the face of the concrete which is subjected to water pressure. Method of repair shall be reviewed by ENGINEER.
- B. Testing of the structure shall not take place until the last concrete placed in the structure has developed 28-day design strength as determined by testing field-cured concrete cylinders.
- C. After repair, the structure shall again be tested as above. Testing and repair shall continue until all leaks or moist spots have disappeared to the satisfaction of ENGINEER. Unless otherwise stated, water for testing shall be supplied by CONTRACTOR.

3.13 NONSHRINK GROUT

- A. Nonshrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by ENGINEER. Store, mix, and place the nonshrinking compound as recommended by the manufacturer. The minimum compressive strength shall be 5,000 psi at age 7 days and 7,500 psi at age 28 days.

3.14 TESTING AND SAMPLING

- A. The following tests of fresh concrete shall be performed by CONTRACTOR. CONTRACTOR shall prepare, protect, transport, and have tested all cylinders at his expense.
1. Sampling of concrete for slump tests, air tests, temperature tests, and for making concrete test cylinders shall be performed in accordance with ASTM C143.
 2. Cylinders:
 - a. Three test cylinders shall be made for each pour less than 25 cubic yards, 4 test cylinders shall be made for each pour between 25 and 100 cubic yards, and 8 test cylinders made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least 4 cylinders for the entire job. Concrete for cylinders shall be collected near the middle of the load and/or as requested by ENGINEER.
 - b. Cylinders shall be made and tested in accordance with ASTM C31 and ASTM C39, respectively. The cylinders must be kept moist and at temperatures between 60°F and 80°F and shall remain undisturbed and stored in a location free from vibration. In hot weather, the cylinders shall be covered with wet burlap and stored in a shaded area. It is CONTRACTOR's responsibility to provide a suitable protected location for storing cylinders on the job site.
 - c. After 24 hours, the cylinders shall be transferred to an independent testing laboratory acceptable to OWNER. The cylinders shall be packed in sawdust or other cushioning material for transit to avoid any bumping or jarring of the cylinders.
 - d. Cylinders shall be broken at 7 and 28 days or as requested by ENGINEER. Test result shall be mailed immediately and directly to ENGINEER. Test data shall include date and location of pour and concrete mix used.
 3. Slump Test: CONTRACTOR shall make one slump test near the beginning of all pours with two tests being made for all pours in excess of 25 yards or as requested by ENGINEER. Slump tests shall conform to ASTM C143.
 4. Air Test:
 - a. When air-entrained concrete is used, the air content shall be checked by CONTRACTOR near the beginning of all pours with at least two checks being made for all pours in excess of 25 cubic yards, or as requested by ENGINEER..
 - b. The air contents shall be checked using the pressure method in accordance with ASTM C231. The pocket-sized alcohol air indicator shall not be used unless it is first used in conjunction with the pressure method test.
- B. All costs of additional testing and sampling of fresh or hardened concrete needed because of suspected or actual violation of the specifications shall be borne by CONTRACTOR.

3.15 RECORDS

- A. A record is to be kept of all concrete work. The record shall include the date, location of pour, concrete mix, slump, air content, test cylinder identification, concrete temperature, and ambient air temperature. In addition, for cold weather concreting the record shall include the daily maximum-minimum thermometer readings of all thermometers during the entire curing period for all concrete pours. The project representative will keep this record, and CONTRACTOR shall assist in obtaining needed information.

3.16 GROUT TOPPING AND FILL

- A. The clarifier bottoms shall receive a 2-inch concrete topping as specified below. The topping coat shall be struck off by placing a screen on clarifier mechanism arms and rotating the mechanism. After striking off, a light steel troweled finish shall be applied. CONTRACTOR shall run the clarifier mechanism.
- B. The Screening Building precast concrete hollow core planks shall receive a concrete topping as shown on the plans and as specified below.
- C. Before the grout topping is applied, the base slab and precast plank shall be thoroughly cleaned. The base slab and precast plank shall be wetted and kept saturated prior to placing the topping. A thin coat of cement grout shall be broomed into the base slab and precast plank for a short distance ahead of the topping. The topping shall be applied before the grout is hardened.
- D. Grout shall contain pea-gravel, crushed stone, or other suitable coarse aggregate graded from 1/8-inch to 3/8-inch in addition to well graded sand. Use seven bags of Portland cement per cubic yard. Not more than five gallons of mixing water per bag of cement, including free water in aggregate, shall be used.

3.17 CONCRETE REMOVAL AND PATCHING

- A. All areas disturbed due to concrete removal or repair shall be patched as specified in Bonding to Existing Concrete.

3.18 CURING AND SEALING INTERIOR BUILDING FLOORS

- A. Install cure-seal-hardener product in accordance with manufacturer's instructions. Apply only to those floors noted to be sealed in the finish schedule.
- B. Where product will be used for moist curing, sealing and hardening, apply to new concrete as soon as the concrete is firm enough to walk on after troweling.
- C. Spray on at rate of 200 square feet per gallon.
- D. Keep surfaces wet with cure-seal-hardener for minimum soak-in period of 30 minutes, without allowing drying out or becoming slippery. In hot weather slipperiness may appear before the 30-minute time period has elapsed. If that occurs, apply more cure-seal-hardener as required to keep entire surface in a non-slippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state.
- E. After this period, when treated surface becomes slippery, lightly mist with water until slipperiness disappears.
- F. Wait for surface to become slippery again and then flush entire surface with water removing all residue of cure-seal-hardener.
- G. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
- H. Wet vacuum or scrubbing machines may be used to remove residue, provided manufacturer's instructions are followed.

- I. Protect installed floors until chemical reaction process is complete; at least three months.
- J. Clean up spills immediately and spot-treat stains with good degreaser or oil emulsifier.
- K. Protection and cleaning of floors are the responsibility of CONTRACTOR until final completion. Replace concrete that becomes stained due to improper precautions or lack of cleaning.

END OF SECTION

SECTION 03415

PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Precast concrete hollow core planks.
 - 2. Connection plates and hangers.
 - 3. Grouting plank joint keys.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ACI 318 - Building Code Requirements for Reinforced Concrete.
- B. ASTM C150 - Portland Cement.
- C. AWS D1.1 - Structural Welding Code.
- D. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- E. PCI - Manual For The Design of Hollow Core Slabs.
- F. PCI MNL-116—Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- G. PCI MNL-120—Design Handbook—Precast and Prestressed Concrete.
- H. PCI MNL-123—Manual on Design of Connections for Precast Prestressed Concrete.
- I. PCI - Design Handbook - Precast and Prestressed Concrete.
- J. PCI - Tolerances for Precast and Prestressed Concrete.

1.03 DESIGN REQUIREMENTS

- A. Size components to withstand design loads in an unrestrained condition as follows:
 - 1. Roof Assembly: All dead loads plus 25 psf live loads plus concentrated loads shown on the drawings. At pitched roof structures, the loads will be transmitted to the panels through the attic stud walls. Increased loading due to snow drifting at obstructions and changes in roof elevation shall be included in the design.
 - 2. Floor Assembly: All dead loads plus 100 psf live loads plus concentrated loads shown on the drawings. Dead loads shall include concrete topping as shown on the plans.
- B. Plank shall be designed in accordance with the PCI - Manual For The Design of Hollow Core Slabs and PCI - Design Handbook.

- C. Plank shall be capable of resisting shear forces as a diaphragm. Diaphragm chords will be the masonry bond beams.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate plank locations, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.
- B. Product Data: Indicate standard component configuration, design loads, deflections, and cambers.

1.05 QUALIFICATIONS

- A. Fabricator: Company specializing in manufacturing the work of this section with three years experience. Maintain plant records and quality control program during production of precast planks. Make records available upon request.
- B. Erector: Company specializing in erecting the work of this Section approved by fabricator.
- C. Design precast concrete members in accordance with PCI Manual For The Design of Hollow Core Slabs under direct supervision of a Structural Engineer experienced in design of this work and licensed in the State of Illinois.
- D. Welder: Qualified within previous 12 months in accordance with AWS D1.1.

1.06 REGULATORY REQUIREMENTS

- A. Conform to ACI 318 and the 2003 International Building Code for design load and on-site construction requirements.

1.07 PRE-INSTALLATION CONFERENCE

- A. Convene minimum one week prior to commencing work of this section under provisions of Section 01039 - Coordination, Field Engineering and Meetings.
- B. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Lifting or handling devices shall be capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
- B. Mark each member with date of production and final position in structure.

1.09 COORDINATION

- A. Coordinate the work of framing components not post tensioned but directly associated with the work of this section.

- B. Coordinate field cut openings with affected section.
- C. Coordinate location of hanger tabs and devices for mechanical and electrical work.
- D. Coordinate location of anchors to be placed in masonry walls.

PART 2-PRODUCTS

2.01 FABRICATORS

- A. The plank shall be prestressed hollow-core precast concrete plank as fabricated by the Spancrete Company, Flexicore Company, or equal.

2.02 MATERIALS

- A. Materials shall comply with provisions of ACI 318.
- B. Cement grout for grouting joints shall be one part Portland Cement per ASTM C150, three parts sand and water.

2.03 ACCESSORIES

- A. Connecting and supporting devices shall be ASTM 304 stainless steel unless noted otherwise.
- B. Bearing pads shall be high-density plastic, 1/8-inch-thick.
- C. Caulk as approved by plank manufacturer.

2.04 FABRICATION

- A. Conform to AWS D1.4., PCI MNL-116, and PCI MNL-120, and PCI MNL-123.
- B. Embed anchors, inserts, plates, angles, and other items at locations indicated.
- C. Cut exposed ends flush.

2.05 FINISHES

- A. Plank to be painted shall be field abrasive blasted and painted as specified in Section 09900 - Painting.

2.06 FABRICATION TOLERANCES

- A. Conform to PCI - Tolerances for Precast and Prestressed Concrete.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions and supporting structure are ready to receive work and field measurements are as indicated on shop drawings.

3.02 PREPARATION

- A. Prepare support devices for the erection procedure and temporary bracing.

3.03 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- B. Align and maintain uniform horizontal and end joints as erection progresses.
- C. Maintain temporary bracing in place until final connection is made. Protect members from staining.
- D. Install bearing pads at bearing ends of planks as indicated.
- E. Adjust differential camber between precast members to tolerance before final attachment and grouting.
- F. Adjust differential elevation between precast members to tolerance before final attachment.
- G. Grout plank joints, trowel smooth. Any grout that may have seeped through to the ceiling below shall be removed before it hardens. Grout shall also be placed between masonry and underside of roof plank in spaces created by roof plank camber over all exterior walls and bearing walls. On nonbearing interior walls, a void over 1/2-inch shall be filled with 1/2-inch expansion material and grout the remainder. This grout shall be applied following roofing. It is the intent that a space of 1/4-inch to 1/2-inch be left for caulking as required in Section 07900 - Caulking and Sealants.
- H. Underside of joints between planks that remain exposed shall be caulked with the plank manufacturer's material.
- I. Where open cores at end of planks are to remain exposed to view. The cores shall be grouted full for a minimum 6-inch depth to provide finished end of plank.
- J. Secure units in place. Perform welding, where shown, in accordance with AWS D1.1.

3.04 ERECTION TOLERANCES

- A. Erect members level and plumb within allowable tolerances. Conform to PCI MNL-116.

3.05 CUTTING OPENINGS

- A. Cooperation shall be extended all trades in permitting the insertion of anchors, hangers, vents, electrical outlets, etc. Holes needed for such devices shall be cut in the field by the various trades. Cuts shall be made with a masonry saw or core drill. The various trades shall be present during installation of the roof deck. All openings not dimensioned or shown

on the drawings shall be located by the trades requiring the openings. All openings larger than 8 inches in any dimension shall be made by the roof slab supplier, and where necessary, hangers shall be furnished by the supplier. All spalling shall be repaired by the roof plank supplier prior to caulking. It is essential that plank which will remain exposed from below have a neat finished surface. Particular care shall be given to appearance of holes and openings.

END OF SECTION

SECTION 04100

MORTAR AND MASONRY GROUT

PART 1—GENERAL

1.01 SUMMARY

- A. The work includes mortar and grout for masonry.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. 2003 International Building Code.
- B. ASTM C144—Aggregate for Masonry Mortar.
- C. ASTM C150—Portland Cement.
- D. ASTM C207—Hydrated Lime for Masonry Purposes.
- E. ASTM C404—Aggregates for Masonry Grout.
- F. ASTM C476—Grout for Masonry
- G. ASTM C979—Pigments for Integrally Colored Mortar/Concrete.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300—Submittals.
- B. Submit information on Portland cement, integral waterproofing compound, and hydrated lime for mortar. Include design mix with proportions of materials being used. Submit gradation on aggregates.
- C. Submit design mix for grout including gradation of aggregates.
- D. Manufacturer's certificate: Certify that products meet or exceed specified requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. All cement shall be stored in a dry, weatherproof, properly ventilated structure which will protect it from dampness and freezing.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. See Section 04300—Unit Masonry System, for cold weather requirements.

PART 2-PRODUCTS

2.01 MORTAR

- A. Mortar shall be Type S Portland cement-lime mortar with proportion restrictions as stated in the 2003 International Building Code. Mortar and masonry cements will not be permitted. Provide integral waterproofing compound in mortar for all exterior masonry mortar.
- B. Portland cement shall conform to ASTM C150, Type I or III.
- C. Hydrated lime shall conform to ASTM C207, Type S.
- D. Integral waterproofing compound shall be Dry-Block by W.R. Grace Company, or equal.
- E. Mortar aggregate for ordinary tile, brick, stone, and block shall consist of clean, sharp sand, conforming to ASTM C144. The sand shall be graded within the following limits:

Sieve Number	Percent by Weight Passing
4	100
8	95 to 100
16	70 to 100
30	40 to 75
50	10 to 35
100	2 to 15
200	---

- F. Sand from any one source shall not vary over the extreme limits shown above. For unusually thin joints, such as occur with a unit having cut or ground edges, the aggregate used shall conform to these specifications except that 95% shall pass a No. 16 sieve.
- G. Water used in mixing water shall be clean and free of injurious materials.
- H. Mortar shall be thoroughly mixed until of uniform color and consistency. Only sufficient mortar to meet the immediate requirements of the work shall be mixed at one time. No mortar shall be retempered after it has begun to set, and no partially set mortar shall be used. No antifreeze material shall be used in the mortar to lower the freezing point.

2.02 GROUT

- A. Grout shall conform to ASTM C476–Mortar and Grout for Reinforced Masonry.
- B. Aggregates shall conform to ASTM C404–Aggregates for Masonry Grout.
- C. Grout shall have a minimum 28-day compressive strength of 2,500 psi with the following proportions:
 - 1. Fine Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate.
 - 2. Coarse Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate: 1 to 2 coarse aggregate.

- D. Fine grout shall be used in spaces with least horizontal dimension greater than 3/4 inches and less than 2 1/2 inches. Coarse grout shall be used in all spaces with least dimensions 2 1/2 inches or greater.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Brace masonry for wet grout pressure.
- B. Work grout into masonry cores and cavities.
- C. Where joints occur in grout, they shall be made 2 inches below the block joint so that a key is provided.
- D. Grout full masonry walls from top of floor to underside of all lintels at openings for a distance of 16 inches adjacent to each side of opening, unless shown otherwise on the drawings.

END OF SECTION

SECTION 04300

UNIT MASONRY SYSTEM

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Concrete block.
 - 2. Brick.
 - 3. Reinforcement, anchorage, control joints, and accessories.
 - 4. Cold weather requirements.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 ALLOWANCES

- A. The bricks to be used shall be of the following size, bond, and assumed net price to purchase and deliver. Modular size (7 5/8 by 2 1/4 by 3 5/8) running bond assumed price of \$500 per M, f.o.b. Installation shall be included in the Lump Sum Bid.
- B. Face brick shall be included in CONTRACTOR's proposal at assumed net price as indicated per M, f.o.b. delivered to the job site. Should net cost of brick be more or less than assumed amount, OWNER will adjust amount of Contract at time of final payment based on number of bricks used in the work and actual net price paid to supplier by CONTRACTOR for brick delivered as noted above.

1.03 REFERENCES

- A. 2003 International Building Code.
- B. ASTM C67—Sampling and Testing Brick and Structural Clay Tile.
- C. ASTM C90—Load Bearing Concrete Masonry Units.
- D. ASTM C216—Facing Brick.
- E. ASTM C744—Pre-Faced Concrete and Calcium Silicate Masonry Units.
- F. UL—Fire Resistance Directory.

1.04 QUALITY ASSURANCE

- A. Variation from the plumb in the lines and surfaces of columns and walls shall not exceed 1/4-inch in 10 feet, 3/8-inch in a story height or 20 feet maximum, nor 1/2-inch in 40 feet or more. Variation from plumb for external corners, expansion joints, and other conspicuous lines shall not exceed 1/4-inch in any story or 20 feet maximum nor 1/2-inch in 40 feet or more.

- B. Variation from the level of the grades indicated on the drawing for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines shall not exceed 1/4-inch in any bay or 20 feet nor 1/2-inch in 40 feet or more.
- C. Variation of the linear building line from an established position in plan and related portion of columns, walls, and partitions shall not exceed 1/2-inch in any bay or 20 feet maximum nor 3/4-inch in 40 feet or more.
- D. Variation in cross-sectional dimensions of columns and thickness of walls shall not exceed minus 1/4-inch nor plus 1/2-inch from the dimensions indicated on the drawings.

1.05 MOCK-UP

- A. Provide a 4-foot by 4-foot mock-up panel of masonry, including anchor accessories and flashings, before any masonry work begins. Location will be indicated by OWNER. Mock-up panel shall be approved by OWNER and used as a sample of the quality of work to be expected on the job. Mock-up may not remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Masonry units, when delivered to the site, shall be thoroughly cured and shall be dry. When stored on the site, they shall not be in contact with the ground, shall be kept clean, and shall be covered with waterproof cover.

1.07 COLD WEATHER REQUIREMENTS

- A. All masonry units delivered to use in freezing weather shall be fully protected by a weather-tight covering to prevent accumulation of ice on the units. Loose board covering will not be permitted.
- B. Cold Weather Protection:
 - 1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
 - 2. Remove all masonry determined to be frozen or damaged by freezing conditions.
 - 3. Perform the following construction procedure while the work is progressing. When air temperature is from 40°F (4°C) to 32°F (0°C), heat sand or mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C):
 - a. When air temperature is from 32°F (0°C) to 25°F (-4°C) heat sand or water to produce mortar temperature between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
 - b. When air temperature is from 25°F (-4°C) to 20°F (-7°C) heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing; use salamanders or other heat sources on both sides of walls under construction; use wind breaks when wind is in excess of 15 mph.
 - c. When air temperature is from 20°F (-7°C) and below, heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); provide enclosures and auxiliary heat to maintain air temperature above 32°F (0°C); do not lay units which have a surface temperature of 20°F (-7°C).

4. Perform the following protections for completed masonry and masonry not being worked on:
 - a. When the mean daily air temperature is from 40°F (4°C) to 32°F (0°C), protect masonry from rain or snow for at least 24 hours by covering with weather-restrictive membrane.
 - b. When the mean daily air temperature is from 32°F (0°C) to 25°F (-4°C), completely cover masonry with weather-restrictive membrane for at least 24 hours.
 - c. When the mean daily air temperature is from 25°F (-4°C) to 20°F (-7°C), completely cover masonry with insulating blankets or similar protection for at least 24 hours.
 - d. When mean daily temperature is 20°F (-7°C) and below, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures, blankets, and supplementary heat.

PART 2—PRODUCTS

2.01 CONCRETE BLOCK

- A. Concrete block shall be load bearing and shall conform to the requirements of ASTM Designation C90 and the 2003 International Building Code. Bond shall be running bond. Concrete block shall be the two-cell-type and shall be made with normal weight aggregate.
- B. Unless otherwise indicated, interior concrete block at window sills and lintels, pilasters, and the top course of walls at roof lines shall be constructed of solid concrete block, lintel block filled with grout, or the cores of the block filled with grout. Interior block at window sills shall be solid concrete block unless otherwise noted. Bullnose block shall be used at all door, window, and wall corners that remain exposed.
- C. All interior concrete block walls shall extend to the underside of roof deck or floor above unless noted otherwise.

2.02 BRICK

- A. Face brick shall be ASTM C-216, latest edition, Grade SW, Type FBS, made from clay, shale, fine clay, or mixture thereof. All brick shall be free from cracks, laminations, and other defects which may interfere with proper laying of brick or impair the strength or permanence of the structure.
- B. A certificate of conformance as to grade and type shall be supplied by the manufacturer.
- C. CONTRACTOR shall submit brick samples to ENGINEER for selection. The bricks to be used shall be of Modular Size (7-5/8 by 2-1/4 by 3-5/8)—and running bond.
- D. Provide all brick masonry to complete work.

2.03 REINFORCEMENT AND ANCHORAGE

- A. For concrete block walls, masonry wall reinforcement shall be Dur-O-Wal Truss Design manufactured by Dur-O-Wal Products, Blok-Trus manufactured by AA Wire Products Co., or equal.

- B. For cavity walls, masonry wall reinforcement shall be Dur-O-Wal Truss/Dur-O-Eye Design, or Econo-Cavity Blok-Trus AA 680, or equal.
- C. Wall reinforcement and ties shall be hot-dipped galvanized having a minimum 1.50 ounce/square foot zinc coating in accordance with ASTM A153 Class B2.
- D. Side rods shall be 9 gauge wire, and cross rods and tabs shall be 9 gauge wire. Maximum spacing of tabs shall be 24 inches.
- E. Prefabricated corner and tee sections shall be used to form continuous reinforcement around corners and for anchoring abutting walls and partitions.
- F. Masonry Ties To Concrete Backing: For tying masonry to concrete, unless noted otherwise, use individual dove-tail flat bar or wire anchors, the equivalent of not less than 3/16-inch-diameter steel rods, inserted in slots built into concrete with one tie for not more than 4 1/2 square feet of wall area. Ties in alternate courses shall be staggered. The maximum vertical distance shall not exceed 16 inches. The maximum horizontal distance shall not exceed 36 inches. Ties shall be galvanized.
- G. Masonry Ties to Stud Walls: Ties shall be minimum 22 gauge corrugated sheet steel, 7/8-inch-wide with one tie per 2 square feet of wall area.

2.04 ACCESSORIES

- A. Cellular or honeycomb cell vents, 2 1/2 inches high, shall be provided at weep holes. Cell vents shall be U.V.-resistant polypropylene, Durowall D/A 1006, or equal.
- B. Vertical expansion control joints shall be located as shown on the drawings. Control joints shall be constructed with a factory extruded section of rubber equal to Dur-O-Wal Rapid Control Joint, AA Wire Products Co. Titewall, or equal and shall extend for the entire height of the wall. Care shall be taken to insure that the gap is free of mortar or debris. Control joint shall be caulked on exposed faces with caulk of a color to match mortar.
- C. See Section 07620–Flashing and Sheet Metal for masonry flashing specifications.

PART 3–EXECUTION

3.01 MASONRY WORKMANSHIP

- A. All masonry shall be laid plumb and true to lines. Brick shall be laid with complete full mortar joints. Mortar beds shall be spread smooth or only slightly furrowed. The ends of brick shall be buttered with sufficient mortar to fill the end joint. The vertical longitudinal joint in solid brick walls shall be completely filled by parting, by pouring the vertical joint full of grout, or by shoving. Closures shall be rocked into place with the head joints thrown against the two adjacent brick in place.
- B. All masonry shall be laid in running bond, unless specified otherwise.
- C. In laying brick and block masonry, the mason shall avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after being set in position. Where an adjustment

must be made after the mortar has started to harden, the mortar shall be removed and replaced with fresh mortar.

- D. In building cavity walls, the cavity shall be kept clean by slightly beveling the mortar bed to incline toward the cavity or by placing wood strips with attached wire pulls on the metal ties. The strips shall be withdrawn and cleaned before placing the next row of metal ties. Any mortar fins which protrude into the cavity space as the wall is built shall be troweled flat onto the inner face of the wythe.
- E. Where cutting of exposed masonry is necessary, the cuts shall be made with a motor-driven masonry saw or by other methods which provide cuts that are straight and true.
- F. Where flashing is to be laid on or against masonry, the surface of the masonry shall be smooth and free from projections which might puncture the flashing material. Through-wall flashing shall be placed on a bed of mortar, and mortar shall be placed above the flashing.
- G. Weep holes spaced 32-inch on center 2 1/2 inches high shall be provided in the first course immediately above all flashing. Weep holes shall be kept free of mortar droppings.
- H. Outside joints around the perimeter of exterior door and window frames or other wall openings shall be not less than 1/4-inch nor more than 3/8-inch-wide and shall be cleaned out to a uniform depth of at least 3/4-inch ready for placement of caulk.
- I. All walls shall be adequately braced until they are completed and anchored to the roof construction.
- J. Construction designated as requiring "special observation" shall be constructed only in the presence of ENGINEER.
- K. All brick having initial rates of absorption in excess of 0.25 ounce per square inch per minute shall be wetted sufficiently so that the rate of absorption when laid does not exceed this amount. Wetting of units shall be such as to insure that each unit is nearly saturated, surface dry when laid. During freezing weather, units that require wetting shall be sprinkled with warm water just before laying.

3.02 MORTAR JOINTS

- A. All joints shall be laid plumb to lines. Unless specified otherwise, mortar beds shall be full 3/8-inch-thick and shall be spread smooth or only slightly furrowed. Vertical joints shall be shoved not over 3/8-inch-thick, unless otherwise shown. All joints shall be completely filled.
- B. Interior and exterior joints shall be tooled concave. All joints shall be tooled to uniform depth and shall be straight and true. Mortar joints shall be cut flush with masonry where rigid thermal insulation will be applied to interior masonry surfaces.

3.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcement shall be installed in the first and second bed joint 8 inches apart immediately above lintels and below sills at openings. Elsewhere, spacing shall be at 16-inch vertical intervals or as shown on the drawings. Reinforcement in the second joint

above and below openings shall extend 2 feet beyond the jambs. All other reinforcing shall be continuous.

- B. Side rods shall be lapped 6 inches minimum at splices. Reinforcement units shall be of widths required for wall thicknesses as shown. Reinforcement shall be placed to assure a 5/8-inch mortar cover on the exterior face of walls and 1/2-inch mortar cover on interior faces.

3.04 BUILT-IN WORK

- A. As work progresses, install all built-in work (such as: window and door frames, anchor bolts, plates, lintels, etc.) to be provided by other sections.
- B. Install built-in items plumb and level.
- C. Bed anchors of metal door frames in adjacent mortar joints. Grout all steel door frames full with mortar except those called for to be "removable."
- D. Do not build-in organic materials subject to deterioration.

3.05 PARGING

- A. Dampen masonry walls prior to parging.
- B. Steel members embedded in exterior masonry shall be "battered" with not less than 1/2-inch of setting mortar on all surfaces.

3.06 JOINING OF WORK

- A. Where fresh masonry joins masonry that is partially set or totally set, the exposed surface of the set masonry shall be cleaned and lightly wetted so as to obtain the best possible bond with the new work. All loose brick and mortar shall be removed. If it becomes necessary to "stop-off" a horizontal run of masonry, this shall be done only by racking back brick in each course, and if grout is used, stopping grout four inches back of the rack. Tooothing will not be permitted.

3.07 PROTECTION OF WORK

- A. During erection, all walls shall be kept dry by covering at the end of each day or shutdown period with a canvas or waterproof covering. Partially completed walls not being worked on shall be similarly protected at all times. All covering shall overhang at least two feet on each side of the wall and shall be securely anchored.

3.08 MASONRY CONTROL JOINTS

- A. Provide vertical masonry control joints in brick and block as detailed on the drawings.
- B. Where control joint locations are not shown on the drawings, they shall be provided as follows:

	Brick Veneer	Block Veneer
Distance from wall corner (maximum)	15 feet	12 feet

Spacing between joints (maximum)	30 feet	20 feet

- C. Where possible, joints shall be located at edges of door, window, and louver openings, and at changes in wall height.

3.09 CLEANING NEW WORK

- A. Masonry faces to remain exposed shall be wiped with a damp cloth as the work progresses and thoroughly cleaned and pointed upon completion. If stiff brushes and water will not suffice, the surface shall be thoroughly wetted with plain water and then scrubbed with a 5 or 10% solution of hydrochloric acid. Alternatively, a commercial cleaner such as Sure Klean, or equal, may be used. Immediately after, the surface shall be washed to remove all traces of acid. All surfaces not being cleaned shall be protected from the acid. All mortar shall be removed from surfaces other than masonry.

3.10 EXISTING MASONRY

- A. Openings in existing walls which are to be filled shall be filled with masonry units to match existing.
- B. Where possible, new openings in existing masonry shall be sawcut.
- C. Provide all necessary removals and repairs required for installation of new louvers, fans, openings, etc.
- D. At lintel bearings of all new openings, grout masonry full for 16 inches full height on both sides of opening.
- E. Repair all masonry damaged during construction.
- F. All existing masonry which will remain exposed shall be cleaned as specified for new masonry.
- G. New units shall be toothed into existing units.
- H. Masonry reinforcing shall be carried through new units.

END OF SECTION

SECTION 05120
STRUCTURAL STEEL

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Structural carbon steel framing members.
 - 2. Steel base plates and bearing plates.
 - 3. Structural steel bolted connections and anchor bolts.
 - 4. Welding of structural steel.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. AISC–Code of Standard Practice–Manual of Steel Construction–Allowable Stress Design (ASD).
- B. ASTM A36/A36M–Structural Steel.
- C. ASTM A53–Pipe, Steel, Black, and Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
- D. ASTM A123–Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
- E. ASTM A153–Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A307–Carbon Steel Externally Threaded Standard Fasteners.
- G. ASTM A325–High-Strength Bolts for Structural Steel Joints.
- H. ASTM A500–Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- I. ASTM A992/A992M–Standard Specification for Structural Steel.
- J. AWS A2.4–Symbols for Welding, Brazing, and Nondestructive Examination.
- K. AWS D1.1–Structural Welding Code.
- L. SSPC (Steel Structures Painting Council)–Painting Manual.

1.03 SUBMITTALS FOR REVIEW

- A. Comply with pertinent provisions of Section 01300–Submittals.

- B. Provide shop drawings with complete details and schedules for fabrication and shop assembly of members.
 - 1. Include details of cuts, connections, camber, holes, and other pertinent data.
 - 2. Indicate welds by AWS symbols, and show size, length, and type of weld.
 - 3. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages.
 - 4. Identify details by reference to sheet and detail number on the drawings.
- C. Unless shown otherwise, all connections shall be designed and detailed by the fabricator to support one-half of the total uniform load capacity shown in the tables for uniform load constants in the AISC Specifications.
- D. Except as shown otherwise, structural steel details shall conform to standard practice as illustrated in Structural Shop Drafting Textbook of the AISC.
- E. Indicate all temporary bracing or cabling required to stabilize the structural frame during erection.

1.04 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC Code of Standard Practice.
- B. Mill Test Reports: Submit indicating structural strength and composition.
- C. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

1.05 QUALIFICATIONS

- A. Qualify welding processes and welding operators in accordance with AWS "Standard Qualifications Procedures."
- B. CONTRACTOR shall design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Illinois.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.
- B. Store all members off the ground using pallets, platforms, or other supports.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.
- D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

PART 2-PRODUCTS

2.01 MATERIALS

- A. Structural Steel Members:
 - 1. ASTM A36/A36M (channels, angles, plates).
 - 2. ASTM A992-50 (wide flange sections).
- B. Structural Tubing: ASTM A500, Grade B.
- C. Pipe: ASTM A53, Grade B.
- D. Bolts, Nuts, and Washers: ASTM A307 or ASTM A325, galvanized in accordance with ASTM A123 and A153.
- E. Anchor Bolts: ASTM A307.
- F. Welding Materials: AWS D1.1; E70XX electrodes.
- G. Galvanizing: ASTM A123 and A153 for structural steel plates, shapes and bars, and structural steel tubing. ASTM A53 for steel pipe.

2.02 FABRICATION

- A. Fabrication and Assembly:
 - 1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
 - 2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
 - 3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 - 4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
 - 5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.
- B. Connections:
 - 1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
 - 2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
 - 3. Assemble and weld built-up sections to produce true alignment of axes without warp.
 - 4. Welding shall be done by the shielded arc process.
 - 5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.
- C. Holes for Other Work:
 - 1. Provide holes for securing other work to structural steel framing and for the passage of other work through steel framing members as indicated.
 - 2. Provide threaded nuts welded to framing and other specialty items as shown to receive other work.
 - 3. Drill, cut, or punch holes perpendicular to metal surfaces.
 - 4. Do not flame cut holes or enlarge holes by burning.
 - 5. Drill holes in all bearing plates.

2.03 FINISH

- A. Before shipping, prepare structural component surfaces in accordance with SSPC SP 10.
- B. Immediately after surface preparation, shop prime structural steel members in accordance with Section 09900–Painting. Do not prime surfaces that will be field-welded, galvanized, or high-strength bolted with friction-type connection.
- C. Surfaces which will be inaccessible after assembly or erection shall be field finish coated prior to assembly or erection.

PART 3–EXECUTION

3.01 EXAMINATION

- A. Correct conditions detrimental to proper and timely completion of the work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 ERECTION

- A. General: Comply with AISC Specifications and Code of Standard Practice and as specified herein.
- B. Surveys:
 - 1. Establish permanent bench marks necessary for the accurate erection of structural steel.
 - 2. Check elevations of concrete and masonry, bearing surfaces, and locations of anchor bolts and similar items before erection proceeds.
- C. Temporary Shoring and Bracing:
 - 1. Provide temporary shoring and bracing members with connection of sufficient strength to bear imposed loads.
 - 2. Provide temporary guidelines to achieve proper alignment of the structures as erection proceeds.
 - 3. Remove temporary connections and members when permanent members are in place and final connections are made.
- D. Anchor Bolts:
 - 1. Provide anchor bolts and other connectors for securing structural steel to foundations and other in-place work.
 - 2. Provide templates and other devices as needed for the presetting of bolts and other anchors to accurate locations.

- E. Setting Bases and Bearing Plates:
 - 1. Clean bearing surfaces free from bond-reducing materials and then roughen to improve bond to surface.
 - 2. Set loose and attached base plates and bearing plates for structural members using wedges, leveling nuts, or other adjusting devices.
 - 3. Tighten anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edges of the base or bearing plates prior to packing with grout.
 - 4. Pack grout solidly between bearing surfaces and bases to ensure that no voids remain.
 - 5. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's instructions.
- F. Field Assembly:
 - 1. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before fastening permanently.
 - 2. Clean the bearing surfaces and other surfaces which will be in permanent contact before assembly.
 - 3. Perform necessary adjustments to compensate for discrepancies in elevation and alignment.
 - 4. Level and plumb individual members of the structure within specified AISC tolerances.
 - 5. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- G. Gas Cutting:
 - 1. Do not use gas cutting torches in the field for correcting fabricating errors in the structural framing.
 - 2. Cutting will be permitted only on secondary members which are not under stress as acceptable to ENGINEER.
 - 3. When gas cutting is permitted, finish the sections equal to the sheared appearance.
- H. After erection, prime welds, abrasions, and surfaces not shop-primed or galvanized, except surfaces to be in contact with concrete.

3.03 FIELD QUALITY CONTROL

- A. CONTRACTOR shall inspect all field-bolted connections in accordance with the AISC Specifications.
- B. Field Welding:
 - 1. CONTRACTOR shall visually inspect all welds and test during erection of structural steel.
 - 2. CONTRACTOR shall certify welders and conduct inspections and tests as required by applicable standards.
 - 3. CONTRACTOR shall record types and locations of defects found and record the work required and performed to correct deficiencies.

C. Correction:

1. Correct deficiencies in structural steel work which inspections and test reports have indicated to be not in compliance with the specified requirements.
2. CONTRACTOR shall perform all additional testing required to show compliance of corrected work.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Shop-fabricated carbon steel, stainless steel, and aluminum items, including lintels, and metal stairs.
 - 2. Stair treads and nosings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36—Structural Steel.
- B. ASTM A53—Pipe, Steel, Black, and Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
- C. ASTM A123—Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A143—Practice for Safeguarding Against Embrittlement of Hot-Dipped Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- E. ASTM A153—Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A176—Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.
- G. ASTM A307—Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- H. ASTM A384—Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- I. ASTM A385—Practice for Providing High Quality Zinc Coatings (Hot-Dipped).
- J. ASTM A570—Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.
- K. ASTM A611—Steel Sheet, Carbon, Cold-Rolled, Structural Quality.
- L. ASTM B209—Aluminum and Aluminum-Alloy Sheet and Plate.
- M. ASTM B211—Aluminum-Alloy Bar, Rod, and Wire.
- N. ASTM B221—Aluminum-Alloy Extruded Bar, Rod, Wire, Shape and Tube.
- O. AWS A2.0—Standard Welding Symbols.

P. AWS D1.1–Structural Welding Code.

1.03 DESIGN REQUIREMENTS

A. All fabrications shall meet applicable code requirements including OSHA.

1.04 SUBMITTALS FOR REVIEW

A. Comply with pertinent provisions of Section 01300–Submittals.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, sections, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

A. Fabricate steel members in accordance with AISC Code of Standard Practice.

B. Mill Test Reports: Submit indicating structural strength and composition.

C. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

1.06 QUALIFICATIONS

A. Qualify welding processes and welding operators in accordance with AWS “Standard Qualifications Procedures.”

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

B. Store all members off the ground using pallets, platforms, or other supports.

C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.

D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

PART 2–PRODUCTS

2.01 MATERIALS–CARBON STEEL

- A. Steel Sections:
 - 1. ASTM A36 (channels, angles, plates).
 - 2. ASTM A992-50 (wide flange sections).
 - 3. Pipe: ASTM A53, Grade B.
 - 4. Tubes: ASTM 500, Grade B.
- B. Sheet Steel: ASTM A570 or A611.
- C. Plain Washers: Round carbon steel complying with FS FF-W-92.
- D. Bolts and Nuts: ASTM A307 Grade A, or galvanized to ASTM A153 for galvanized components for exterior use and where built into exterior walls.
- E. Lock Washers: Helical spring-type carbon steel complying with FS FF-W-84.
- F. Welding Materials: AWS D1.1; E70XX electrodes.
- G. Select fasteners for the type, grade, and class required.

2.02 MATERIALS–STAINLESS STEEL

- A. Unless otherwise noted, all stainless steel shall meet the requirements of ASTM A240 and shall be Type 316L.
- B. If components are not available in Type 316L, other 300 Series type shall be used as approved by ENGINEER.

2.03 MATERIALS–ALUMINUM

- A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.
- B. Sheet Aluminum: ASTM B209, Alloy 3005.
- C. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.
- D. Bolts, Nuts, and Washers: Steel, galvanized to ASTM A153.
- E. Welding Materials: AWS D1.1; type required for materials being welded.

2.04 ACCESSORIES

- A. Stair Treads: Stair treads for aluminum stairs shall be constructed of nonslip grating and shall have an integral nosing. Treads shall be IKG Borden, or equal, serrated, aluminum swage-locked treads with 1 1/4-inch abrasive nosing.

2.05 FABRICATION

- A. Fabrication and Assembly:

1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
 2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
 3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
 5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.
- B. Connections:
1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
 2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
 3. Assemble and weld built-up sections to produce true alignment of axes without warp.
 4. Welding shall be done by the shielded arc process.
 5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.
- C. Workmanship:
1. Use materials of size and thickness shown or, if not shown, of size and thickness to produce strength and durability in the finished product.
 2. Work to dimensions shown or accepted on the Shop drawings using proven details of fabrication and support.
 3. Form exposed work true to line and level, with accurate angles and surfaces, and with straight sharp edges.
 4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing works.
 5. Cap all open ends of pipe and structural tubing.
 6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
 7. Provide for anchorage of the type shown. Coordinate with supporting structures. Fabricate and space the anchoring devices to provide adequate support for intended use.
 8. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive hardware and similar items.

2.06 MISCELLANEOUS METAL FABRICATION

- A. Metal Stairs:
1. Fit and shop-assemble components in largest practical sections for delivery to site.
 2. Fabricate components with joints tightly fitted and secured.
 3. Supply components for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
 4. Treads and risers for metal pan stairs shall be fabricated with 14 gauge sheet steel, closed risers, treads ready to receive concrete.
 5. Aluminum grating stair treads shall be bolted to stringers with aluminum or stainless steel bolts.
 6. Aluminum safety treads shall be screwed to aluminum carrier angles.

- B. Weirs and Baffles: Weirs and baffles shall be fiberglass. See Section 06614–Fiberglass Weirs, Baffles and Troughs for fiberglass.

2.07 FINISHES

- A. Carbon steel surfaces shall be prepared by abrasive blasting to SSPC-SP10 as specified in Section 09900–Painting.
- B. Do not prime surfaces where galvanizing or field welding is required.
- C. Immediately after surface preparation, prime paint carbon steel items with one coat in accordance with manufacturer's instructions and Section 09900–Painting.
- D. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.
- E. Surfaces which will be inaccessible after assembly or erection shall be finish painted prior to assembly or erection.
- F. Galvanizing:
 - 1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
 - 2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in "Recommended Details for Galvanized Structures" as published by the American Hot Dip Galvanizer's Association, Inc.
 - 3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
 - 4. Steel shall conform to ASTM A36 except that the silicone content shall be in the range of 0 to 0.04%.
 - 5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
 - 6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, "Welding Zinc Coated Steel." All uncoated weld areas shall be touched up.
- G. Aluminum shall have a mill finish unless otherwise specified. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

PART 3–EXECUTION

3.01 EXAMINATION

- A. Correct conditions detrimental to the proper and timely completion of the work.

- B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete construction.
- B. Coordinate delivery of such items to project.
- C. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

- A. Setting Precast Anchorages:
 - 1. Clean bearing surfaces free from bond-reducing materials, and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.
 - 2. After the bearing members have been positioned and plumbed, tighten and anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
 - 3. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- C. Cutting, Fitting and Placement:
 - 1. Perform cutting, drilling, and fitting for installation of miscellaneous metal fabrications.
 - 2. Set work accurately in location, alignment, and elevation and make plumb, level, true, and free from rack measured from established lines and levels.
 - 3. Fit exposed connections accurately together to form tight hairline joints.
 - 4. Weld connections which are not to be left as exposed joints, grind joints smooth, and touch-up shop paint coat or galvanizing repair.

3.04 FIELD WELDING

- A. Comply with AWS Code for procedures of manual shielded metal arc welding, appearance and quality of weld made, and methods in correcting welding work.

3.05 TOUCH-UP PAINTING

- A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting in accordance with Section 09900–Painting.

3.06 GALVANIZING REPAIR

- A. Areas damaged by welding, flame-cutting or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16-inch in width.
 - 1. Cold Galvanizing Compound:

- a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
 - b. Areas to be repaired shall be power disc-sanded to bright metal. To ensure that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
 - c. Touch-up paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
 - d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
 - e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
2. Zinc-Based Solder:
- a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
 - b. Areas to be repaired shall be wire brushed.
 - c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.
 - d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

3.07 SCHEDULE

- A. The following schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- B. Guard Posts: Steel pipe, concrete-filled, crowned cap, as detailed; galvanized and field finish paint per Division 9.
- C. Lintels: Shop prime paint finish for interior wall lintels; galvanized finish for exterior wall lintels. Lintels approved by ENGINEER shall be placed over all masonry openings, even though not shown on the drawings. See lintel schedule on the drawings.
- D. Door Frames for Overhead Door Openings: Angle sections; shop prime paint finish.

- E. Aluminum stairs, serrated aluminum treads and landings, mill finish.

END OF SECTION

SECTION 05502

SLIDE GATES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation slide gates and weir gates as listed below and indicated. Slide gates and weir gates shall be complete with gate, guides, framing, operator, and other components as required to make a complete system.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Application:
 - 1. Slide gates and weir gates shall be suitable for use in wastewater streams that in addition, may contain iron salts, polymers, chlorine solution, or sulfur dioxide solutions.
 - 2. Weir gates shall be downward acting and shall form a sharp crested weir. Weir gates shall be used in modulating service to control flow rates.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Fabricated stainless steel slide gates and weir gates shall be Rodney Hunt Series 700 or equal.

2.02 GATE CONSTRUCTION

- A. Disc: The gate disc shall consist of a flat plate reinforced with structural or formed members welded to the plate. The disc is to be designed to limit the deflection of the gate to 1/360 of its span under design head. The working design stresses shall not exceed the lesser of 40% of the yield strength or 25% of the ultimate strength of the material. All disc components shall have a minimum material thickness of 1/4-inch. Provide ultra-high molecular weight polymer bearing bars on each side of gate.
- B. Frame: The gate frame shall consist of guides, invert member, and operator yoke welded or bolted together to form a rigid one-piece frame. The guides shall be of a sandwiched-type construction build up of plates, angles, and formed shapes. The guide slot shall engage the disc plate a minimum of 1 inch. The invert member shall be an angle, channel, or formed shape welded to the bottom of the guide to form a flush surface and to meet with the disc seal. For self-contained gates, the yoke members shall be designed to limit the deflection to 1/360 of its span. The working stresses shall not exceed the lesser of 40% of the yield strength or 25% of the ultimate strength of the material and shall be arranged to permit removing the disc from the frame.

- C. Seals: "J"-type seals shall be attached to the frame to restrict the leakage to the following limits:
 - 1. Under a design seating head of 5 feet (measured from gate invert), the leakage shall not exceed 0.1 gpm per foot of seating perimeter.
 - 2. Under a design unseating head of 5 feet (measured from the gate invert), the leakage shall not exceed 0.2 gpm per foot of seating perimeter.
- D. Stems: Stems shall be Type 304 stainless steel. Stem threads shall be of the cut Acme type. Stems shall be designed to transmit in compression a minimum of 2 times the rated output of the hoist at 40 pounds effort on the crank or handwheel. The L/r ratio of the unsupported stem shall not exceed 200. Stem guides, where required to limit the unsupported stem length, shall be bronze bushed. All gates having widths greater than two times their height shall be provided with two lifting devices connected by a tandem shaft for simultaneous operation.
- E. Stem Covers: Rising stem gates shall be provided with clear butyrate stem covers to provide indication of gate position, permit inspection of the stem threads, and to protect the stem from contamination. The stem cover shall be constructed of clear rigid butyrate. Vent holes shall be provided to prevent condensation.
- F. Provide a horizontal member at 21 inches above the operating floor where handrailing is interrupted by the slide gate.

2.03 MATERIALS

- A. Slide or weir gate components shall be Type 304 stainless steel unless otherwise indicated. All welds shall be passivated at the factory.
- B. "J"-type side seals shall be rubber conforming to ASTM D2000.

2.04 MANUAL OPERATORS

- A. Unless otherwise specified, operation of the gate shall be by an antifriction handwheel bench stand or by crank operation through right angle bevel gears as shown on the drawings. Maximum effort shall not exceed 40 pounds on handwheel or crank to raise gate under full operating head. The lift mechanism shall be capable of withstanding, without damage, a handwheel or crank effort of 200 pounds. Bench stand shall be minimum of 36 inches above operating floor. Where possible, the bench stand shall be 42 inches above the operating floor where the gate interrupts handrailing. If the bench stand must be higher to allow operation of the gate, provide a horizontal member across the yoke at 42 inches above the operating floor. The member shall meet OSHA strength requirements for guardrail.
- B. A suitable side mount operator system shall be provided where the bench stand is located over 48 inches above the operating floor. System shall include right angle bevel gear boxes, stainless steel shafting, and flexible couplings as required for operation 36 inches above the operating floor.

- C. The hoist nut shall be manganese bronze conforming to ASTM B584 C86500. The hoist nut shall be supported on roller bearings. A lubrication fitting shall be provided for lubrication of the hoist bearings without disassembly of the hoist. Suitable seals shall be provided to prevent entry of foreign matter. The direction of handwheel or crank rotation to open the gate shall be clearly and permanently marked on the hoist. Where the actuators will be interconnected, it shall be by a flexible coupling and stainless steel tubing.

2.05 ANCHOR BOLTS

- A. CONTRACTOR shall provide anchor bolts necessary for equipment furnished. Anchor bolts shall be Type 304 stainless steel and shall be of ample strength for intended service. Provide anchor bolts in accordance with Section 05560–Anchor Bolts, Expansion Bolts and Resin Anchors.

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 05520

HANDRAILS AND RAILINGS

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes aluminum handrails, railings, and fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM B241—Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

1.03 DESIGN REQUIREMENTS

- A. Handrail shall be designed in accordance with and meet the applicable requirements of the Occupational Safety and Health Act and the 2003 International Building Code.

PART 2—PRODUCTS

2.01 ALUMINUM RAILING SYSTEM

- A. Provide a mechanically joined pipe railing system, Tabco 2500 Railing System as manufactured by Tuttle Aluminum and Bronze Co. or equal.
- B. Rails shall be ASTM B241, Aluminum Alloy 6063-T6, Schedule 40, 1 1/2-inch-diameter pipe extrusion.
- C. Posts shall be ASTM B241, Aluminum Alloy 6063-T6, 1 1/4-inch by 2 1/4-inch tube extrusion.
- D. Furnish and install 4-inch by 1/4-inch toeboards as shown on the drawings.
- E. Provide expansion joints in railing and toeboards at expansion joints in structures and as necessary to prevent buckling or buildup of stresses. Expansion joints shall occur within 1 foot of posts.
- F. Finished joints shall be smooth.
- G. All rails, posts, toeboards, and connectors shall have a M12C22A41 clear anodized finish.
- H. Posts shall be anchored to the top of walls and decks with a flange base plate. Base plate shall reinforce the bottom end of the post as required to meet OSHA design criteria.
- I. Stainless steel expansion bolt anchoring system, in accordance with manufacturer's recommendations, shall be used.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install all railing in accordance with approved shop drawings and manufacturer's instructions providing a complete installation.
- B. Install components plumb and level, accurately fitted, and free from distortion or defects.
- C. Clean all components as recommended by railing manufacturer.

END OF SECTION

SECTION 05531

GRATINGS AND FLOOR PLATES

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes floor and stair tread grating and checkered floor plate.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A123—Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1.03 PERFORMANCE REQUIREMENTS

- A. Floor grating shall be designed for a maximum deflection of 1/4 inch when supporting a 100 psf uniform load.
- B. Plate thickness shall be determined based on a maximum deflection of L/150 of the short side or a stress of 15,000 psi under a 100 psf uniform load. The larger plate thickness shall govern.

1.04 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

PART 2—PRODUCTS

2.01 ALUMINUM FLOOR GRATING

- A. All grating, unless otherwise specified, shall be rectangular bar style, swage-locked aluminum floor grating with serrated surface.
- B. Acceptable manufacturers include the following or equal: IKG Borden, Type BS.
- C. All edges of the grating and all openings in the grating for pipe and miscellaneous equipment shall be banded by welding on minimum 1/8-inch-thick bars. The band shall have less depth than the bearing bars to permit drainage.
- D. Individual sections shall be of a size to permit ease in handling with a maximum length not in excess of 8 feet.
- E. Where possible, provide a 12-inch-wide section of grating over each stop gate and over each valve operating nut.

- F. All aluminum grating support angles shall be aluminum. Support angles shall be provided at the bearing ends of all grating. This includes locations such as wall openings and corners.
- G. For aluminum grating stair treads, refer to Section 05500–Metal Fabrications.
- H. Provide 4-inch by 1/4-inch toeboards anchored to edge of grating at all slide gates in grated areas.

2.02 ALUMINUM CHECKERED FLOOR PLATE

- A. Aluminum checkered plate shall be manufactured from aluminum alloy 6061-T6.
- B. Where shown on the drawings, aluminum plate shall be insulated with 2-inch-thick polystyrene foam cemented and mechanically attached securely to aluminum floor plate.
- C. Support angles for floor plate shall be aluminum.
- D. Provide hand hole in each plate.
- E. Plate size shall be limited to a maximum weight of 40 pounds.

2.03 FINISHES

- A. Any aluminum in contact with concrete shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

PART 3–EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes and dimensional tolerances are acceptable.
- B. Verify that supports are correctly positioned.

3.02 INSTALLATION

- A. Place frames and supports in correct position, plumb and level.
- B. All aluminum floor grating shall be secured to supporting members with aluminum or stainless steel saddle clips supplied by the grating manufacturers. Stud bolts and other hardware shall be supplied by CONTRACTOR.

END OF SECTION

SECTION 05560

ANCHOR BOLTS, EXPANSION BOLTS, AND ADHESIVE ANCHORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Anchor bolts, expansion bolts, and adhesive anchors.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36/A36M—Structural Steel.
- B. ASTM F1554—Anchor Bolts, Steel, 36, 55, and 105-ksi yield strength.

PART 2—PRODUCTS

2.01 ANCHOR BOLTS

- A. Anchor bolts complete with washers and nuts shall be fabricated as shown or as specified by the equipment manufacturer and unless otherwise indicated shall be hot-dip galvanized carbon steel or 316 stainless steel. Anchor bolts shall, as a minimum, conform to the requirements of ASTM F1554-Grade 36.
- B. Stainless steel anchor bolts shall be used in all submerged locations, below final grade, and in contact with aluminum and other items not to be painted. Galvanized anchor bolts shall be used elsewhere.

2.02 EXPANSION BOLTS

- A. Expansion bolts shall be Power-Stud+SD2 by Powers Fastening Systems, Strong Bolt by Simpson Strong-Tie Anchor Systems, or equal.
- B. Expansion bolts will not be permitted as substitutes for embedded anchor bolts except with the prior written acceptance of ENGINEER or where otherwise specifically called for.
- C. Unless indicated otherwise on the drawings or specified, use the following bolt material for the various installation situations:
 - 1. Stainless Steel: For all submerged locations, below final grade, and in contact with aluminum appurtenances and other items not to be painted. Also for anchoring equipment, unless otherwise specified.
 - 2. Steel: In other locations in contact with items to be painted or encased in concrete.

2.03 ADHESIVE ANCHORS

- A. Adhesive anchors shall be PE1000+ by Powers Fastening Systems, Set-XP by Simpson Strong-Tie Anchor Systems, or equal.

PART 3-EXECUTION

3.01 ANCHOR BOLTS

- A. Anchor bolts for structural members shall be located as shown and specified.
- B. Anchor bolts for mechanical equipment shall have embedment length, edge distances, and spacing as required by the equipment manufacturer.
- C. All dirt or foreign materials shall be removed prior to embedding into concrete. After anchor bolts have been embedded, their threads shall be protected by grease and by installing the nuts or by other means until the time of installation of the equipment or metal work.

3.02 EXPANSION BOLTS

- A. Unless otherwise noted on the drawings, expansion bolt edge distance and spacing shall be in accordance with manufacturer's recommendations.
- B. Bolt embedment shall at least equal six bolt diameters.
- C. All procedures shall be in accordance with the manufacturer's recommendations.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and bolts and shall be located to clear reinforcing steel.

3.03 ADHESIVE ANCHORS

- A. At locations shown on the drawings, reinforcing bars or threaded rod shall be provided in existing concrete by drilling holes, injecting epoxy adhesive, and inserting the reinforcing bar.
- B. All existing surfaces to receive adhesive anchors, including the entire area in contact with the new concrete, shall be cleaned and roughened to amplitude of 1/4 inch.
- C. All procedures shall be in accordance with the manufacturer's recommendations.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and bolts and shall be located to clear reinforcing steel.

END OF SECTION

SECTION 06112

WOOD FRAMING AND SHEATHING

PART 1—GENERAL

1.01 SUMMARY

- A. Work included:
 - 1. Structural wall and roof framing.
 - 2. Wall and roof sheathing.
 - 3. Miscellaneous framing and sheathing.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ALSC—American Lumber Standards Committee.
- B. APA—American Plywood Association.
- C. AWWA—American Wood Preservers Association.
- D. NFPA—National Forest Products Association.
- E. NLGA—National Lumber Grades Authority.
- F. SPIB—Southern Pine Inspection Bureau.
- G. WCLIB—West Coast Lumber Inspection Bureau.
- H. WWPA—Western Wood Products Association.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber and other building materials and keep under cover both in transit and at the job site. Protect from dampness. Stack framing lumber and plywood to insure proper air circulation. Locate stacks on well-drained areas. Support 6 inches above grade and protect with waterproof cover.

PART 2—PRODUCTS

2.01 MATERIALS

- A. Lumber shall be kiln-dried with moisture content not to exceed 19% at time of installation and grade marked according to the National Lumber Manufacturer's Association.
- B. All studs shall be 2 inches by 4 inches nominal or 2 inches by 6 inches nominal as shown on the drawings and shall be No. 2 Douglas Fir, No. 2 Southern Pine, or better.

- C. Plywood roof and wall sheathing shall be grade C-D Ext., or better, graded in accordance with the American Plywood Association.
- D. Wood sills, plates, blocking, etc., to be same grade as studs.

PART 3—EXECUTION

3.01 FRAMING

- A. General: All rough framing lumber and all other wood framing, studs blocking, and furring shall be accurately set to required lines and levels, closely fitted, shimmed, and rigidly secured in place.
- B. Place all wood studs in sizes as shown and spaced at 16 inches o.c., unless noted otherwise. Erect studs on single bottom and single top plate at nonbearing walls, double studs at all openings, triple studs at corners. Install blocking between studs as required. Bolt plates and blocking to concrete at 32-inch centers, unless noted otherwise. Space framing to receive electrical piping or ductwork without cutting joist. Verify all duct and piping runs prior to framing to eliminate conflict. Stud walls shall extend a minimum of 8 inches above the ceiling line. Stud walls shall be adequately braced off of other stud walls and/or masonry walls.
- C. Construct load bearing, framing, and curb members full length without splices.
- D. Provide double studs at openings over 24 inches wide. Space short studs over and under opening to stud spacing.
- E. Unless shown otherwise, provide double joists at floor and ceiling openings over 24 inches wide and under wall stud partitions that are parallel to floor joists. Frame rigidly into joists.
- F. Unless shown otherwise, provide mid-span bridging between joists spanning 12 feet or more. Unless shown otherwise, provide solid wood blocking at ends of joists placed between alternate joist spaces.

3.02 PLYWOOD SHEATHING

- A. Plywood sheathing shall be nailed at 6 inches on center at edges and 12 inches on center at intermediate supports with 8d common nails.
- B. Secure roof sheathing perpendicular to framing members with ends staggered and sheet ends over firm bearing. Use sheathing clips between sheets between roof framing members, or provide solid edge blocking between sheets.
- C. Secure wall sheathing with long dimension perpendicular to wall studs with ends over firm bearing and staggered.

3.03 CONNECTIONS

- A. All framing connections and nailing shall be in accordance with the details shown and/or the 2003 International Building Code minimum requirements, whichever is more restrictive.

- B. Framing connectors shall be Simpson Strong Tie or equal. Connector numbers shown on details are Simpson. Submit engineering data on any substitutes.
- C. Connectors shall be installed in accordance with manufacturer's requirements.

END OF SECTION

SECTION 06114

WOOD BLOCKING AND CURBING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Roof curbs and cants.
 - 2. Wood blocking.
 - 3. Wood furring and grounds.
 - 4. Preservative treatment of wood.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ALSC–American Lumber Standards Committee.
- B. AWWPA–American Wood Preservers Association.
- C. NFPA–National Forest Products Association.
- D. NLGA–National Lumber Grades Authority.
- E. SPIB–Southern Pine Inspection Bureau.
- F. WCLIB–West Coast Lumber Inspection Bureau.
- G. WWPA–Western Wood Products Association.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300–Submittals.
- B. Certification of type of wood and wood treatment to be used.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be thoroughly sealed and protected from weather during transport and at the job site. Protect from dampness.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Lumber for roof curbs, cants, blocking, furring, and grounds shall be “standard” grade Douglas Fir, No. 2 Southern Pine, or better, graded in accordance with the WWPA, WCLIB, NLGA, or SPIB grading rules as applicable. Lumber shall bear the grading agency’s stamp.
- B. Wood shall be kiln-dried with moisture content not to exceed 19% at time of installation.
- C. All lumber furnished under this section shall be pressure-treated with a chromated copper arsenite (CCA) waterborne preservative to a minimum retention of 0.40 pounds per cubic foot. Acceptable products include Hoover Treated Wood Products CCA, Wood Preserving Co. Osmose CCA, or equal. Cuts shall be treated in the field with a brush-on waterborne preservative compatible with the pressure treatment.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Provide and install wood curbs, cants, blocking, furring, and grounds of proper size and shape where shown on the drawings and where required to secure other work or equipment in place.
- B. Members shall be installed true to lines, level, plumb, and secure.
- C. Connections and nailing shall be in accordance with the details shown and/or the 2003 International Building Code minimum requirements, whichever is more restrictive.
- D. Apply brush-on wood preservative treatment to cuts in accordance with manufacturer’s recommendations.

END OF SECTION

SECTION 06193

PLATE CONNECTED WOOD TRUSSES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All materials, equipment, and labor necessary for the prefabrication, delivery, and permanent setting of wood trusses on buildings.
 - 2. Bridging.
 - 3. Temporary and permanent bracing.
 - 4. Related hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ALSC—American Lumber Standards Committee.
- B. APA—American Plywood Association.
- C. ASTM A167—Stainless and Heat-Resisting Chromium–Nickel Steel Plate, Sheet, and Strip.
- D. ASTM A653—Sheet Steel, Zinc-Coated (Galvanized) by the Hot Dip Process, (Structural Physical) Quality.
- E. AWWA—American Wood Preservers Association.
- F. NFPA—National Forest Products Association.
- G. SPIB—Southern Pine Inspection Bureau.
- H. TPI—Truss Plate Institute.
- I. WWPA—Western Wood Products Association.

1.03 DESIGN REQUIREMENTS

- A. The basic design loads shall be in accordance with the 2003 International Building Code.
- B. Dead Loads and Collateral Loads: Trusses shall be designed for a Top Chord dead load of 10 psf.
- C. Live Loads:
 - 1. Roof live loads shall be computed in accordance with the 2003 International Building Code using a ground snow load of 20 psf, a snow load importance factor of 1.1, and snow exposure and thermal factors as per Code. Minimum roof live load shall be 20 psf. Snow load and minimum roof live load shall be applied to the top chord.

2. Design for unbalanced snow loads in accordance with the building code.
 3. Design for sliding and drifted snow loads as shown on the drawings.
 4. Roof live loads shall be applied to the horizontal projection of the roof.
- D. Wind Loads:
1. Wind loads shall be computed in accordance with the 2003 International Building Code using a 3-second gust wind speed of 60 mph, exposure category C, and an importance factor of 1.15.
- E. Concentrated Loads: Design for any concentrated loads shown on the drawings.
- F. Combination of Loads: The combining of loads for design purposes shall be as prescribed with the 2003 International Building Code.

1.04 SUBMITTALS

- A. Submittals shall be as in Section 01300–Submittals.
- B. Professional Engineer: All truss designs shall bear the name and seal of a State of Illinois Licensed Structural Engineer. CONTRACTOR shall be responsible for submitting the required additional copies of truss drawings with original stamp and signature for submittal to the State of Illinois. These materials must be submitted prior to installation.
- C. Truss designs shall include the following information: Pitch, span, dimensions, and spacing of trusses; truss bearing sizes and locations; design loading of truss and allowable stress increase; axial forces in each truss member; nominal sizes and location of connector plates at all joints; size, species, and stress of grade of lumber for all truss members; camber; permanent lateral bracing as required by design to reduce buckling length of individual truss members; and handling and erection recommendations. Where sheathing is not attached directly to truss bottom chords, provide bottom chord bracing and bridging as required by design to resist wind uplift loads.

1.05 QUALITY ASSURANCE

- A. The design and fabrication criteria of all wood trusses shall meet the following:
1. "National Design Specifications for Stress-Grade Lumber and its Fastenings," by National Forest Products Association (latest revision).
 2. "Timber Construction Standards," by American Institute of Timber Construction (latest revision).
 3. "Design Specifications for Light Metal Plate Connected Wood Trusses," by Truss Plate Institute (latest revision).
 4. 2003 International Building Code.
- B. Fabricator Manufacturer: Minimum three years experience in successful fabrication of trusses comparable to type indicated for this project.
- C. Design Trusses under direct supervision of a Structural Engineer experienced in design of this work and licensed in the State of Illinois.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Fabricated trusses and subcomponents shall be so handled and stored that they are not subject to damage.
- B. If the trusses are to be stockpiled prior to erection, sufficient bearing points and/or bracing shall be provided to prevent excessive lateral bending or tipping over.

PART 2-PRODUCTS

2.01 MATERIALS

- A. Lumber:
 - 1. All lumber used for truss members shall be Spruce-Pine-Fir, Douglas Fir, Southern Pine, Hem-Fir, or Western Larch and shall conform to lumber for trusses and shall have a minimum nonrepetitive fiber bending strength of 1,050 psi. If design calls for use of a lumber with greater strength, then that lumber shall be used for the associated members.
 - 2. At the time of delivery, the moisture content of all lumber shall not exceed 19% kiln-dried.
 - 3. All lumber shall conform to the species and shall be fully recognized nominal sizes shown on the drawings or truss engineering design.
 - 4. All members shall be cut from lumber which bear the proper grade-mark stamps of a licensed lumber inspection agency.
- B. Connectors:
 - 1. All truss connector plates shall be manufactured from ASTM A653, Grade A, prime commercial quality galvanized sheet steel of no less than 20 gauge thickness which has a minimum yield of 33,000 psi and a minimum ultimate tensile strength of 45,000 psi.
 - 2. The corrosion-resistant coating shall be ASTM A924, "Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements; Coating Designation C90 or G60, or ASTM A591, Standard Specification for Electrolytic Zinc-Coated Steel Sheets," Coating Class C, or such treatment as will give equivalent corrosion protection.
 - 3. The connectors shall have a series of nail-like projections which are designed to separate the fibers of the wood into which they are pressed in accordance with accepted nailing practices.
 - 4. Where field-assembly of truss subcomponents is necessary, the connections shall be in accordance with the details shown on the truss design drawings, approved by a Professional Engineer.

2.02 FABRICATION

- A. All trusses and other roof structural components shall be fabricated in a properly equipped manufacturing facility of a permanent nature. They shall be manufactured by experienced workmen using precision cutting and truss fabricating equipment under the direct supervision of a qualified foreman. All trusses shall be fabricated under strict rules of inspection and quality control as the local code may require and be open to the observation of ENGINEER or his representative at all times.

- B. All truss members shall be accurately cut to length, angle, and be true to line to assure tight joints for finished truss.
- C. All truss members and connector plates shall be properly placed in special jigs and the members tightly clamped in place remaining in that position until the connector plates have been pressed into the lumber simultaneously on both sides of the joints.
- D. Camber shall be built into the trusses, as noted on the engineering truss designs, by properly positioning the members in the fabricating jig. No camber will be allowed on the bottom chord.

PART 3-EXECUTION

3.01 ERECTION

- A. Install trusses in accordance with manufacturer's instructions and TPI BWT (latest revision).
- B. Framing anchors and/or truss hangers shall be provided by CONTRACTOR, as required, or detailed to withstand all loads, both dead and live, as well as wind and transfer loads to bearing.
- C. Field erection of the trusses, including items such as handling, safety precautions, and temporary bracing to prevent toppling or the domino effect on the trusses during erection, and any other safeguards or procedures consistent with good workmanship and good building erection practices, shall be employed.
- D. During the entire construction period, all contractors shall provide means for adequate distribution of concentrated loads so that the carrying capacity of any one truss and/or other component is not exceeded.
- E. Proper erection bracing shall be installed to hold the trusses true and plumb and in safe condition until permanent truss bracing and bridging can be solidly nailed in place to form a structurally sound roof framing system. All erection and permanent bracing shall be installed and all components permanently fastened before the application of any loads. Provide all permanent bracing necessary for truss stability. Where sheathing is not attached directly to truss bottom chord and where required by design, provide bottom chord bracing and bridging as required to resist wind uplift loads.
- F. Frame openings between trusses with lumber in accordance with Section 06112-Wood Framing and Sheathing.

END OF SECTION

SECTION 06610

FIBERGLASS FABRICATIONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes fiberglass structural shapes (angles, channels, I-beams, tubes, bars, plates, etc.), fiberglass ladders, and fiberglass handrail.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALIFICATIONS

- A. Manufacturer of fiberglass structural shapes, ladders, and handrail shall have a minimum of five years of verifiable experience in the manufacture and fabrication of pultruded fiberglass structural shapes and fabrications.

PART 2—PRODUCTS

2.01 FIBERGLASS STRUCTURAL SHAPES

- A. Fiberglass structural shapes shall be manufactured by the pultrusion process using the following materials:
 - 1. Isophthalic polyester resin with flame-retardant additive.
 - 2. Glass fiber reinforcing consisting of both continuous strand mat and continuous strand longitudinal fiber (roving).
 - 3. Surfacing veil of polyester nonwoven fabric.
 - 4. UV inhibitor.
- B. Acceptable product lines include the following or equal:
 - 1. Extren Series 525 by Strongwall Extren.
 - 2. Pultex Series 1525 by Creative Pultrusions, Inc.
 - 3. Dynaform ISOFR system by Fibergrate Composite Structures, Inc.
- C. Sections shall be constructed of materials recommended for use in a submerged condition in contact with wastewater and with chlorine at any concentration.
- D. Provide 1/8-inch fiberglass gritted plate cover to fiberglass grating where shown on the plans.

2.02 FASTENERS/ADHESIVES

- A. Unless noted otherwise, all bolts, nuts, and washers shall be Type 316 stainless steel as specified in Section 05120—Structural Steel. Fiberglass bolts, nuts, and washers shall be Dynaform as manufactured by Fibergrate Composite Structures, Inc., FibreBolt as manufactured by Strongwell, or equal.

- B. Adhesive resin used for joining sections and for sealing cut edges shall be approved for use by the manufacturer.

2.03 FIBERGLASS LADDERS

- A. Fiberglass ladders shall be designed in accordance with OSHA requirements. All ladder components shall be fabricated to support a rung load of 350 pounds with a safety factor of 1.5.
- B. Ladder and cage shall be Dynarail, fabricated from Dynaform ISOFR with safety yellow pigment and produced by Fibergrate Composite Structures, Inc., or equal.
- C. Ladders that are located outdoors shall be factory coated with a UV resistant coating.

2.04 FIBERGLASS HANDRAIL

- A. The fiberglass handrail system shall be fabricated into finished sections by fabricating and joining together the pultruded square tube using molded internal connecting plugs and spiral grooved pultruded rod epoxy bonded and joined together as shown on the drawings.
- B. Kickplate shall be 4-inch by 1/2-inch by 0.125-inch-thick pultruded fiberglass shape and shall be attached to the handrail posts with nylon drive rivets. Rails and posts shall be 2-inch by 2-inch by 0.156-inch-square tube manufactured by pultrusion process.
- C. The FRP handrail system shall be designed to meet the configuration and loading requirements of OSHA with a minimum factor of safety on loading of 2.0. Handrail shall be capable of withstanding a load of 200 pounds applied at any point noncurrently, vertically, downward, or horizontally.
- D. Handrail system shall be Dynarail, fabricated from Dynaform ISOFR, with safety yellow pigment and produced by Fibergrate Composite Structures, Inc., or equal.
- E. All shop fabricated cuts are to be coated with a vinyl ester resin to provide maximum corrosion resistance. Field cuts are to be similarly coated by CONTRACTOR in accordance with the manufacturer's instructions.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Installation/erection of components shall be in accordance with the design drawings and shop drawings.
- B. All cut edges shall be sealed with a resin recommended by the manufacturer.

END OF SECTION

SECTION 06611

FIBERGLASS GRATING

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes fiberglass grating.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 DESIGN REQUIREMENTS

- A. Grating shall be designed to safely support a uniform load of 100 psf. Deflection shall be limited to 1/360 of the span or 1/4 inch, whichever is less.

PART 2–PRODUCTS

2.01 GRATING

- A. Fiberglass grating and stair treads shall be manufactured by the wet lay-up (molded) process using the following materials:
 - 1. Isophthalic polyester resin with flame-retardant additive. Resin content shall be a minimum of 60% and fiberglass a maximum of 40% by weight.
 - 2. Continuous strand glass fiber roving woven at intersections of bearing bars and cross bars.
 - 3. UV inhibitor.
- B. Acceptable products include the following or equal:
 - 1. Rectangular Bar Style:
 - a. Duragrate Series by Strongwell.
 - b. Chemgrate and Fibergrate by Fibergrate Composite Structures, Inc.
 - 2. I-Shaped Bar Styles:
 - a. Duragrate Series by Strongwell.
 - b. Safe-T-Span by Fibergrate Composite Structures, Inc.
- C. Grating shall be of depth required to meet design requirements.
- D. Rectangular bar-style grating bars shall be tapered to promote self-cleaning.
- E. Angular silica particles shall be integrally embedded in the top surface of the grating to create an antislip surface. The tips of the bearing bars and cross bars shall be in the same plane to maximize the antislip top surface area.
- F. Provide 316 stainless steel hold down clips for all grating. Hold down clips for covered fiberglass grating panels shall not damage fiberglass covered panels specified in Section 06610–Fiberglass Fabrications.

- G. Individual grating sections shall be of a size to permit ease of handling with a maximum length not in excess of 8 feet.

2.02 GRATING SUPPORT ANGLES

- A. Grating support angles shall be provided as detailed on the drawings and in accordance with Section 06610—Fiberglass Fabrications. Support angles shall be provided under all edges of grating. Support angles shall be mitered at corners.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install grating in accordance with design drawings, shop drawing, and grating manufacturer's written instructions.
- B. Field cut or sanded surfaces shall be coated with resin furnished by the manufacturer and applied in accordance with manufacturer's instructions.
- C. Provide a 1/8-inch to 1/4-inch gap between adjacent grating panels.

END OF SECTION

SECTION 06612

FIBERGLASS STOP GATES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Stop gates and grooves.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 DESIGN REQUIREMENTS

- A. The gates shall be designed to deflect less than 1/360 of the horizontal span of the gate under full differential head.

1.03 SUBMITTALS FOR REVIEW

- A. Comply with pertinent provisions of Section 01300–Submittals.
- B. Shop Drawings: Indicate number, sizes, handles or handholes, anchorage, size and type of fasteners, accessories, and deflection calculations.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to job site properly marked to identify the gate for which it is intended and at such intervals to ensure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.
- B. Store all members off the ground using pallets, platforms, or other supports.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.
- D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Stop gates shall be Fiberglass-Reinforced Polyester Hand Lift Stop Plates as manufactured by Plasti-Fab of Oregon or equal.
- B. Stop plate core, when required, shall be high-density polyurethane closed cell foam for high rigidity, high strength, and water-resistant integrity.

- C. Stop gate grooves shall be of fiberglass as stated for stop gates.
- D. Mounting hardware shall be of cast Type 316 stainless steel construction.

2.02 FABRICATION

- A. Stop gate shall be individually molded of Fiberglass-Reinforced Polyester to the exact size, to provide resin-rich sealed edges. Both sides of the plates shall be faced with a 10 mil C-Veil and finished smooth with a layer of ultraviolet inhibited resin to provide for weather and corrosion resistance. Stop plates shall be provided with a sandwich core. The stop plates shall be laminated with a sandwich core where required to meet design requirements.
- B. Stop gate grooves shall be assembled continuous on sides and bottom.
- C. Guide frames built up from plate or structural shapes will not be acceptable.
- D. Mounting hardware, if required, shall be of size and type recommended by the manufacturer, shall be Type 316 stainless steel, and shall be provided as part of the stop plate groove.
- E. Metal stiffeners shall not be used.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Stop gate grooves shall installed in accordance with manufacturer's recommendations.
- B. Stop gate grooves shall be anchored in forms so that plate bearing surface remains in a vertical plane.

3.02 SCHEDULE

- A. See drawings for stop gate schedule.

END OF SECTION

SECTION 06614

FIBERGLASS WEIRS AND BAFFLES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Fiberglass weirs and baffles as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/AWWA F102-Matched-Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles, and Mounting Brackets; American Water Works Association.
- B. ANSI/NSF-61 Standard.
- C. ASTM D 570-Standard Test Method for Water Absorption of Plastics.
- D. ASTM D 638- Standard Test Method for Tensile Properties of Plastics.
- E. ASTM D 790- Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- F. ASTM D 2583- Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

1.03 QUALITY ASSURANCE

- A. Manufacturer shall maintain a continuous quality control program and shall, upon request, furnish ENGINEER with certified test reports of physical properties.
- B. Weir plates, baffles, and mounting brackets shall be fabricated to ANSI/AWWA F102-96 Standards.

1.04 PACKING AND STORAGE

- A. Should it be necessary to store product prior to installation, precautions should be taken to prevent warpage or distortion, and provide protection from construction traffic and damage.

PART 2–PRODUCTS

2.01 WEIRS AND BAFFLES

- A. Weirs and baffles shall be stainless steel or fiberglass. See Section 05500–Metal Fabrications for stainless steel.

- B. Fiberglass shall be as manufactured by Warminster Fiberglass Company, NEFCO Incorporated, or equal. All fasteners and anchors shall be type 304 stainless steel of size and type recommended by manufacturer of weirs and baffles.
- C. The weirs, scum baffles and supports shall be polyester plastic resin, reinforced with glass fiber. All weir plates, weir washers, weir splice plates, scum baffle panels, scum baffle splice plates and baffle support brackets shall be fiberglass reinforced plastic molded to produce uniform smooth surfaces. The surface shall be resin rich, free of voids and porosity, without dry spots, crazes or unreinforced areas and shall provide for increased corrosion resistance and UV protection. All edges shall be sealed in the mold. The weirs and scum baffles shall be green in color.
- D. Laminate will have Type "C" (chemical) glass surfacing mat, 10 to 20 mils thick, with a silane finish and a styrene soluble binder, on both sides. Required thickness will be achieved using the appropriate number of piles of Type "E" (electrical borosilicate) glass mat with chrome or silane finish and a styrene soluble binder. Glass content of laminate will be $28 \pm 3\%$ by weight. Resin filters shall be $40 \pm 2\%$ of the resin mixture. Final laminate thickness shall be within $\pm 10\%$ of the nominal specified thickness.
- E. The fiberglass laminate shall have the following minimum physical properties:

		Test Method
Tensile strength	14,000 psi	ASTM D638
Flexural strength	25,000 psi	ASTM D790
Flexural modulus	1.0×10^6	ASTM D790
Impact, Notched, Izod, foot pound per inch	15.0	ASTM D256
Barcol hardness	40 Min. Aver.	ASTM D2583
Water absorption, % 24 hours	0.1%	ASTM D570
Average coefficient of thermal expansion inch per inch per °F	10.5×10^{-6}	ASTM D696

- F. All machined or cut edges shall be sealed with Polyester Resin.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install weirs and baffles in accordance with details shown on the drawings using Type 316L stainless steel or fiberglass connection hardware.
- B. Weirs and scum baffles shall be installed level to within $\pm 1/8$ -inch.
- C. All weir splices and connections shall be watertight. Provide splice plates as required.

END OF SECTION

SECTION 06616

FIBERGLASS REINFORCED PLASTIC CHEMICAL TANKS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes providing and placing into successful operation a single-wall filament-wound fiberglass-reinforced plastic (FRP) chemical storage tank as shown on the drawings. Tank PRCT-20-01 shall be used for storing 37% to 42% ferric chloride, 30% ferrous chloride, or 50% alum. Provide all labor, equipment, and material for complete and proper installation, testing, and start-up for the storage tank.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements: Tank PRCT-20-01 shall be used to store up to 37% to 42% ferric chloride, 30% ferrous chloride, or 50% alum. The tank will be located on the exterior of the Screening Building.
- B. Performance Requirements:
 - 1. Tanks shall be manufactured in accordance with ASTM D-3299-88.
 - 2. Tanks shall be inert to the chemical being stored.
 - 3. Tank PRCT-20-01 shall be capable of storing up to 37% to 42% ferric chloride, 30% ferrous chloride, or 50% alum. Tank shall have minimum capacity of 5,804 gallons to the overflow.
- C. Design Requirements: Manufacturer shall design tank for Seismic Site Class D per the International Building Code, 2003 Edition.

1.03 WARRANTY

- A. The tank manufacturer shall warranty the tanks and all appurtenances against defects in workmanship and against chemical incompatibility for a period of 5 years. The warranty shall be in printed form.

PART 2—PRODUCTS

2.01 MANUFACTURERS

- A. The chemical tanks shall be similar in construction and physical appearance and shall be manufactured by Belding Tank Technologies, Inc., Belding Michigan, Plas-Tanks of Fairfield Ohio, Viatic of Belding, Michigan, or equal.

- B. The drawings and specifications were prepared based on Belding Tank Technologies. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural and mechanical work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 GENERAL

- A. It is the intent of this specification that the tank provided be capable of storing the listed chemicals at the specified concentrations at ambient exterior temperatures; manufacturer shall certify. Tanks shall have like appearance in shape, color, and accessories provided with the tank.

2.03 TANK CONSTRUCTION

- A. All materials used for construction of the tanks and accessories shall be compatible with the chemical being stored. Tank shall be a grade 1 vinylester resin.
- B. Tank PRCT-20-01 have an inside diameter of 10 feet and overall height of 140 inches and shall be Belding Model C-CSV-1-10, or equal. Tank shall have an internal sloped bottom 1/4-inch per foot to suction flange and a dome top.
- C. A boxout shall be provided on the concrete tank base to allow clearance/support for the side bottom flange. CONTRACTOR shall confirm size and location of the boxout with the equipment manufacturer. Side bottom flange shall allow complete drainage of tank.
- D. Tie down lugs shall be constructed of FRP with 316 stainless steel clamps, anchor bolts, and nuts. An adequate number of tie down lugs and anchor bolts shall be provided to prevent floatation of tank in the event that the respective containment area is filled with chemical solution contained in tank to a depth of 5 feet. Provide anchor bolts in accordance with Division 5.
- E. Lift lugs shall be constructed of FRP.
- F. Tanks shall be provided with reinforced inlet and outlet nozzles, vents, and other penetrations as shown on the drawings.
- G. A six-inch-diameter penetration shall be provided with blind flange on the specified tanks to accept 2-inch NPT connection for an ultrasonic level transducer. Locate penetration next to the manway as shown on the drawings. CONTRACTOR shall coordinate blind flange with Division 16 Contractor.
- H. All flanged nozzles shall be full plate gusseted.
- I. 30-inch gasketed manway with bolted on cover shall be located on the top of tank. Gaskets shall be EPDM. All hardware for the manway shall be FRP.
- J. Each tank shall be provided with a sight glass assembly and calibrated gradation strip incremented in gallons for measuring the volume of the chemical in the tank. Calibration strip shall be marked at a minimum of 25-gallon increments.

- K. A sight glass assembly shall include isolation PVC union ball valves and pipe support brackets for easy replacement of 1-inch sight glass. Sight glass to be 1-inch schedule 40 clear PVC. Location shall be as shown on drawings.
- L. The laminate comprising the structural tank (bottom head, sidewall, and top head) shall consist of four separate laminates. These are the inner surface and the interior layer which make up the corrosion barrier, the structural layer, and the outer surface.
- M. The inner surface exposed to the chemical environment shall be a resin-rich layer 0.010- to 0.020-inch-thick reinforced with a surfacing veil. The glass content shall be 10% by weight maximum in this layer.
- N. The interior layer shall consist of a resin-rich laminate reinforced with chopped strands. The glass content shall be 27%, 5% by weight. The combined thickness of the inner surface and the interior layer shall not be less than .100-inch.
- O. Subsequent reinforcement shall be continuous strand roving. Glass content of the filament wound structural layer shall be 60% to 70% by weight. The thickness of the filament wound portion of the tank shell will vary with tank height (tapered wall construction). If additional axial strength is required, the use of chopped strands or unidirectional glass strands interspersed between wind layers is acceptable.
- P. Exterior shall be finished with a 10 mil thick translucent protective resin coating for spill protection with ultraviolet inhibitors.
- Q. Provide internal and external 4-inch overflow pipe on each tank as shown on drawings.

2.04 COLD WEATHER PROTECTION

- A. The storage tanks shall be supplied with a complete heat panel system including a sufficient number (minimum of four) of Eagle, or equal, tank heating panels, 500 watt, 120 volt minimum, to maintain a fairly constant temperature of the phosphorus removal chemical of 40°F with an outside temperature of -20°F. The heat panel system shall contain a product control thermostat and a panel overheat thermostat to protect tank and contents from damage. The heating panels and thermostats shall be preinstalled and prewired to a NEMA 4X solid state temperature controller. Enclosure shall be equipped with a pilot light to indicate when heating panels are on.
- B. The storage tank shall be coated with 2 inches of 2-pound polyurethane foam insulation with fiberglass exterior coating on top and sides of tank suitable for outside protection.
- C. All suction piping and valves located outside and within chemical tank spill containment vessel shall be heat traced and insulated.

PART 3-EXECUTION

3.01 GENERAL

- A. See Division 1 for requirements related to equipment installation, field quality control, testing, supervision, and startup.

3.02 EQUIPMENT INSTALLATION

- A. Provide two layers of 30-pound roofing felt as a buffer between base pad and tank bottom.
- B. CONTRACTOR shall coordinate tank installation with existing clearances to avoid conflicts.
- C. Chemical-resistant coating shall be in place and allowed to properly cure prior to installation of tanks.

END OF SECTION

SECTION 07120

FLUID APPLIED WATERPROOFING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Fluid applied elastomeric waterproofing membrane for below grade walls. Fluid applied waterproofing membrane is required on the earth side of exterior concrete walls which are below grade and are common with rooms, tunnels, or galleries to be occupied by equipment, piping, or personnel. Membrane is not required for walls which are poured directly against an excavated surface.
- B. Fluid-applied elastomeric waterproofing membrane for below grade structures.
- C. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. NRCA (National Roofing Contractors Association)—Waterproofing Manual.

1.03 SUBMITTALS

- A. Submit two samples of coating system applied to 1/4-inch plywood or similar rigid base.
- B. Submit list of at least five projects of similar nature by waterproofing applicator which have been installed within the last five years, identified with project name, location, and date.
- C. Submit letter from membrane manufacturer stating that applicator is an approved or certified applicator of their product.
- D. Submit copies of warranty.

1.04 QUALIFICATIONS OF APPLICATOR

- A. Membrane applicator shall be approved by the manufacturer and shall have a minimum of 5 years experience in application of fluid-applied waterproofing coatings.

1.05 ENVIRONMENTAL CONDITIONS

- A. No waterproofing work shall be performed at ambient temperatures below 40°F.
- B. No waterproofing work shall be performed during inclement weather or when such weather is imminent.

1.06 WARRANTY

- A. Provide installer's five-year total system warranty of water-tightness covering cost (labor and materials) to repair any leaks in the waterproofing membrane, including cost to remove backfill material or other materials concealing the membrane, if required.

PART 2-PRODUCTS

2.01 MEMBRANE

- A. Membrane shall be fluid-applied, single-component, modified, moisture-curing polyurethane elastomer.
- B. Acceptable products include the following, or equal: Tremproof 60, manufactured by Tremco.

2.02 ACCESSORIES

- A. Cleaners and conditioners, primers, sealants, backer rod, flashing and flashing reinforcements, and other accessories related to the membrane application shall be provided as required by the membrane manufacturer.
- B. Provide 1/8-inch-thick protection board, Tremboard by Tremco, or equal.

PART 3-EXECUTION

3.01 SURFACE PREPARATION

- A. Surface preparation shall be in accordance with the membrane manufacturer's recommendations.
- B. Verify that curing methods used for concrete are compatible with the membrane system.
- C. Concrete surfaces shall be free of laitance, loosely adhering materials, oil, curing compounds, and all other contaminants prior to membrane application. Prepare all concrete surfaces by sandblasting followed by vacuum cleaning or by acid etching.
- D. Concrete surfaces shall be visibly dry and shall pass a 4-hour rubber mat test (no condensation) prior to application of coating system. Mat shall be taped to deck on all edges.

3.02 PRODUCT APPLICATION

- A. Preparatory work (priming and flashing) must be fully cured in accordance with manufacturer's recommendations prior to coating application.

- B. Apply coating in accordance with manufacturer's recommendations using approved squeegee, trowel, or spray equipment to produce a 60 mil wet film thickness (Tremproof 60). This is in addition to the primer and flashing coats. Extend coating over all previously flashed and primed areas.
- C. The membrane shall be cured as recommended by the manufacturer prior to water testing, backfilling, or allowing foot traffic on surfaces.
- D. Horizontal surfaces shall be flooded to a depth of 2 inches maintained over a 12-hour period. Any leaks evident after this period shall be repaired and the leaky areas retested until leaks are stopped.
- E. Apply protection board to all surfaces prior to backfilling.

END OF SECTION

SECTION 07191

VAPOR AND AIR BARRIER

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes: Vapor barrier under concrete floors on grade and on top of precast roof plank.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Vapor barrier for below slabs: Vapor barrier shall consist of 10 mil ASTM E1745 Class B polyethylene sheeting with less than 0.3 perm water vapor permeance in accordance with ASTM E96.
- B. Vapor barrier for precast plank construction: Vapor barrier shall consist of 6 mil ASTM D4397, Class B polyethylene sheeting with less than 0.3 perm water vapor permeance in accordance with ASTM E96

PART 3–EXECUTION

3.01 INSTALLATION–UNDER CONCRETE FLOORS ON GRADE

- A. Provide continuous vapor barrier under concrete floors on grade that are 8 inches or less in thickness, lap all joints a minimum of 12 inches.
- B. Place 6 inches of granular cushion over under vapor barrier.

3.02 INSTALLATION ON TOP OF PRECAST ROOF PLANK

- A. Provide continuous vapor barrier on top of precast plank.
- B. Lap all joints a minimum of 12 inches and tape all joints.

END OF SECTION

SECTION 07212

BOARD INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes board insulation for cavity wall construction, for perimeter foundation walls, and under floor slabs-on-grade.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 CAVITY WALL INSULATION

- A. Cavity wall insulation shall be 1 1/2-inch-thick polyisocyanurate foam board with foil facing on both sides. Aged thermal resistance (R-value) at 72°F shall be a minimum of 10.0.
- B. Acceptable products include the following, or equal. DOW Thermax by DOW Corporation.
- C. Adhesive for adhering insulation to backup wall shall be as recommended by the insulation manufacturer.

2.02 FOUNDATION AND UNDER-SLAB INSULATION

- A. Foundation and under-slab insulation shall be 2-inch-thick extruded polystyrene closed cell rigid foam board with continuous skins on both sides. Aged thermal resistance (R-value) at 75°F shall be a minimum of 10.0
- B. Acceptable products include the following, or equal:
 - 1. Styrofoam Square Edge by Dow Chemical Company.
 - 2. Foamular 250 by UC Industries, Inc.

PART 3–EXECUTION

3.01 INSTALLATION–CAVITY WALLS

- A. Insulation shall be installed horizontally within the cavity space between masonry wythes.
- B. Take care during installation to ensure all insulation boards are butted and installed between ties and fit flush against inner wythe or backup wall.
- C. Cut insulation neatly to fit around obstructions across the cavity such as vents, louvers, pipes, and conduits.

- D. Secure insulation in place against backup wall with mastic adhesive and observe label directions.

3.02 INSTALLATION—FOUNDATION WALLS AND UNDER FLOORS

- A. Rigid insulation shall be laid dry against the foundation walls as backfill is placed. Insulation shall be located at all perimeter frost walls and below-grade walls of buildings and structures containing areas that may be occupied by personnel.
- B. At perimeter frost wall foundations, insulation shall be 40 inches high and located on the inside of foundation walls.
- C. At foundation walls that extend above a building floor level (including basement floor) and are partially or fully buried, insulation shall be 48 inches high and located on the outside of the walls, with top of insulation terminating 4 inches below finished grade.
- D. Insulation under edges of slab-on-grade floors shall be 24 inches wide.

END OF SECTION

SECTION 07213
BATT INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes batt insulation for attic spaces as called for on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C665–Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

PART 2–PRODUCTS

2.01 ROOF INSULATION

- A. Batt insulation placed on top of precast plank in attic spaces shall be unfaced fiberglass batt 12 inches thick conforming to ASTM C665, Type 1, and providing a minimum R-value of 38. Two layers of 6-inch batt placed perpendicular to each other may be used in place of one layer of 12-inch batt.
- B. All batt insulation in attic spaces shall be unfaced or foil-reinforced kraft faced meeting the 2003 International Building Code or governing local building code requirements.
- C. Acceptable manufacturers include the following or equal:
 - 1. Owens Corning.
 - 2. Manville.
 - 3. Certainteed.

PART 3–EXECUTION

3.01 INSTALLATION–ROOF INSULATION

- A. Prior to installing insulation, vapor barrier shall be in place (See Section 07191–Vapor Barrier).
- B. Insulation shall be loose laid on the precast plank over the vapor barrier. If two layers of insulation are used to make up the required thickness, upper layer shall be installed perpendicular to the lower layer.

END OF SECTION

SECTION 07311

ASPHALT SHINGLE ROOFING

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes granular-surfaced asphalt shingle roofing, including shingles, underlayment, eave protection membrane, shingle-over ridge vents, sheet flashing, drip edging, and related accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM D3018–Class A Asphalt Shingles Surfaced with Mineral Granules.
- B. ASTM D3462–Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules.
- C. UL 580–Tests for Wind Uplift Resistance of Roof Assemblies.
- D. ASTM D226–Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- E. ASTM D4586–Asphalt Roof Cement–Asbestos Free.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with the provisions of Section 01300–Submittals.
- B. Submit two copies of shingle warranty for review.
- C. Submit shingle color samples for selection by OWNER.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply felts or shingles in cold weather. Storage of bundles in heated area several days prior to use can permit shingling where unheated shingles would crack.

1.05 WARRANTY–SHINGLES

- A. Provide 30-year material warranty covering cost to replace defective shingles, exclusive of labor, in the event of manufacturing defect(s) in the shingles. In addition, provide a 5-year material/labor warranty covering cost to repair or replace defective shingles, including cost of roof tear-off and excluding costs of flashing and metal work, up to the full replacement cost of the shingles.

- B. Material warranty shall be equal to the CertainTeed Corporation 30-year limited warranty. Material and labor warranty shall be equal to the CertainTeed Corporation 5-year Sure Start Protection warranty.

PART 2-PRODUCTS

2.01 ASPHALT SHINGLES

- A. Asphalt shingles shall be 12 inches by 36 inches 3 Tab, 250 pounds per square, self-sealing, UL Class A, wind-resistant, fiberglass shingles surfaced with mineral granules, and conforming to ASTM D3018 and ASTM D3462.
- B. Acceptable products include the following, or equal:
 - 1. CertainTeed.
 - 2. GAF Materials Corporation.
- C. Color shall be as selected by OWNER.

2.02 UNDERLAYMENT AND EAVE PROTECTION MEMBRANE

- A. Underlayment for all areas, except along eaves, shall be No. 15 unperforated asphalt saturated felt conforming to ASTM D226.
- B. Eave (ice dam) protection shall be a sheet membrane of rubberized asphalt bonded to sheet polyethylene, 40 mils minimum total thickness, with strippable release paper. Acceptable products include the following, or equal:
 - 1. Ice and Water Shield by W.R. Grace Company.
 - 2. Winter Guard Waterproofing Shingle Underlayment by CertainTeed Corporation.

2.03 ACCESSORIES

- A. Nails shall be annular-barbed or ring-barbed galvanized roofing nails with minimum 3/8-inch-diameter head and sufficient length to penetrate through the plywood sheathing.
- B. Plastic cement shall be asphalt type with mineral fiber components conforming to ASTM D4856. It shall be free of asbestos and toxic solvents and shall be capable of setting within 24 hours at temperatures of 75°F and 50% RH.
- C. Lap cement shall be fibrated cutback asphalt type recommended for use in underlayment and shall be free of asbestos and toxic solvents.
- D. Continuous shingle-over ridge vents shall be constructed of plastic and shall be formed with vent openings that do not permit direct water or weather entry or insect/bird entry. Vents shall provide minimum 12.2 square inches of net free ventilation per linear foot. Acceptable products include the following:
 - 1. Ridge Master by Mid-America Building Products Corporation.
 - 2. Series 4 or Series 5 by North American Building Products, Inc. Manufacturer shall provide 40-year limited material warranty on product.

2.04 FLASHING

- A. Sheet flashing shall be minimum 0.03-inch-thick aluminum, mill finish, conforming to ASTM B209.
- B. Exposed edges of flanges shall be hemmed a minimum 1/4-inch on the underside. Underside shall be coated with acid and alkali-resistant bituminous paint.
- C. Drip cap edging shall be aluminum style "D".
- D. Provide aluminum pipe boots for roof pipe penetrations.

PART 3-EXECUTION

3.01 EXAMINATION

- A. CONTRACTOR shall examine all roof decks on which roofing is to be applied and shall notify ENGINEER in writing prior to starting work of any defects which he may consider detrimental to the proper installation of his materials. Roof deck shall be smooth, dry, free from dirt and foreign material before starting roofing.
- B. Verify that roofing penetrations are in place and properly flashed and that roof openings are correctly formed.

3.02 INSTALLATION-EAVE (ICE DAM) PROTECTION

- A. Place eave edge and gable edge metal flashings tight with fascia boards. Weather lap joints 2 inches and seal with plastic cement. Secure flange with galvanized nails spaced 8 inches o.c.
- B. Apply eave protection membrane in accordance with manufacturer's instructions. Extend eave protection membrane minimum 4 feet upslope beyond interior face of exterior wall.

3.03 INSTALLATION-PROTECTIVE UNDERLAYMENT

- A. Place one ply of underlayment over areas not protected by eave protection. Install underlayment perpendicular to slope of roof. Underlayment shall be weather lapped a minimum 4 inches over eave protection membrane, and weather lapped minimum 4 inches. Stagger end laps of each consecutive layer. Nail in place.
- B. If the roof slope is 4 in 12 or flatter, place a second ply of underlayment over first layer with ends and edges weather lapped minimum 4 inches. Stagger end laps of each consecutive layer. Nail in place.
- C. Weather lap and seal watertight with plastic cement items projecting through or mounted on roof.

3.04 INSTALLATION–VALLEY PROTECTION

- A. Place one layer of sheet metal flashings, minimum 24 inches wide, centered over open valleys and crimped to guide water. Weather lap joints minimum 2 inches. Nail in place minimum 8 inches o.c. and 1 inch from edges.

3.05 INSTALLATION–METAL FLASHING AND ACCESSORIES

- A. Weather lap joints minimum 2 inches and seal weathertight with plastic cement.
- B. Secure in place with nails at 8 inches o.c. Conceal fastenings.
- C. Flash and seal work weathertight projecting through or mounted on roofing with plastic cement.

3.06 INSTALLATION–ASPHALT SHINGLES

- A. Place shingles in straight coursing pattern with 4-inch weather exposure on slopes of 4 in 12 or flatter and 5-inch weather exposure on slopes 5 in 12 and steeper.
- B. Project first course of shingles 3/4-inch beyond fascia boards.
- C. Extend shingles 1/2-inch beyond face of gable edge fascia boards.
- D. Cap hips and ridges with individual shingles maintaining 5-inch weather exposure. Place to avoid exposed nails.
- E. Coordinate installation of roof-mounted components of work projecting through roof with weathertight placement of counter flashings.
- F. Complete installation to provide weathertight service.

END OF SECTION

SECTION 07620

FLASHING AND SHEET METAL

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes masonry wall flashing, custom fabricated sheet metal flashing, and counter flashing at eave, gable, and ridge lines; roof-mounted equipment, vent stacks, and other locations.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A653—Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- B. ASTM A924—General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.
- C. ASTM B32—Solder Metal.
- D. ASTM B209—Aluminum and Alloy Sheet and Plate.
- E. ASTM D4586—Asphalt Roof Cement, Asbestos-Free.
- F. SMACNA—Architectural Sheet Metal Manual.

1.03 SUBMITTALS

- A. See Section 01300—Submittals for general submittal requirements.
- B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details and requirements.

1.05 QUALIFICATIONS

- A. Fabricator and installer shall be a company specializing in sheet metal fabrication work with a minimum of five years of verifiable experience in that field.

1.06 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

PART 2—PRODUCTS

2.01 MATERIALS

- A. Masonry wall flashing and flashing around windows, doors, and other openings shall be 32 mil of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane. Flashing shall be PERM-A-BARRIER. Wall flashing as manufactured by Grace Construction Products, or equal. Provide primer or surface conditioner as recommended by manufacturer.
- B. Galvanized steel sheet: 26-gauge meeting ASTM A525, Grade A with G90 zinc coating.
- C. Aluminum sheet: 0.032-inch-thick meeting ASTM B209.
- D. Fasteners: Same material and finish as flashing sheet. Stainless steel fasteners may be used with any flashing material. Provide soft neoprene washers with fasteners.
- E. Primer: Zinc chromate type.
- F. Protective Backing Paint: Bituminous type.
- G. Sealant: See Section 07900—Caulking and Sealants.
- H. Bedding Compound: Rubber asphalt or butyl type.
- I. Plastic Cement: ASTM D4586, Type I or II.
- J. Reglets: Galvanized steel or PVC, surface-mounted or recessed, or as shown on the drawings.
- K. Solder: ASTM B32. Soldering is not permitted on aluminum or stainless steel sheet.

2.02 FABRICATION

- A. All flashing and fascia shall be formed to the configurations shown on the drawings and/or the applicable manufacturer's details, or in accordance with SMACNA standard details where not shown on the drawings or in manufacturers details. Form sections true to shape, accurate in size, square, and free from buckles, kinks, or other defects.
- B. All exposed edges shall be folded or returned on themselves at least 1/2-inch. Corners shall be mitered and seamed.
- C. Form pieces in the longest possible lengths. Form material with flat lock seams.
- D. All sections shall be provided with slip joints at 8 feet on center.
- E. Cleats shall be fabricated of the same materials as the flashing sheets and shall be interlockable with the sheets.

- F. Fabricate vertical faces with bottom edge formed outward 1/4-inch and hemmed to form a drip.
- G. Fabricate corners from one piece with minimum 18-inch-long legs. Seam or solder for rigidity and seal with sealant.

2.03 FINISH

- A. Back paint all sheet metal with asphaltum paint where sheet metal surfaces come in contact with masonry or steel.
- B. Flashing and fascia shall be painted where exposed to view from the ground. Galvanized steel shall be painted in accordance with Section 09900–Painting. Aluminum shall be coated with a Kynar 500 coating system.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Through-wall flashing shall be installed 1/2-inch back of the outside face of the wall, carried through the outside wythe, turned up in the collar, and adhered to back-up wall as shown on the drawings. At no time should any portion of the flashing be allowed to hang or drape beyond the width of the wall. All laps shall be sealed and shall not be less than 3 inches in width. Flashing around openings shall extend at least 3 inches beyond each side of opening.
- B. Fit flashing tight in place. Make corners square, surfaces true and straight in planes, and line accurate to profiles. Seal metal joints watertight.
- C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted by ENGINEER.
- D. Insert flashings into reglets where shown on the drawings. Seal flashings into reglets with sealant.
- E. Counter flashing shall be provided at all vertical masonry and/or concrete walls which extend above the roof line. The counter flashing shall be installed in a reglet unless otherwise shown. Surface-mounted reglets shall be used where noted.
- F. CONTRACTOR shall provide copper sleeves for hot pipes penetrating the roof as approved by the roofing manufacturer. The annular space between the sleeve and the pipe shall be packed with insulation capable of withstanding the maximum temperature of the pipe. CONTRACTOR to provide a galvanized steel rain collar welded to the hot pipe.

END OF SECTION

SECTION 07631

GUTTERS AND DOWNSPOUTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Aluminum gutters and downspouts.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM B209—Aluminum and Aluminum Alloy Sheet and Plate.
- B. SMACNA—Architectural Sheet Metal Manual.

1.03 DESIGN REQUIREMENTS

- A. Conform to SMACNA manual for sizing components for a 10-year storm event.

1.04 REGULATORY REQUIREMENTS

- A. Conform to the 2003 International Building Code or governing local building code for size and method of rainwater discharge.

PART 2—PRODUCTS

2.01 GUTTERS AND DOWNSPOUTS

- A. Gutters and downspouts shall be constructed of 0.050-inch-thick aluminum sheet conforming to ASTM B209 and shall be made from the same manufacturer as the fascia and soffit system.

2.02 ACCESSORIES

- A. Anchorage devices shall meet SMACNA or manufacturer's requirements.
- B. Gutter supports shall be straps and fasteners at maximum 3'-0" on center.
- C. Downspout supports shall be brackets of the appropriate size and spacing.
- D. Fasteners shall be aluminum or stainless steel.

2.03 SPLASH PADS

- A. Splash pads shall be precast concrete of the appropriate size with minimum 28-day compressive strength of 3,000 psi and minimum 5% air entrainment.

2.04 FABRICATION

- A. Form gutters and downspouts to SMACNA requirements.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion by providing expansion joints as required.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

2.05 FINISHES

- A. Finish on gutters and downspouts shall match finish on fascia system. All components, including fasteners and supports, shall be prefinished to match gutters and downspouts.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install gutters, downspouts, and accessories with manufacturer's instructions.
- B. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Install gutters with a 1/8-inch per foot slope.
- D. Seal metal joints watertight.
- E. Set splash pads under downspouts.

END OF SECTION

SECTION 07710

MANUFACTURED ROOF SPECIALTIES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Metal fascia, soffit.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. SMACNA—Architectural Sheet Metal Manual.

1.03 SUBMITTALS

- A. Submittals shall comply with requirements of Section 01300—Submittals.
- B. Submit sample panels for selection of anodized or Kynar 500 finish colors.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details.

1.05 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

PART 2—PRODUCTS

2.01 FASCIA

- A. Metal fascia system shall be constructed of 24 gauge galvanized steel and shall include all necessary angles, clips, corners, and other accessories of the same material as the finish panels.
- B. Acceptable products include the following, or equal: Fascia System by Peterson Aluminum Corporation.

2.02 SOFFIT

- A. Metal soffit system shall be constructed of 0.032-inch-thick aluminum sheet and shall include all necessary channels, angles, clips, flashing, fasteners, and other accessories of the same material as the soffit panels. Soffit panels shall be perforated to allow for ventilation and shall have stiffener grooves spaced at 6 inches on center.

- B. Acceptable products include the following, or equal: PAC 750 by Peterson Aluminum Corporation.

2.03 FINISHES

- A. Finish on all products shall be a 1.0 mil DFT two-coat factory-applied 70% Kynar 500 fluoropolymer coating over an epoxy prime coat. Colors shall be selected by OWNER. All exposed fasteners shall be provided with the same finish as the sheet metal products.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install components in accordance with the drawings and the manufacturer's instructions.
- B. Installation details shall be such as to allow for thermal expansion and contraction of the components and to provide for a complete weatherproof installation.

END OF SECTION

SECTION 07900

CAULKING AND SEALANTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Caulking and sealants on the project, including primers and backer rod material.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C920–Elastomeric Joint Sealants

1.03 SUBMITTALS

- A. Submittals shall comply with provisions of Section 01300–Submittals.
- B. Submit color chart for each sealant used on project. Colors will be selected by ENGINEER.

1.04 WARRANTY

- A. Caulked joints shall be weather-tight and guaranteed watertight for five years from date of final payment. Deliver original guarantee to OWNER with copies to ENGINEER.

PART 2–PRODUCTS

2.01 CAULK–NONSUBMERGED APPLICATIONS–GENERAL

- A. Caulk for nonsubmerged applications in all locations except floor joints shall be a one-part polyurethane sealant.
- B. Acceptable products include the following, or equal:
 - 1. NP1 by BASF Construction Chemicals, LLC.
 - 2. Vulkem 116 by Tremco Inc.

2.02 CAULK–NONSUBMERGED APPLICATIONS–FLOOR JOINTS

- A. Caulk for floor joints in nonsubmerged applications shall be a one-part, self-leveling, polyurethane sealant.
- B. Acceptable products include the following, or equal:
 - 1. SL1 by BASF Construction Chemicals, LLC.
 - 2. Vulkem 45 by Tremco Inc.

2.03 CAULK-SUBMERGED APPLICATIONS-GENERAL

- A. Caulk in all submerged applications except a potable water contact shall be a two-part, polysulfide base synthetic rubber sealant.
- B. Acceptable products include the following, or equal:
 - 1. Sonolastic two-part by BASF Construction Chemicals, LLC.
 - 2. Vulken 45 by Tremco Inc.

2.04 CAULK-SUBMERGED APPLICATIONS-POTABLE WATER CONTACT

- A. Caulk in all submerged potable water contact applications shall be an NSF-approved two-part polysulfide base synthetic rubber sealant or an NSF-approved one-part polyurethane sealant recommended by the sealant manufacturer for potable water contact.
- B. Acceptable products include the following, or equal: Sika Duoflex NS/SL.

2.05 ACCESSORIES

- A. Backer rod shall be flexible, closed-cell polyethylene rod stock sized to be under at least 25% compression when positioned in the joint. In shallow joints and where backer rod is not used, polyethylene bond breaker tape shall be used. It is essential that the caulk bond to the side of the joint but not to the base of the joint.
- B. Primer(s) shall be used where required by the manufacturer for the specific product(s) used and the specific application(s) intended. Specific product(s) shall be as recommended by the manufacturer.
- C. Cleaning fluid shall be methyl ethyl ketone (MEK), methyl tone (MIKS), or similar solvent material which will not etch or mar metal finishes and shall be the product of a nationally recognized manufacturer, of type expressly recommended for use with the caulking or sealant compound used.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Seal completely all joints around entire perimeter of all openings in all exterior walls (inside and outside faces), including joints at all exterior doors, windows, louvers, sills, and elsewhere as noted on the drawings and as necessary to seal all open joints in the building in a complete manner. Joints in exterior walls shall be caulked in a completely weather-tight manner. Joints between interior walls and concrete ceilings and other interior joints shall be caulked as indicated on the drawings. Caulking not specified in other sections shall be performed under this heading.
- B. All caulking shall be done in accordance with manufacturer's specifications. Allow minimum 28-day curing period for concrete, grout, or mortar prior to caulking unless requested otherwise. Caulking work shall be done before the final coat of paint is applied except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting. All caulking shall occur only when the temperature is above 40°F.

- C. Joints shall be thoroughly cleaned and primed before caulking in accordance with manufacturer's instructions. Unless otherwise shown, joints shall be square in cross section 1/2 inch by 1/2-inch and shall comply with manufacturer's joint width/depth ratio limitations.
- D. Backer rod shall be used in all openings 3/4-inch or more in depth and shall be tightly packed to completely fill the space to 1/2-inch back of face. The 1/2-inch shall then be filled with caulking compound.
- E. Caulking shall be done by hand gun. Compound shall be driven into joint grooves with sufficient pressure to force out all air and fill joint grooves solidly. Caulking where exposed shall be free of wrinkles and shall be uniformly smooth.
- F. At completion of caulking, clean off all excess material from adjoining surfaces and material. Entire installation shall be left in a perfect appearing weather-tight condition.

3.02 CAULKING EXISTING JOINTS

- A. All caulked joints in walls, ceilings, and floors requiring painting in the Room Finish Schedule (see drawings) shall be recaulked. Existing caulk and backer shall be completely removed. Caulk joints as specified for new construction.
- B. Caulking of existing joints shall be coordinated with Section 09900–Painting.

END OF SECTION

SECTION 08111
STANDARD STEEL DOORS

PART 1–GENERAL

1.01 SUMMARY

- A. Work included: Thermally insulated and fire-rated steel doors.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/SD1-100–Standard Steel Doors and Frames.
- B. UL 10B–Fire Tests of Door Assemblies.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01300–Submittals.
- B. In addition to shop drawings and product data, indicate type of primer paint to be used and verify compatibility with field paint system specified.

PART 2–PRODUCTS

2.01 THERMALLY INSULATED DOORS

- A. Thermally insulated doors shall be hollow full flush, 1 3/4-inch-thick, 16 gauge steel sheet in accordance with ANSI/SD1-100 with polyurethane core rigid reinforcing full thickness.
- B. Acceptable products include the following, or equal:
 - 1. Ceco Imperial.
 - 2. Curries 707 Series.

2.02 FABRICATION

- A. Doors shall be welded construction with all surface welds, joints, and seams filled and ground smooth.
- B. Tops and bottoms of doors shall be completely closed with 16 gauge channels. No inverted channels will be allowed.
- C. Mortise, reinforce, drill, and tap doors to receive hardware. Reinforcement shall be welded within the stiles and rails. Reinforce top rails to accommodate closers on either side and reinforce bottom for kickplate.

- D. All Underwriters' fire doors shall be constructed to meet Underwriters' Laboratories specific approval according to current procedure for the indicated class.
- E. Glass in exterior doors shall be 1-inch-thick.

2.03 FINISH

- A. Hollow metal doors shall receive one coat of rust-inhibitive, shop-applied primer paint. Primer paint must be compatible with field paint system specified.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install doors in accordance with ANSI/SD1-100.
- B. Coordinate installation of doors with installation of frames, hardware, glass and glazing, and field painting.
- C. Set all doors as supplied by manufacturer. Hang all doors allowing for expansion and contraction at time of setting.
- D. Set all hardware in accordance with templates as supplied by hardware supplier.
- E. Cover all exposed hardware until completion of painting and finishing.
- F. Examine hardware at completion; test, oil, grease, and adjust for perfect operation.

3.02 SCHEDULE

- A. See Door Schedule on the drawings.

END OF SECTION

SECTION 08112
STANDARD STEEL FRAMES

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes nonrated and fire-rated steel door frames.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/SD1-100–Standard Steel Doors and Frames.
- B. UL 10B–Fire-Rated Tests of Door Assemblies.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01300–Submittals.
- B. In addition to shop drawings and product data, indicate type of primer paint to be used and verify compatibility with field paint system specified.

PART 2–PRODUCTS

2.01 FRAMES

- A. Steel door frames shall be made of 14 gauge cold rolled prime quality steel in accordance with ANSI/SD1-100.
- B. Frames shall be removable where shown on the drawings.

2.02 FABRICATION

- A. Fabricate frames as welded unit.
- B. Mullions for double doors shall be removable type of same profiles as jams.
- C. Frames shall be 2 inches by 5 3/4 inches. Frames shall have 4-inch head member at 7-foot 0-inch doors in masonry walls.
- D. Fabricate frames with hardware reinforcement plates welded in place.
- E. All Underwriters' fire-rated frames shall be constructed to meet Underwriters' Laboratories specific approval according to current procedure for the indicated class.
- F. Provide anchors appropriate to wall type.

2.03 FINISH

- A. Frames shall receive one coat of rust-inhibitive, shop-applied primer paint. Primer paint must be compatible with field paint system specified.
- B. Frames shall be finish painted as specified in Section 09900—Painting prior to installation. This includes back sides of door frames.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install frames in accordance with ANSI/SD1-100.
- B. Coordinate installation of frames with wall construction for anchor placement.
- C. Coordinate installation of frames with installation of doors, hardware, joint sealers, and field painting.
- D. Set all frames as supplied by manufacturer.
- E. Frames in masonry walls shall be grouted full.

3.02 SCHEDULE

- A. Unless noted otherwise, provide hollow metal frames for all hollow metal doors. See Door Schedule on the drawings.

END OF SECTION

SECTION 08221

FIBERGLASS DOORS AND FRAMES

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes:
 - 1. Fiberglass doors.
 - 2. Fiberglass frames for non-rated doors and doors with 20-minute fire rating.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section. Provide hollow metal frames for doors with fire rating exceeding 20 minutes. See Section 08110—Standard Steel Doors and Frames.

1.02 REFERENCES

- A. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E152—Standard Method of Fire Tests of Door Assemblies.
- C. ASTM D635—Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- D. NFPA 252—Standard Methods of Fire Test of Door Assemblies.
- E. UL10C—Positive Pressure Fire Tests of Door Assemblies.

1.03 REGULATORY REQUIREMENTS

- A. Fire-rated door construction: Conform to ASTM E152, UL10C, and NFPA252.
- B. Install door assembly conforming to NFPA 80 for fire-rated class.
- C. Flame Spread: All FRP component parts, including the gelcoat finish, shall have a flame spread classification of 25 or less per ASTM E84 and shall be self extinguishing per ASTM D635.

1.04 WARRANTY

- A. Provide manufacturer's 20-year warranty against failure due to corrosion.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable products include the following, or equal: CORRIM Company, Oshkosh, WI, or equal.

2.02 MATERIALS

- A. Resins:
 - 1. Manufacturer's formulation for corrosion-resistant resin system with light stabilizing additives.
 - 2. Minimum glass fiber to resin ratio: 40%.
- B. Anchors: Manufacturer's standard stainless steel expansion anchors for existing openings and stainless steel masonry tee anchors for new construction.
- C. Fasteners: Stainless steel.
- D. Glazing: Type specified in Section 08800-Glazing; factory installed.

2.03 DOORS

- A. Thickness: 1 3/4 inches.
- B. Thermal Insulating Value: Minimum R value of 11.
- C. Construction:
 - 1. Core: Polyurethane foam for non fire rated doors and 1-1/2 hour mineral core for fire rated doors.
 - 2. Face Sheets: FRP molded in one continuous piece, resin reinforced with hand-laid glass fiber mat, nominal 0.120-inch-thick, minimum 15 mil gel-coated surface.
 - 3. Stiles and rails shall be 1 1/2-inch-square pultruded fiberglass tubes. Provide polymer blocking for all hardware reinforcing.
- D. Door Edges: Smooth, seamless finish.
- E. Seals: Intumescent seals factory applied around perimeter required for all fire doors.
- F. Label: UL fire door label required on hinge edge of all fire doors.

2.04 FIBERGLASS FRAMES

- A. Provide fiberglass frames for non rated doors and doors with 20-minute fire rating.
- B. Construction: One-piece pultruded fiberglass-reinforced plastic, minimum 1/4-inch wall thickness, jamb-to-head joints mitered and reinforced with FRP clips and stainless steel fasteners; conforming to SDI requirements for performance equivalent to 16 gauge steel frames.
- C. Frame Profile: 5 3/4 inches deep, 2 inches wide face; double rabbeted with 5/8-inch-high stop. Provide 4-inch head frames in masonry openings.

- D. Finish: Gel-coat 15 mils thickness on all exposed surfaces. Color to match doors.

2.05 WINDOWS

- A. Stops: Pultruded fiberglass reinforced plastic construction.
- B. Glazing: Specified in Section 08800—Glazing.
- C. Sizes: Manufacturer's standards as indicated in Door Schedule. Window sizes for fire rated doors shall be limited to that permitted by the applicable building code.
- D. All fasteners shall be 316 stainless steel.

2.06 HARDWARE

- A. All doors and frames shall be mortised and reinforced with polymer blocking for all hardware in accordance with manufacturer.
- B. Provide fiberglass astragal at double doors.
- C. Remainder as specified in Section 08710—Door Hardware and called for in Door Schedule.
- D. All fasteners shall be 316 stainless steel.

2.07 FINISH

- A. Doors and frames shall have a 15 mil gel-coat finish.
- B. Color shall be a custom color selected by OWNER.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Set all doors and frames as supplied by manufacturer. Use stainless steel masonry anchors to support frame.
- B. Hang all doors allowing for expansion and contraction at time of setting.
- C. Set all hardware in accordance with templates as supplied by hardware supplier.
- D. Examine hardware at completion; test, oil, grease, and adjust for perfect operation.
- E. Maintain plumb and level tolerances as specified in manufacturer's installation instructions.

3.02 SCHEDULE

- A. See Door Schedule on the drawings.

END OF SECTION

SECTION 08305

ACCESS DOORS

PART 1-GENERAL

1.01 SUMMARY

- A. Work included: Aluminum floor doors and frame units.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2-PRODUCTS

2.01 ALUMINUM FLOOR DOORS AND FRAMES

- A. Acceptable products include the following, or equal: The Bilco Company, Type K as scheduled.
- B. Door type K shall be designed for minimum live load of 150 psf with a maximum deflection of 1/150 of span.
- C. Cover shall be stiffened 1/4-inch aluminum diamond pattern plate.
- D. Hinges shall be through bolted to the door and frame with tamper-proof type 316 stainless steel lock bolts.
- E. Type K doors shall have cast steel cam-action hinges which pivot on torsion bars. Cover shall have smooth controlled operation and not be affected by temperature.
- F. Provide hold open arm that automatically locks in open position. Provide snap lock with fixed handle mounted to underside of cover. Provide removable exterior turn/lift handle with spring-loaded ball detent to open cover. All hardware shall be Type 316 stainless steel for corrosive environment.

2.02 FINISH

- A. Aluminum floor doors and frames shall be mill finish, with bituminous coating applied to exterior of frames in contact with concrete.

2.03 ACCESSORIES

- A. Provide safety net system for each floor door as specified in Section 10050-Miscellaneous Specialties. Manufacturer's integral hinged fall protection grating may be provided in lieu of safety net system subject to approval of ENGINEER.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions.

3.02 SCHEDULE

- A. See Door Schedule on the drawings.

END OF SECTION

SECTION 08360

SECTIONAL OVERHEAD DOORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Manually-operated insulated overhead sectional door.
 - 2. Operating hardware, track, and supports.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A526—Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
- B. ASTM E283—Standard Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
- C. ANSI/NFPA70—National Electrical Code.

1.03 SYSTEM REQUIREMENTS

- A. Total air leakage through the doorway opening at a wind velocity of 15 mph shall be 0.08 cfm per square foot or less in accordance with ASTM E283.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01300—Submittals.
- B. Submit air leakage test data done by lab in accordance with ASTM E283.

PART 2—PRODUCTS

2.01 INSULATED DOORS

- A. Thermally insulated sectional overhead doors shall be nominal 2-inch-thick ribbed, embossed panels with 0.016-inch-thick G90 galvanized steel faces in accordance with ASTM A526 and polyurethane core.
- B. Acceptable products include the following, or equal:
 - 1. Dalton International Thermospan 200.
 - 2. Overhead Door Corporation Thermacore 592.

2.02 ACCESSORIES

- A. Provide one row of double-glazed acrylic lites.

2.03 FABRICATION

- A. Insulated doors shall have a thermal break between exterior and interior faces.
- B. Insulated doors shall have joint seals between sections, jamb seals, top seal, and a "U"-type threshold gasket.
- C. Track shall be 2-inch, minimum 14 gauge galvanized steel. Provide high lift track where noted.
- D. Provide lock on manually operated doors.

2.04 FINISH

- A. Exterior face shall be primed with a baked-on polyester primer and finished with a baked-on polyester finish coat. Color shall be selected by OWNER.
- B. Interior face shall be primed and finish coated with baked-on polyester. Color shall be white.
- C. All other ferrous surfaces, except galvanized surface and working parts of machinery, shall receive one shop coat of rust-inhibitive metal primer. Primer shall be compatible with field paint system.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Erection shall be performed in accordance with the manufacturer's standards and instructions by their authorized representatives.
- B. All required casing materials shall be provided by CONTRACTOR.
- C. Upon completion of installation, operating devices and controls shall be adjusted and lubricated to operate properly.

3.02 SCHEDULE

- A. See Door Schedule on the drawings.

END OF SECTION

SECTION 08710
DOOR HARDWARE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Hardware to fully equip all doors.
 - 2. Thresholds and weatherstripping.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. NFPA 80–Fire Doors and Windows.

1.03 REGULATORY REQUIREMENTS

- A. Hardware shall conform to the 2003 International Building Code for requirements applicable to fire-rated doors and frames. Hardware shall comply with NFPA 80 and shall be properly stamped or labeled for easy identification.

PART 2–PRODUCTS

2.01 LOCKS AND LATCHES

- A. Locks, latches, and dead locks shall be Yale cylindrical locks 5300LN Series, Style AU, with 2 3/4-inch backset. Strikes shall be curved lip. Lockset and latchset numbers specified in paragraph 3.02 are Yale. Provide removable core brass 6- or 7-pin cylinders.

2.02 EXIT DEVICES

- A. Exit devices shall be Yale 2100 x 620F Series, or equal, and shall be equipped with reinforced cross bars and functions as indicated on the hardware sets. The exit device shall be operated by a lockable lever from the exterior side.

2.03 HINGES

- A. Butt hinges shall be Stanley FBB 191, Hager BB 1191, or equal, full mortise, ball bearing, nonferrous, nonremovable, flat bottom tip, unless otherwise specified. Provide three 4 1/2-inch by 4 1/2-inch butts per door for doors 7 feet or less in height with one additional butt for each additional 30 inches or fraction thereof, unless otherwise specified. Provide additional butt or heavy-weight hinges for all doors that are over 36 inches wide, unless specified otherwise. Finish on aluminum entrance doors shall match framing.

2.04 CLOSERS

- A. Door closers shall be LCN Series 1460 for exterior doors and 1461 for interior doors, or equal. Provide aluminum finish on closers. Provide full covers. Door closers for locations noted as (ss) shall have the SRI primer for corrosion resistance. Door closers specified in paragraph 3.02 are LCN. (H-Hold Open)

2.05 OVERHEAD HOLDERS

- A. Door holders shall be Glynn Johnson GJ 81H Series, or equal, unless otherwise specified. Holders for locations noted as (ss) shall be fabricated with stainless steel components. Numbers specified in paragraph 3.02 are Glynn Johnson.

2.06 SURFACE BOLTS

- A. Surface bolts shall be 8-inch Ives 1630 series, or equal. At doors with (ss) hardware, bolts shall be 8-inch Ives 1640 Series, or equal.

2.07 KICKPLATES

- A. Kickplates shall be Rockwood, or equal, 6 inches high. Kickplate width shall be 2 inches less than door width.

2.08 DOOR STOPS

- A. Provide wall- or floor-mounted door stops at all interior doors. Stops shall be Glynn Johnson GJFB-13, GJ60C, GJ60W for locations noted as (ss), or equal.

2.09 THRESHOLD AND WEATHERSTRIPPING

- A. All exterior doors shall be weatherstripped with Reese DS106, National Guard Products, Inc. 190, or equal, weatherstripping. Provide Reese 323C, Pemko 315AN, or equal, sweeps; and Reese S425A, Pemko 171A, or equal, thresholds. Interior doors No. 7002A and No. 7002B shall be weatherstripped and have sweeps and thresholds as specified for exterior doors. Exterior and interior doors without mullion shall have Reese No. 87, Pemko 352A, or equal, positive sealing astragal.

2.10 KEYING

- A. Door keys shall be keyed to match existing doors on site. Provide two keys per lock. Doors shall have temporary construction cylinders. Provide permanent cylinders at project completion.

2.11 FINISH

- A. Finish for all hardware, except as noted below, shall be US 26D or US 32D where stainless steel (ss) hardware is specified in paragraph 2.
- B. Finish for surface bolts shall be US 26D; finish for kickplates shall be 32D.
- C. Where stainless steel (ss) is specified, all hardware, including threshold and weather stripping, shall be installed with stainless steel fasteners.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Provide finish hardware to fully equip all doors.
- B. Install hardware in accordance with manufacturer's instructions.

3.02 SCHEDULE

- A. Provide the following hardware groups in the amounts indicated on the door schedule or required for a complete and proper installation:

Group 1

Lockset-5304LN
Door Closer-1460H (Parallel Arm)
Butts & Kickplate

Group 2

Exit Device-2108 x 627F(ss)
Door Closer-1460 (ss) (Parallel Arm)
Butts & Kickplate (ss)

Group 3

Knobs-Rigid, each face
Surface bolts-One top and bottom
Door Holder GJ 81 H-HD
Butts & Kickplate

Group 4

Latchset 5301LN
Door Closer-1461 BF (Regular Arm)
Butts & Kickplate

END OF SECTION

SECTION 08800

GLAZING

PART 1-GENERAL

1.01 SUMMARY

- A. Work includes glass and glazing for door lights.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. FGMA-Flat Glass Marketing Association, "Glazing Manual."

1.03 WARRANTY

- A. Exterior insulating glass shall be provided with a 10-year warranty against failure of the seal.
- B. Coated glass shall be provided with a 10-year warranty against peeling, cracking, or deterioration of the coating.

PART 2-PRODUCTS

2.01 EXTERIOR GLASS

- A. Glass in exterior door lights shall be 1-inch-thick insulating glass consisting of two pieces of 3/16-inch float glass separated by a 5/8-inch air space.
- B. Acceptable manufacturers include the following, or equal: Interpane Glass Company.
- C. Glass shall be Low-E bronze tint ILE 474 with the following maximum values, or equal.

		U-Value		
	Shading Coefficient	Winter	Summer	SHGC
Bronze tint	.42	.31	.33	.37

- D. Exterior door lights shall have tempered glass in compliance with the governing building code.

2.02 GLAZING COMPOUNDS AND ACCESSORIES

- A. Glazing system shall consist of a polyisobutylene-butyl tape, liquid polymer sealant, and vinyl roll-in strip.
- B. Acceptable products include the following, or equal:

1. Tremco Vision Strip System.
2. General Electric Silglaze.

2.03 FABRICATION

- A. Glazing of windows shall be from the interior.
- B. Accessories such as setting blocks, clips, etc., shall be provided to properly set glass.
- C. Obtain sizes from work at the site or from the manufacturer of work into which the materials will be set. Responsibility for the correctness of measurements shall be assumed by CONTRACTOR.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Comply with "Glazing Manual" by Flat Glass Marketing Association (FGMA), except as specifically recommended otherwise by manufacturers of the glass and glazing materials.
- B. Completed installation shall be water- and airtight.

END OF SECTION

SECTION 09850

CHEMICAL RESISTANT COATING

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes high-performance chemical-resistant epoxy coating system.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01300–Submittals.
- B. Submit copy of manufacturer's Material Safety Data Sheets (MSDS) for each product.

1.03 QUALITY ASSURANCE

- A. Applicator shall have minimum 5 years of satisfactory documented experience on projects of similar size and scope.
- B. Furnish primers, pretreatments, thinners, and finish coats by the same manufacturer.

1.04 ENVIRONMENTAL CONDITIONS

- A. Storage and application temperatures shall be in strict accordance with manufacturer's recommendations.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal: Tnemec Company, Inc.

2.02 MATERIALS

- A. Primer shall be compatible with coating; Tnemec Series 201 Epoxoprime, or equal.
- B. Coating for floors in chemical containment areas shall be chemical-resistant, Novolac epoxy coating, Tnemec Series 239 Chemtread followed by Tnemec Series 282, or equal.
- C. Coating for walls in chemical containment areas shall be Novolac epoxy coating, Tnemec Series 282, or equal.

PART 3-EXECUTION

3.01 PREPARATION

- A. Surfaces to receive coating shall be cleaned and prepared as recommended by manufacturer.
- B. Concrete surfaces shall be abrasive blast cleaned to a texture similar to 40-60 grit sandpaper.
- C. A representative of the manufacturer shall observe and approve the surface preparation prior to application of coating.

3.02 APPLICATION

- A. Mix components in strict accordance with manufacturer's instructions.
- B. Surface and material temperature shall be between 70°F and 90°F during application.
- C. Coating for Floors and Bases:
 - 1. Primer shall be applied at the rate of 160 square feet per gallon.
 - 2. Intermediate coat shall be applied within 4 to 6 hours of prime coat. Intermediate coat shall be applied to 1/4-inch thickness (100 S.F./Large Kit) and in accordance with manufacturer's instructions.
 - 3. Top coat shall be applied at 250 square feet per gallon.
- D. Coating for walls shall be applied as follows:
 - 1. One coat Tnemec Series 201 Epoxoprime (160 square feet per gallon).
 - 2. One coat Tnemec Series 282 (180 square feet per gallon).
 - 3. One coat Tnemec Series 282 (250 square feet per gallon).
- E. Exposed perimeter edges of topcoat, including doorways, drains, traffic aisle sides, etc., shall be "keyed" into substrate to allow full 1/4-inch thickness at these points. Saw cut substrate using power saw with carbide or diamond tip blades.
- F. Where the concrete floor meets the wall, provide a 45° angle cove with a height of 1 to 2 inches.
- G. Do not install coating over expansion joints.

END OF SECTION

SECTION 09900

PAINTING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Surface preparation and application of paints and coatings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM D4060—Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- B. ASTM D4541—Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- C. ASTM D3363—Test Method for Film Hardness by Pencil Test.
- D. ASTM D2247—Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
- E. ASTM D4585—Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- F. ASTM B117—Test Method of Salt Spray (Fog) Testing.
- G. SSPC—The Society for Protective Coatings—Steel Structures Painting Manual.
- H. Federal Register—Code of Federal Regulations (CFR).
- I. Federal Register—Resource Conservation and Recovery Act (RCRA).
- J. Federal Register—Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01300—Submittals.
- B. Shop primer proposed for use shall be submitted with all material and equipment submittals. All shop primers shall be of the same generic type and quality as those specified herein.
- C. Submit two copies of manufacturer's Material Safety Data Sheets (MSDS) for each type of paint with each shop drawing submittal. MSDS sheets shall be posted at the construction site at all times painting is in progress.

- D. Substitution submittals shall include performance test data, as certified by a qualified testing laboratory, for the ASTM tests specified in paragraph 2.01.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
 - 2. All paints shall be NSF Standard 61-approved when they are in contact with potable water or within potable water reservoirs.
- B. Prepainting Meeting:
 - 1. A prepainting meeting shall be held immediately following the project preconstruction conference. The prepainting meeting is to be held prior to any material and equipment that requires painting is delivered to the site.
 - 2. CONTRACTOR, the paint Subcontractor, and the paint manufacturer's representative shall be present to review the specifications and project scope.
 - 3. The paint manufacturer's representative shall review progress at the site as requested by ENGINEER. These are generally expected to be prior to monthly progress meetings.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original containers with labels intact and seals unbroken.
- B. Drop cloths shall be used in all areas where painting is done to fully protect other surfaces.
- C. Oily rags and waste must be removed from the building each night or kept in an appropriate metal container.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. CONTRACTOR shall dry-heat, dehumidify, and ventilate to obtain painting conditions recommended by the paint manufacturer during surface preparation, application, and cure.
- B. Relative humidity conditions as specified by the paint manufacturer's data sheet shall be adhered to. This includes times in which supplemental heat is used. Supplemental heat shall be indirect-fired hot air furnaces or electric heat. Open flame heaters shall not be used.
- C. No unprotected, unheated exterior painting shall be undertaken when damp weather appears probable, nor when the temperature of the substrate is below 55°F, unless approval in writing is received from the paint manufacturer.

1.07 EXTRA MATERIALS

- A. Provide one gallon of each component of paint/coating. Label with color, type, and room location.

PART 2-PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. All materials required for painting shall be types and quality as manufactured by Tnemec Company, Inc., Sherwin Williams Company, or equal, unless noted otherwise in the schedule.
- B. Where thinning is necessary, only the products of the manufacturer furnishing the paint will be allowed. All such thinning shall be done strictly in accordance with the manufacturer's instructions.
- C. Paint and paint products of Tnemec Company and Sherwin Williams, listed in the following specifications, are set up as standard of quality. Other manufacturer's products will be considered as a substitution if CONTRACTOR and paint manufacturer certify that the products offered are recommended for the service intended, are compatible with the shop primers used, are equal in solids content and composition, and are of the same type. Submittal shall include the following performance data as certified by a qualified testing laboratory. ASTM specifications shall be the latest revision.
 - 1. Abrasion-ASTM D4060, CS-17 Wheel, 1,000 grams load.
 - 2. Adhesion-ASTM D4541.
 - 3. Hardness-ASTM D3363.
 - 4. Humidity-ASTM D2247 and D4585.
 - 5. Salt (Fog) Spray-ASTM B117.

PART 3-EXECUTION

3.01 SURFACE PREPARATION

- A. General:
 - 1. All surfaces to be painted shall be prepared as specified herein and by the manufacturer's published data sheet and label directions. The objective shall be to obtain a uniform, clean, and dry surface.
 - 2. No field painting shall be done before the prepared surfaces are observed by ENGINEER. Surfaces painted without such observation shall be abrasive blast cleaned and repainted.
 - 3. Prior to field blasting, a sample of the blast abrasive shall be provided to ENGINEER for pH testing. Additional samples of subsequent deliveries or batches of blast abrasive shall be provided to ENGINEER for pH testing.
 - 4. For on-site abrasive blasting, low-dust, low-silica content material shall be used. Coal slag abrasive shall be used on pipe and ferrous materials. Staurolite abrasive shall be used on concrete and concrete block.
 - 5. Quality of surface preparations listed below are considered a minimum. If paint manufacturer requires a better preparation for a particular application, it shall be considered a requirement of this specification.
- B. Ferrous Metal:
 - 1. All ferrous metal to be primed in the shop shall have all rust, dust, and mill scale, as well as all other foreign substances, removed by abrasive blasting. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
 - 2. All ferrous metals not primed in the shop shall be abrasive blasted in the field prior to application of the primer, pretreatment, or paint.

3. Abrasive blasting of metals in the shop shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for immersion service shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for nonimmersion service shall be in accordance with SSPC-SP6 Commercial Blast Cleaning.
4. Solvent cleaning in accordance with SSPC-SP1 shall precede all abrasive blasting operations.
5. Ductile iron pipe shall be prepared by abrasive blasting per NAF 500C.
6. Existing motors and pumps which are to remain shall be power tool cleaned as specified in SSPC-SP15 Commercial Grade Power Tool Cleaning. Existing ferrous metal materials which are impractical to abrasive blast on site and impractical to remove from the site shall be power tool cleaned to bare metal as specified in SSPC-SP15 Commercial Grade Power Tool Cleaning.
7. Prior to finish coating, all primed areas that are damaged shall be cleaned and spot primed.

C. Concrete:

1. All concrete surfaces, including precast concrete to be painted, shall be cleaned of all form oil, curing compound, and other foreign matter. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues.
2. All new concrete and precast concrete walls, floors, and ceilings shall be abrasive blast cleaned in accordance with ASTM D4259 in order to prepare the surfaces for adherence of the painting systems as specified. Abrasive blasting of concrete shall result in a texture similar to 40-60 grit sandpaper (ICRI SP3-5). Bug-holes that are opened up shall be filled with an appropriate filler.
3. Bug-holes shall be filled as specified in Section 03300–Cast-in-Place Concrete without placing a friable sand-cement surface overall. The dried surface shall be stoned down.
4. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
5. After cleaning, the surface shall be washed and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.

D. Existing Concrete and Concrete Block:

1. All previously coated walls and ceilings of concrete and concrete block of existing structures, as noted in the Room Finish Schedule, shall be pole-sanded and hand-sanded to remove all old peeling paints as well as roughen-up existing paints.
2. All concrete and precast concrete walls, floor, and ceiling which are not currently painted but are scheduled for painting shall be abrasive blasted in accordance with ASTM D4259. Abrasive blasting of concrete shall result in a texture similar to 40-60 grit sandpaper (ICRI SP3-5).
3. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues and allowed to dry.
4. All existing floors, unless otherwise specified, shall be power-sanded with a Clark HD floor scrubber, or equal, with a rubber pad and abrasive disc, followed by vacuuming and removing all oil and grease contamination and particulate matter.
5. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
6. After cleaning, the surface shall be washed, and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.

- E. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with non-hydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC SP 1 and shall be abrasive blasted in accordance with SSPC-SP7.
- F. Copper: Where copper piping is not submerged or buried, it shall be solvent cleaned in accordance with SSPC SP 1 and shall be lightly sanded.
- G. PVC and CPVC: All PVC and CPVC to be painted shall be solvent cleaned in accordance with SSPC SP 1 and shall be lightly sanded.
- H. Aluminum: Where listed in the Schedule to be painted, it shall be solvent cleaned in accordance with SSPC SP 1 and shall be lightly sanded.

3.02 APPLICATION

- A. All materials shall be used as specified by the manufacturer's published data sheets and label directions.
- B. No paint shall be applied on a wet or damp surface and in no case until the preceding coat is dry and hard. Each coat shall be allowed to dry in accordance with manufacturer's data sheets before the next coat is applied.
- C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, other drying times will be necessary.
- D. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry and cured.
- E. Steel that will be inaccessible in the completed work shall receive the final coat before enclosure.
- F. Paint shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Tops and bottoms of walls and areas that are "cut-in" by brush prior to rolling shall have a uniform appearance in comparison with adjoining surfaces.
- G. Concrete block walls shall be back-rolled to achieve a pinhole-free surface coat.
- H. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of the first field coat of primer or intermediate coat. This includes, but is not limited to: between pipe flanges, pipe flange/pipe barrel joints, equipment fittings, and other narrow openings.
- I. No paint shall be applied to new or existing surfaces until joints have been caulked according to Section 07900 requirements, except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting.
- J. For PVC and CPVC piping, unions and valves shall not be painted.

3.03 FIELD QUALITY CONTROL

- A. Examination of work on the site by the manufacturer's representative shall be performed when requested by ENGINEER.

3.04 CLEANING

- A. All stains and marks shall be removed from other surfaces upon completion of the work.

3.05 SCHEDULE

A. General:

1. At the completion of the project, all painted surfaces which have been damaged shall be repainted or touched up.
2. See Finish Schedule on the drawings for an additional reference for areas to be painted.
3. The painter shall use some discretion in what should and should not be painted. Do not paint over labels and other information, bronze or brass, machined surfaces, moving parts where painting may impair movement, hot surfaces which may peel, etc. If in doubt whether a part should be painted, ask ENGINEER.
4. Products listed first are Tnemec and second are Sherwin Williams.

B. New Work:

1. All new work done by all trades shall be painted by CONTRACTOR in accordance with the following schedule and in accordance with paint manufacturer's recommendation. It is the intent of these specifications that all ferrous metal items scheduled for painting be shop primed. If items are not shop coated, surfaces shall be prepared and painted in the field as specified. If any items of new construction are not listed, CONTRACTOR shall request paint system from ENGINEER, and the items shall be painted as part of this Contract without additional cost.

2. Interior Concrete Floors:

One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, thinned 10%, hand broadcast anti-skid sand into the wet paint during application in locations as requested by OWNER; and

One coat of N69 Hi-Build Epoxoline II, Macropoxy 646.

3. Interior Concrete Block Walls:

Three coats of N69 Hi-Build Epoxoline II, Macropoxy 646.

If lightweight concrete block is used, four coats as specified, minimum, shall be applied.

Note: Paint shall be roller- or brush-applied to concrete sound absorptive block.

4. Interior Concrete Walls, Including Equipment Bases:

One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, thinned 10%; and
One coat of N69 Hi-Build Epoxoline, Macropoxy 646.

Note: Interior face of concrete tank walls and floors, channels, and pipe trenches are not to be painted.

5. All Exposed Concrete Ceilings (ceilings of water-containing tanks are not considered exposed):

One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, thinned 10%; and
One coat of N69 Hi-Build Epoxoline, Macropoxy 646.

6. Cast or Ductile Iron; Not Submerged or Buried:

One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
Touch up prime coat prior to finish coating; and apply either:

Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or

One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and
One coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

7. Cast or Ductile Iron, Tar Coated; Buried:

Not painted

8. Cast or Ductile Iron; Submerged:

One shop coat N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
Touch up prime coat prior to finish coating; and
Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646.

9. Steel, Machinery, and Equipment; not Submerged:

One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
Touch-up primer prior to finish coat; and either

Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or

One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and
One coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

First field coat shall be applied prior to installation to surfaces inaccessible after installation, including back sides of door frames. See Division 8 for factory applied door primers.

10. Motors, gear drives, and doors delivered with non-epoxy primers:

Degrease per SSPC-SP1.

Lightly hand-sand per SSPC-SP2.

Apply one coat 135-1255 Chembuild Beige, Macropoxy 646 Beige.

Apply two finish coats as follows:

Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or

One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and
One coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

11. Steel, Machinery, and Equipment; Submerged:

One shop coat N69-1255 High-Build Epoxoline, Macropoxy 646 Beige as primer; and
Two field coats N69 High Build Epoxoline II, Macropoxy 646.

12. Galvanized, Copper, CPVC, and PVC; not Submerged or Buried:

One coat of N69-1255 Hi-Build Epoxoline II, Macropoxy 646; and either

Two coats of N69 Hi-Build Epoxoline, Macropoxy 646 for interior surfaces; or

One coat of N69 Hi-Build Epoxoline, Macropoxy 646; and
One coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

13. Insulation of Equipment, Pipes, and Ductwork:

Two coats of Series 6 Tnemec-Cryl, DTM Acrylic B66W1.

14. Galvanized, Copper, CPVC, and PVC; Submerged or Buried:

Not painted

15. Aluminum Items:

Exposed areas of structural items such as railings and grating shall not be painted.

For structural items in contact with concrete; See Division 5.

16. Painted Wood; Outside:

Sherwin Williams products;
One coat of A-100 Alkyd Exterior Wood Primer;
Two coats of A-100 Satin Latex House and Trim.

17. Stainless Steel:

Not painted

18. Brick:

Not painted

C. Existing Areas: Existing areas damaged by removal of existing work and/or installation of new work shall be repainted to match existing and in accordance with the schedule for new work.

D. Existing Areas: Existing equipment and structures shall be painted in accordance with the following schedule and as listed in the Finish Schedule shown on the drawings. All salvaged equipment and piping scheduled to be incorporated in the work shall be painted in accordance with the schedule for new work if not specifically listed below. All existing painting which is not to be removed shall be painted in accordance with the schedule listed below.

1. Steel Doors, and Exterior Gas Piping to Remain:

Hand sanded with rusted areas disc-abraded and then solvent cleaned with mineral spirits. Spot prime with 135-1255 ChemBuild at 3.0 mils.

Coat in accordance with Item 10 of new work

2. PVC and Plastic Piping:

Hand sand;
Solvent clean; and
Coat in accordance with Item 12 of new work.

3. DI Piping:

Abrasive blast or power tool;
Clean to SSPC SP-6 or SSPC SP-11; and
Prime and finish coat in accordance with Item 6 of new work with shop primer replaced by field primer.

4. Steel Piping, Handrails, Stairs-Interior:

Abrasive blast or power tool clean to SSPC-SP 6 or SSPC-SP 11;
Solvent clean;
Prime coat of 135-1255 Chembuild; and
Two coats of 69 Hi-Build Epoxoline II.

5. Precast and Cast-in-Place concrete and concrete block walls, ceilings, and floors which are currently unfinished.

No paint.

6. Concrete Floors which are currently finished:

Remove existing coating,
Coat in accordance with Item 2 of new work.

7. Interior Concrete Block Walls which are currently painted and remain exposed:

Abrasive blast,
Coat in accordance with Item 3 of new work.

8. Drywall:

One coat 6 Tneme-Cryl at 180 square feet per gallon.

9. Insulation of Equipment, Pipes, and Ductwork: Two coats of Tnemec Series 6 Tnemec-Cryl.

E. Coverage:

1. Dry mil thickness shall conform to those specified. Mil test measurement shall conform to SSPC Steel Structures Painting Manual. Dry Film Thickness (DFT) shall be verified in accordance with SSPC-PA2.
2. The coatings listed will provide the mil thickness given when applied at the coverages listed. Upon the request of ENGINEER, such surfaces shall be checked by the painter with a calibrated mil thickness gauge and any deficiencies found in the film shall be remedied by additional coat(s) at the expense of CONTRACTOR.
3. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative pinhole-free finish either by decreasing the coverage rate or by applying additional coats of paint.
4. Coverages reflect manufacturer's recommendations using spray application techniques. Where brushing or rolling is specified or performed at the discretion of the painter, one additional coat, minimum, will be required to achieve total DFT thickness as specified and recommended by the manufacturer.

	Sq. Ft.** Coverage	Dry Mil Thickness Per Coat
<u>Products</u>		
6 Tnemec-Cryl, DTM Acrylic B66W1	200	
N69 Hi-Build Epoxoline II, Macropoxy 646		
Concrete Block Primer Coat	90	---
Concrete Block Intermediate Coat(s)	130	---
Concrete Block Finish Coat	140	---
Concrete Primer Coat	100	---
Concrete Intermediate Coat(s)	140	---
Concrete Finish Coat	160	---
Steel or Impervious Substrate Primer Coat	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish coat	---	5.0
135-1255 Chembuild, Macropoxy 646	335	4.0
Steel Doors	---	3.0
1074 Endura-Shield II	---	2.5
<u>Sherwin-Williams Product</u>		
ProMar 200 primer (sprayed)	200	
ProMar200 Primer (rolled/brushed)	260	
ProMar 200 Enamel (sprayed)	280	
ProMar 200 Enamel (rolled/brushed)	360	
A 100 Alkyd Wood Primer (sprayed)	200	
A 100 Alkyd Wood Primer (rolled/ brushed)	260	
A 100 Satin Latex Trim (sprayed)	280	
A 100 Satin Latex Trim (rolled/ brushed)	360	

- ** Roller or brush application requires two or more coats to obtain recommended film thickness. No allowance is made here for overspray, waste in handling, mixing, or application. Final total dry film thickness (DFT) shall be equal to that specified. Paint submittals shall note where roller or brush application is proposed and the paint manufacturer's recommendations of number of coats to achieve the required thickness shall be noted.

Primer, intermediate and/or final surface colors shall be of contrasting colors to assure coverage.

F. Colors:

1. Colors are to be selected by OWNER, with the following piping colors used where applicable:

Sludge line	- brown
Gas line	- orange
Sewage line	- gray
Potable water line	- blue
Nonpotable water line	- blue with 6-inch yellow band at 30-inch centers
Chlorine or sodium hypochlorite line	- yellow
Sulfur dioxide or bisulfite line	- light green with 6-inch yellow band at 30-inch centers
Blower line	- green
Compressed air line	- green
Phosphorous Removal Chemical	- orange with 6-inch green band at 30-inch centers
Plant Water (PLW)	- Blue with 6-inch red band at 30-inch centers

2. Bands above may be similar to labels supplied as specified below. Colored tape will not be permitted.

- G. Labels: In addition to the color code, each pipe shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Labels shall be abbreviated as noted under fluid abbreviations on the drawings. Labels shall be painted with stencils, 2-inch letters on pipes 4 inches and larger and 1-inch letters on pipes smaller than 4 inches. Labels shall include arrows indicating direction of flow. Snap-on pipe markers with permanent tension built into each plastic marker to grip pipe firmly may be used instead of painted labels. Snap-on labels shall be Brady, System 3, or equal mechanically affixed pipe markers.

- H. All piping containing or transporting hazardous or corrosive chemicals shall be identified with labels every 10 feet and with at least two labels in each room, closet, or pipe chase. Color coding shall also be used.

- I. Shop Finish Painting: The following items shall have factory-applied finishes and will not require field painting. CONTRACTOR shall field touch up any damaged areas with factory provided touch up coating.

1. Sectional overhead doors.
2. Fiberglass doors, equipment, structures, stairs, and railing.
3. Hoists, trolleys, and cranes.
4. Factory finished HVAC equipment. Rooftop units are to be field painted.
5. Chemical Feed System Pumps and Accessories.
6. Screening Equipment.

7. Screenings Wash Press.
8. Submersible Mixers.
9. Samplers.
10. Parshall Flume liners.
11. Motor Control Centers.
12. Supervisory Control Centers.
13. Switchgear.
14. Sump pumps.

END OF SECTION

SECTION 10050

MISCELLANEOUS SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Cylinder truck.
 - 2. Lockout/tagout centers.
 - 3. Safety poles.
 - 4. Life preservers.
 - 5. Neoprene gaskets.
 - 6. Safety net system.
 - 7. Splash curtain.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 CYLINDER TRUCK

- A. Provide one two-wheel cylinder truck. Truck shall be suitable for use with 150-pound cylinders of chlorine. Truck shall have rubber wheels. Truck shall be Hercules Model 201-22, or equal.

2.02 LOCKOUT/TAGOUT CENTERS

- A. CONTRACTOR shall provide one lockout/tagout center to be located in the MCC Room of the RAS Pumping Building. Centers shall include 12 lockout/tagout training booklets, 12 padlocks in 6 colors, 12 lockout hasps, and 25 “DANGER–EQUIPMENT LOCKED OUT” lockout tags. Centers shall be durable 24 inches wide by 30 inches high impact-resistant styrene (display board with three 5-inch-deep pockets).
- B. Lockout/tagout centers shall be Seton Model No. 42469. Provide additional equipment to meet quantities as specified above.

2.03 SAFETY POLES

- A. Provide four swim pool rescue poles, one at each clarifier, one at the chlorine contact tank, and one at the oxidation ditch. Poles shall be aluminum, 16 feet long, with V-shaped retrieval hook on one end. Safety poles shall be provided with V-hook brackets for fastening.
- B. Acceptable products include rescue poles Model PO14330 by Swimtime, United Industries, Inc., 1-800-835-3272, or equal.

2.04 LIFE PRESERVERS

- A. Provide four life rings, one at each clarifier, one at the chlorine contact tank, and one at the oxidation ditch. Preservers shall be coast guard-approved Type 4 personal flotation device, 30-inch-diameter rings with grasping rope fastened around the edge. Preservers shall be provided with stainless steel brackets for fastening and with 45 feet of throw line.
- B. Acceptable products for life rings shall be PO14810 and brackets shall be PO14850 by Swimtime, United Industries, Inc., 1-800-835-3272, or equal.

2.05 NEOPRENE GASKETS

- A. Furnish and install neoprene gaskets at weir plates and as called for on the drawings.
- B. Neoprene shall be of the size and thickness shown on the drawings. Minimum thickness shall be 1/8-inch. The material shall be 40-50 durometer premium grade neoprene. Only virgin polymers shall be used to manufacture the neoprene. A certificate of material quality shall be furnished.
- C. Where splices are necessary, they shall be butt splices made with a two-part neoprene base bonding cement. The vulcanizing cement shall be Black Cement by CPR Industries of Carteret, New Jersey, or equal.
- D. At splices in weir plates, provide an additional thickness of neoprene to match the plate material. Bond the additional neoprene to the continuous gasket using the cement specified for splices.
- E. All gaskets shall be watertight.

2.06 SAFETY NET SYSTEM

- A. All aluminum floor/door openings shall be fitted with a permanently installed fall through prevention rail and net system that is easily retractable for access to the opening below. This system shall be Hatch Net 121 at manufactured by Safe Approach, Inc., or approved equal. Manufactured by Safe Approach, Inc., Poland, Maine. Phone: (207) 795-6332, fax (207) 784-2195.
- B. The fall through prevention system shall consist of the following components:
 - 1. A polyester safety net manufactured to ANSI A10.11 specification for personnel nets.
 - 2. Extruded aluminum side rails: Aluminum Alloy 6061-T-6 with an ultimate tensile strength of 18 KSI, a yield strength of 8 KSI, and a shear strength of 12 KSI.
 - 3. 316 stainless steel corner hooks.
- C. Each net assembly will come with a permanently attached label with the following information: Name of manufacturer, identification of net material, date of manufacture, date of prototype test, name of testing agency, and serial number.
- D. All stainless steel hardware and instructions necessary for proper installation of the net system shall be provided by the net system manufacturer. Installation shall be in accordance with the manufacturer's instructions.

- E. The complete assembly, including the net shall be warranted against defects in material and workmanship for manufacturer's standard time period.

2.07 SPLASH CURTAIN

- A. Splash curtain for protection at chemical pumps shall be a standard grade smooth, vinyl panel by Singer Safety Company, or equal. Vinyl panel shall be 16-mil thick and be of adequate length that allows only 3 inches of clear space on bottom or curtain. Panel shall be clear view vinyl full height. Panel shall be grommeted along the top hem for hanging and weighted along the bottom hem for stability. The grommeted top hem shall be hung by swivel hooks connected to wheel rollers allowing the panel to be flexible and moveable. Provide stainless steel universal mounting rack supported by stainless steel threaded hanging rods attached to the ceiling. Ends of panel shall allow both easy access and attachment to wall for a tight seal. All mounting hardware and appurtenances shall be fiberglass.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Fasten safety pole and life preserver brackets to aluminum handrails with stainless steel fasteners. Mount at locations requested by OWNER.

END OF SECTION

SECTION 10441

PLASTIC AND METAL SIGNS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Caution signs.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit under provisions of Section 01300—Submittals.
- B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, and overall dimensions of each sign.

PART 2—PRODUCTS

2.01 CAUTION SIGNS

- A. CONTRACTOR shall provide CAUTION signs as detailed on the drawings.
- B. Signs shall be fiberglass with black letters on yellow background, Brady Systems, B-120, or equal.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install signs after surfaces are finished in locations as directed.

3.02 SCHEDULES

- A. Provide CAUTION signs at scum wet well, Screening Building Chemical Room door, PRC Tank Fill site. Provide 3 total.

END OF SECTION

SECTION 10520

FIRST AID KIT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: First aid kit.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MANUFACTURER

- A. First aid kit shall be Johnson and Johnson Model No. 3114-2 wall-mounted (50-person 225-item kit), Lab Safety Supply Co. (800-356-0783), or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. First aid kit shall be wall-mounted.
- B. Mount in the RAS Pumping Building where requested by OWNER.

END OF SECTION

SECTION 10522

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Fire extinguishers.
 - 2. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/NFPA 10–Portable Fire Extinguishers.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals.
- B. Product Data: Provide extinguisher operational features, color and finish, anchorage details, and cabinet dimensions.

1.04 QUALITY ASSURANCE

- A. Provide units conforming to NFPA 10 requirements for portable fire extinguishers.
- B. Provide fire extinguisher, cabinets, and accessories by single manufacturer.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Larsen's Manufacturing Company, Product MP Series.
- B. Substitutions: Under provisions of Section 01600–Materials and Equipment.

2.02 EXTINGUISHERS

- A. Provide six dry chemical-type, Larsen's MP Series, 10-pound capacity fire extinguishers. Fire extinguishers shall be UL-approved for Class A, Class B and Class C fires.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place extinguishers in brackets where shown on the drawings.
- C. Mount fire extinguisher so the handle is at 48 inches above the finished floor.
- D. The fire extinguishers will be located in the following buildings:
 - 1. Screening Building–Four.
 - 2. RAS Pump Station–Two.

END OF SECTION

SECTION 11300

CENTRIFUGAL VERTICAL NON CLOG WASTEWATER PUMPS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation one new vertical close coupled dry pit non-clog pump and rebuilding two existing vertical close coupled dry pit non-clog pumps and providing new motors.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Application: Raw Sewage Pumps (RSP) 30-RSP-01, 30-RSP-02, and 30-RSP-03 shall be used to pump unscreened raw wastewater and shall be located in the drywell of the Control Building. The pump speed shall be controlled by a variable frequency drive as specified in Division 16.
- B. Design and Performance Requirements:
1. Pump RSP-30-01 shall meet the following performance requirements at a maximum speed of 1175 rpm:

Maximum TDH			Normal TDH			Minimum TDH		
Flow Rate (gpm)	TDH (ft)	Min. Pump Efficiency (%)	Flow Rate (gpm)	TDH (ft)	Min. Pump Efficiency (%)	Flow Rate (gpm)	TDH (ft)	Min. Pump Efficiency (%)
727	55.9	70	1454	42.2	82	2180	26.7	69

2. Pump RSP-30-02 shall meet the following performance requirements at a maximum speed of 1185 rpm:

Maximum TDH			Normal TDH			Minimum TDH		
Flow Rate (gpm)	TDH (ft)	Min. Pump Efficiency (%)	Flow Rate (gpm)	TDH (ft)	Min. Pump Efficiency (%)	Flow Rate (gpm)	TDH (ft)	Min. Pump Efficiency (%)
1628	43.9	72	2170	37	79	3526	21.2	73

3. Pump RSP-30-03 shall meet the following performance requirements at a maximum speed of 1185 rpm:

Maximum TDH			Normal TDH			Minimum TDH		
Flow Rate (gpm)	TDH (ft)	Min. Pump Efficiency (%)	Flow Rate (gpm)	TDH (ft)	Min. Pump Efficiency (%)	Flow Rate (gpm)	TDH (ft)	Min. Pump Efficiency (%)
1628	43.9	72	2170	37	79	3526	21.2	73

4. Each pump shall also be able to pump a minimum flow rate of 500 gpm at 25 feet TDH and a minimum speed of 700 rpm. Minimum pump efficiency at this condition shall be 70%.
5. With two pumps operating and the largest pump out of service, pumps shall be able to pump a maximum flow rate of 5,150 gpm at 30 feet TDH and a maximum speed of 1,185 rpm. Minimum pump efficiency at this condition shall be 69%.
6. The above values were calculated using a pipe friction "C" value of 120.
7. Pump efficiency measured at the shaft input shall not be less than indicated in the above tables when pumping at the specified capacities and total dynamic heads shown.
8. Pump NPSHR, speed and required BHP shall not exceed the values shown in above tables. Pump flows, TDH, and efficiencies shall not be less than the values shown in the above tables.
9. Pump shall not have sediment clogging potential at any operating condition listed above.
10. Pump motors shall be non-overloading over the entire curve and no operating speeds shall be greater than 1185 rpm. Pump motors shall be rated at 25 hp for RSP-30-01 and 30 hp for RSP-30-02 and RSP-30-03.

1.03 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

1.04 WARRANTY

- A. Manufacturer shall warranty rebuilt and new pumps for a period of two years from substantial completion. Warranty shall cover defects in material and workmanship and shall include repair or replacement of defective components. Warranty shall be in written form. Warranty shall specifically exclude buyer's indemnification language. Warranty shall be provided with shop drawings.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. The new pump shall be manufactured by Fairbanks Morse, Aurora, or equal. Remove existing pumps and deliver to Fairbanks Morse certified representative, or equal.

Pump	Status	Fairbanks Morse Model Number	Impeller	Suction Diameter (in)	Discharge Diameter (in)	Passing Sphere (in)
RSP-30-01	Existing	6-B5443	12	6	6	3
RSP-30-02	Existing	8-B5444S	11.9375	10	8	3
RSP-30-03	New	8-B5444S	11.9375	10	8	3

- B. The drawings and specifications were prepared based on Fairbanks Morse Pump Corporation. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 PUMP UPGRADE

- A. Pump upgrade shall include the following components:
 - 1. Remove pump and upgrade in field.
 - 2. Supply written inspection report detailing critical dimension, deviations from desired dimensions, and recommendations part by part for repair, reuse, or replacement.
 - 3. Replace the following components:
 - a. New upper and lower bearings.
 - b. New mechanical seal with new stainless steel shaft sleeve.
 - c. New volute and fronthead gasket.
 - d. Grease seals.
 - e. Motor base suitable for VFD
 - f. New impeller trimmed to conditions.
 - g. Stainless steel wear ring for impeller and volute.
 - h. Stainless steel impeller bolt and washer.
 - 4. Preparation and painting of pump and components shall be as specified herein.
 - 5. Reassemble pump complete using new, refurbished, and reusable components.

2.03 PUMP CONSTRUCTION

- A. This specification includes the supply of a vertical dry-pit solids-handling pump. Pump shall have a maximum 10-inch diameter suction and 8-inch diameter discharge. Each unit shall be furnished with a pump, driver, and VFD rated motor high ring base with guard. Pumps are to be connected to drivers by suitably sized flexible coupling and shaft guards as required.
- B. Impeller: The impeller shall be of the balanced non-clogging type made of close-grained cast iron conforming to ASTM A48 CL30. It shall be of one-piece construction, single suction, enclosed two-vane, radial flow design with well-rounded leading vanes and then tapered toward the trailing edge for a circular flow pattern. The waterways through the impeller will have extremely smooth contours, devoid of sharp corners, so as to prevent rags or stringy, fibrous material from catching or clogging. The clearance between the impeller outside diameter and cutwater shall be capable of passing a 3-inch sphere. The impeller is to be balanced and secured to the shaft by means of a bolt, washer, and key. The arrangement shall be such that the impeller cannot be loosened from torque in either forward or reverse rotation. Wiper vanes on the back impeller shroud are not allowed.
- C. Volute/Casing: The volute shall be matched to the impeller and made of close-grained cast iron conforming to ASTM A48 CL30. The volute is to be of one-piece circular constant flow, equalizing pressure design with smooth fluid passages large enough to pass any size solid that can pass through the impeller. The volute shall be side flanged tangential discharge and capable of rotation in 45 degree increments to accommodate piping orientation. Diffusion vanes are not permitted. The volute shall be furnished with large cleanout openings located at the impeller centerline, to allow access to the impeller. Volute priming, drain and 1/2-inch minimum gauge connections shall be provided. Flanges shall be 125 pounds flat faced flanges per ANSI drilling. The casing shall be designed to permit

the removal of the rotating assembly without disturbing the suction or discharge piping. The casing shall be hydrostatically tested to 1.5 times the design head or 1.25 times the shutoff head whichever is greater.

- D. **Wear Rings:** Wear rings shall be provided on both the impeller and fronthead so that clearances can be maintained throughout the life of the rings and minimize recirculation. Impeller wear rings shall be of the L-shaped axial- or face-type. Fronthead wear rings shall be of the axial- or face-type. Wear rings shall be attached to the impeller and fronthead using an interference fit and Loctite. Wear rings shall be stainless steel, with the impeller wear ring approximately 50 Brinell softer than the fronthead wear ring. Wear ring clearance adjustment shall be attained through impeller adjustment capscrews located at the end of the bearing frame.
- E. **Fronthead:** The fronthead shall be made of close-grained cast iron conforming to ASTM A48 CL30. It shall be cast separately the volute and connected to the suction elbow.
- F. **Backhead:** A separately cast close-grained cast iron backhead with large access openings and integral sealing box conforming to ASTM A48 CL30 shall be provided. The sealing box shall be designed for use with mechanical seal without requiring re-machining. The sealing box shall be furnished with a 1/4-inch injection and vent tap for a clear water or grease connection to a water seal ring to prevent air from entering the pump through the sealing box. A 3/4-inch minimum backhead drain tap shall be provided. Sealing box leakage will be collected by the backhead drain trough and piped directly to drain, eliminating any drippage to the floor. Provide a double mechanical seal as specified herein. Glands shall be two-piece split interlocking, made of cast iron (bronze), held in place by studs and nuts.
- G. **Bearing Frame Assembly:** The bearing housing shall be close-grained cast iron conforming to ASTM A48 CL30 and of heavy, rugged design for carrying the bearings and machined for accurate and permanent bearing alignment completely enclosing the shaft between the bearings. The bearing housing shall be of dust-proof design, incorporating lip-type grease seals in contact with the shaft to prevent the entrance of contaminants. Jacking bolts for external impeller adjustments are required. Zerk-type grease fittings for bearing lubrication shall be supplied at the bearing housing.
- H. **Pump Shaft:** The pump shaft shall be high-strength alloy steel with a minimum 100,000 PSI tensile strength and 75,000 PSI yield strength of sufficient diameter to carry the maximum loads imposed and to prevent vibration and fatigue. The shaft shall be accurately machined along its entire precision ground at bearing locations. Keyways shall be provided at both ends.
- I. **Shaft Sleeve:** A renewable straight shaft sleeve, positive adhesive sealed to prevent leakage between the shaft and the sleeve, shall protect the shaft through the sealing box area. The shaft sleeve shall be stainless steel with Brinell hardness of 300-350 (on mechanical seal pump shaft sleeve may be corrosion-resistant bronze).
- J. **Bearings:** Radial (inboard) bearings shall be single-row grease-lubricated ball bearings designed to carry the hydraulic radial loads encountered in the service conditions. Thrust (outboard) bearings shall be double-row designed to carry the pump hydraulic axial and dead load thrust. Bearings shall be designed for an L10 life of 100,000 hours per AFBMA at best efficiency point.

- K. Base and Suction Elbow: A rugged, heavy-duty fabricated steel base with openings large enough to permit access to the suction elbow and cleanout, bolted directly to the volute, shall be provided. The base shall be designed to support the assembled weight of the pump and shafting. A cast iron suction elbow with 1/2-inch gauge connection, contoured handhole cleanout, and a 125 pound flat-faced flange conforming to ANSI drilling shall be furnished.
- L. Fits and Hardware: The volute/casing, fronthead, backhead, and frame shall be manufactured with concentric shoulder fits to assure accurate alignment. All machined bolts, nuts, and capscrews shall be of the hex-head type and will not require the use of any special tools.
- M. High Ring Base: The motor high ring base shall be cast iron or fabricated steel of adequate height to permit access to the coupling and furnished with a shaft guard and suitable for use with VFD.

2.04 PRESSURE GAUGES

- A. All pumps except as noted shall have suction and discharge pressure gauges shall be 4-1/2 inch dial, Ashcroft AA, US Gauge Figure 1279 with 316 stainless steel tube and socket, or equal, provided with diaphragm seal. Diaphragm seal shall be Red Valve Series 742, or equal, with 316 stainless steel housing and neoprene or EPDM sleeve and each seal shall have two shutoff ball valves. Gauge readout shall be 0 to 50 psi for discharge gauge and 0-30 feet for suction gauge.

2.05 SEALS SYSTEM

- A. The seal system shall be a double carbon and ceramic construction with the rotating carbons held in place by stainless steel springs. The seal housing assembly shall be so constructed as to be readily removable from the shaft for replacement. Mechanical seal shall be Type 21 as manufactured by John Crane, or equal. Non-pressurized oil bath seals are not acceptable.
- B. The seal shall be pressured and lubricated by water taken directly from the non-potable water system run through a filter to seal housing and introduced between the upper and lower sealing surfaces. A pressure reducing valve shall be provided in the on-potable line prior to the filters. The filter shall be of corrosion resistant materials and shall screen out all solids larger than 50 microns (.002 inch). The seal system shall contain a brass valve connected near the top of the seal housing to permit the relief of any air trapped in the seal unit. Seal housing and pump volute shall be fitted with 1-1/2 inch drain line to near floor drains. Each seal water line shall include a motorized valve that is open when the pump is on. Seal shall be set up for normal dead-head arrangement with needle valve on discharge for flushing seal.

2.06 MOTORS

- A. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.

1. Physical Construction:
 - a. Copper windings with ball or roller bearings in end brackets of steel or cast iron, or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two-windings for all two-speed motors.
 - b. Motor shaft shall be high strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft run-out shall be 0.002-inch.
 - c. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be pre-lubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
 2. Mounting: Vertical
 3. Enclosure: TEFC
 4. Efficiency: Premium efficiency as noted in schedule below.
 5. Service Factor: 1.15
 6. Power requirements: 60 Hertz, Three phase, 230/460 volt, factory wired for 460 volt connection, $\pm 10\%$ voltage variation.
 7. Load type: Variable torque.
 8. NEMA Design: B.
 9. Insulation: Class F and rated for a Class B temperature rise.
 10. Nominal operating speed: Single speed, two winding 1200 RPM.
 11. Accessories:
 - a. Thermostats applied to motor windings, capable of shutdown and manual reset by external controls (by Division 16).
 - b. Lifting eyes.
 12. VFD requirements: Motor operating on VFDs shall be inverter duty rated, meet the requirements of NEMA MG1, Part 31, and be capable of a minimum speed turndown of 4:1.
- B. Motor Schedule:
1. If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Pump	Horsepower	Nominal Speed	FLA	Efficiency
RSP-30-01	25	1175	81.4	93%
RSP-30-02	30	1185	81.0	93%
RSP-30-03	30	1185	81.0	93%

2.07 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16 and specification Section 11940.
- B. Equipment manufacturer shall review electrical wiring and control diagrams prepared by the Division 16 contractor. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.
- C. Electrical controls and instrumentation for this equipment are specified under Section 16480–Motor Control and Section 16940–Controls and Instrumentation of these specifications.

2.08 VARIABLE SPEED CONTROLS

- A. Variable speed drives are specified in Division 16 of these specifications. Care shall be taken in sizing the drive to ensure adequate starting torque is available for the pumps. This information shall be provided to the variable speed supplier specified in Division 16.
- B. Pump controls are specified in Division 16, Section 16940—Controls and Instrumentation of these specifications. Pump manufacturer shall review these controls and coordinate with Division 16.

2.09 SPARE PARTS

- A. CONTRACTOR shall provide along with the shop drawings a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of the each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.10 FINISHES

- A. It is the intent of this specification that all equipment, supports and appurtenances shall be furnished shop primed, clean and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. (For equipment surfaces in contact with potable water, primer shall be 140-1255 Beige Pota-Pox Primer and shall be NSF approved.) Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify.

2.11 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be of ample strength for the intended service. Provide anchor bolts in accordance with Division 5.

PART 3—EXECUTION

3.01 GENERAL

- A. See Division 1 for requirements related to equipment installation, field quality control, testing, supervision, and start-up.

3.02 EQUIPMENT INSTALLATION AND COORDINATION

- A. CONTRACTOR shall rebuild existing pumps one at a time while maintaining influent pumping to existing plant

3.03 VARIABLE SPEED CONTROL COORDINATION

- A. The equipment manufacturer shall coordinate with the variable speed drive supplier at the time of equipment startup to address minimum speed requirements to protect both motor and equipment and to meet specified design and performance requirements. Minimum speed settings (in hertz) shall be provided to OWNER. Equipment operation over the entire control range shall be completed to demonstrate successful operation and to meet specified design and performance requirements.
- B. Pump manufacturer shall perform a vibration analysis and harmonics frequency test of the installed units to determine the actual field defined range of VFD speeds that should be locked-out and where the VFD should be ramped across (not operate) in this range to limit harmonic frequencies. This shall be performed and repeated at high submergence, zero submergence and at low submergence.

END OF SECTION

SECTION 11310

CENTRIFUGAL SLUDGE PUMPS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation three RAS pumps (RASP-70-01, RASP-70-02, RASP-70-03), as shown on the drawings and specified herein. The equipment shall consist of three pumps from one manufacturer complete with motors, bases, belt drives, and other appurtenances. The pumps shall include mechanical seals and seal water filters as specified. The pumps and other appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Application:
- Three pumps (RASP-70-01, RASP-70-02, RASP-70-03) shall be used for return activated sludge (RAS) pumping and shall be installed in the RAS Pumping Building. RAS temperature will be approximately 40 to 75°F. Pump speed shall be controlled by VFD provided by Division 16 supplier. RAS concentration is expected to be between 0.3 to 1.0% solids.
- B. Performance:
- The RAS pumps shall meet the following performance requirements at 1,175 rpm speed:

Maximum TDH			Normal TDH			Minimum TDH		
Flow (gpm)	TDH (ft)	Efficiency (%)	Flow (gpm)	TDH (ft)	Efficiency (%)	Flow (gpm)	TDH (ft)	Efficiency (%)
250	32	45	550	19	65	800	9	53

- RASP-70-01, RASP-70-02, and RASP-70-03 shall have a minimum speed of 675 rpm. At 675 rpm, the pump shall be capable of 115 gpm at 11 feet TDH.
- Pump efficiency measured at the shaft input shall not be less than indicated in the above table at full speed when pumping at the maximum capacity and total dynamic head in feet, specified.
- None of the hydraulic heads specified include any allowance for pump internal velocity head, and all specified heads shall be adjusted for the velocity heads applicable to the pumps. Internal pump velocity head shall not be considered effective head delivered by the pump, and shall not be included in the pump test head or performance curve and efficiency calculations. In calculating system heads, suction head was calculated based on elevation difference plus friction losses to the pump suction flange. Discharge head was calculated based on elevation differences plus friction losses from the pump discharge flange to point of discharge.

4. Pump NPSHR shall not exceed 20 feet at any listed operation point of the pump.
5. Pump shall not have sediment clogging potential at any operating condition listed above.

1.03 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Pumps RASP-70-01, RASP-70-02, and RASP-70-03 shall be helical screw centrifugal pumps manufactured by Wemco, Hayward Gordon, or equal.
- B. The drawings and specifications were prepared based on Wemco. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment, including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 GENERAL

- A. The complete units, when assembled and operating, shall be free of cavitation and noise. Vibration shall not be in excess of Hydraulic Institute Standards over the entire range of operation specified, and be verified by supplier after start up. Pump impeller selection must compensate for slip losses or other speed variations due to final motor or control selection in order to deliver flows at head conditions specified herein. Pump supplier shall be responsible for verifying that his pump will operate properly utilizing the suction and discharge pipe sizes, valves, and fittings as shown on the drawings and with the control equipment specified in Section 16940—Controls and Instrumentation, of these specifications.

2.03 RAS SLUDGE PUMPS (RASP-70-01, RASP-70-02, RASP-70-03)

- A. Pumps shall be horizontal, end suction, and shall be as follows:

Pump	Model No.*	Discharge and Suction Size	Impeller	Nominal Speed	Passing Sphere
RASP-70-01	E5K-LM	5 by 6	Screw	1,175 Max.	3.00-inch
RASP-70-02	E5K-LM	5 by 6	Screw	1,175 Max.	3.00-inch
RASP-70-03	E5K-LM	5 by 6	Screw	1,175 Max.	3.00-inch

* To be confirmed by manufacturer.

2.04 PUMP CONSTRUCTION

- A. Pumps shall be screw centrifugal pumps.
- B. Pump volute shall be close grained cast iron and back pullout for the rotating assembly. Cleanouts shall be provided. The suction cover shall be provided with an internal spiral groove to prevent binding of fibrous material between it and the impeller. The casing shall be designed to allow for back pull out of the power frame for maintenance, without removing suction or discharge piping. Furnish pumps with 1/2-inch gauge connection and 3/4-inch volute drain and 3/4-inch vent connection with pipe to floor drain and valve near pump. Suction and discharge connections shall be 125 pound ANSI flanged.
- C. Pump impeller shall be statically and dynamically balanced, non clog conical profile, helical screw centrifugal type with well rounded leading edges. Impeller and suction liner shall be 450 Brinell Hi-Chrome iron, ASTM 532-CL3, Type A and fitted with full back pump out vanes or spiral grooves. Suction liner shall be independently replaceable and the externally adjustable by not more than three regulating screws. Screws shall advance, retreat and lock position of the suction liner. Impeller clearance shall also be externally adjustable at the pump shaft thrust bearing.
- D. Shaft assembly shall be high strength alloy steel. Shaft shall have removable stainless steel sleeve at mechanical seals. Bearings shall be grease lubricated single row radial and double row thrust bearings rated for a minimum B-10 life of 100,000 hours Best Efficiency Point and minimum L-10 life of 50,000 hours at the rated conditions.
- E. Bearing frame shall be close grained cast iron with jacking bolts for impeller adjustment.
- F. Pump base shall be a minimum of 3/8-inch fabricated steel with an open channel base. Motor base, belt drive and guard shall be arranged so that the pump rotating assembly is removable without disturbing motor or connecting piping.

2.05 PRESSURE GAUGES

- A. All pumps except as noted shall have suction and discharge pressure gauges shall be 4-1/2 inch dial, Ashcroft AA, U.S. Gauge Figure 1279 with 316 stainless steel tube and socket, or equal, provided with Diaphragm seal. Diaphragm seal shall be Red Valve Series 742, or equal, with 316 stainless steel housing and neoprene or EPDM sleeve diaphragm filled with ethylene glycol, 1-inch process connection, and flush connection top, and each seal shall have two shutoff ball valves. Gauge readout shall be 0 to 50 psi for discharge gauge and 0-30 feet for suction gauge.

2.06 SEAL SYSTEM

- A. The seal shall be of double carbon and ceramic construction with the rotating carbons held in place by stainless steel springs. The seal housing assembly shall be so constructed as to be readily removable from the shaft for replacement. Mechanical seal shall be Type 21 as manufactured by John Crane, or equal. Non-pressurized oil bath seals are not acceptable.

- B. The seal shall be pressurized and lubricated by water taken directly from the non-potable water system run through a filter to the seal housing and introduced between the upper and lower sealing surfaces. A pressure reducing valve shall be provided in the non-potable line prior to the filters. The filter shall be of corrosion resistant materials and shall screen out all solids larger than 50 microns (0.002 inch). The seal system shall contain a brass valve connected near the top of the seal housing to permit the relief of any air trapped in the seal unit. Seal housing and pump volute shall be fitted with 1-1/2 inch drain line to near floor drains. Each seal water line shall include a motorized valve that is open when the pump is on. Seal shall be set up for normal dead-head arrangement with needle valve on discharge for flushing seal.

2.07 MOTORS

- A. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
1. Physical Construction:
 - a. Copper windings with ball or roller bearings in end brackets of steel or cast iron, or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two-windings for all two-speed motors.
 - b. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be pre-lubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
 2. Mounting: Horizontal
 3. Enclosure: Hostile duty, TEFC.
 4. Efficiency: Premium efficiency as noted in schedule below.
 5. Service Factor: 1.15
 6. Power requirements: 60 Hertz, Three phase, 230/460 volt, factory wired for 460 volt connection, $\pm 10\%$ voltage variation.
 7. Load type: Variable torque.
 8. NEMA Design: B.
 9. Insulation: Class F and rated for a Class B temperature rise.
 10. Nominal operating speed: Single speed, 1200 RPM.
 11. Accessories:
 - a. Thermostats applied to motor windings, capable of shutdown and manual reset by external controls (by Division 16).
 - b. Lifting eyes.
 12. VFD requirements: Motor operating on VFDs shall be inverter duty rated, meet the requirements of NEMA MG1, Part 31, and be capable of a minimum speed turndown of 4:1.
- B. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Pump	Horsepower	Nominal Speed	Efficiency
RASP-70-01	7.5	1,200	91.7%
RASP-70-02	7.5	1,200	91.7%
RASP-70-03	7.5	1,200	91.7%

2.08 PUMP DRIVE

- A. Pumps shall be mounted on a heavy-duty properly sized fabricated steel base fitted with openings for grouting and driven through V-belts by motor in-line with pump, but not over pump. Totally enclosed mesh type belt guards providing quick access for belt adjustments shall be provided. Guard shall meet all OSHA standards. The V-drives shall be of the multiple belt non-sparking type and sized so that if one belt should fail, the balance of the belts will be adequate to drive the pump continuously. Belt drives shall have a minimum service factor of 2.0.

2.09 FINISHES

- A. It is the intent of this specification that equipment supports and appurtenances shall be furnished shop primed, clean and ready to accept finish painting by CONTRACTOR, with a minimal amount of surfaced preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified, galvanized, stainless steel, rubber copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surfaced preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finished coats; CONTRACTOR to verify. Motors and speed reducers shall be factory primed and finished painted and using the manufacturer's standard paint system for the specified application.

2.10 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be Type 316 stainless steel. Anchor bolts shall be of ample strength for the intended services. Provide anchor bolts in accordance with Division 5.

2.11 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The listing shall include a description of each spare part, current pricing, and extend delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.12 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16 and specification Section 11940.
- B. Equipment manufacturer shall review electrical wiring and control diagrams prepared by the Division 16 Contractor. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.
- C. Electrical controls and instrumentation for this equipment are specified under Section 16480–Motor Control and Section 16940–Controls and Instrumentation of these specifications.

2.13 VARIABLE SPEED PUMP CONTROLS

- A. Variable speed drives are specified in Division 16 of these specifications. Care shall be taken in sizing the drive to insure adequate starting torque is available for each pump. This information shall be provided to the variable speed supplier specified in Division 16.
- B. Pump controls are specified in Division 16, Section 16940—Controls and Instrumentation of these specifications. Pump manufacturer shall review these controls and coordinate with Division 16.

PART 3—EXECUTION

3.01 GENERAL

- A. See Division 1 for requirements related to equipment installation, field quality control, testing, supervision and start-up.

3.02 TESTING

- A. During equipment startup, manufacturer's representative shall confirm each pump is operating on the design curve at design speed. Report shall be submitted verifying test. Pump shall be modified if specified conditions are not met.

3.03 VARIABLE SPEED CONTROL COORDINATION

- A. The equipment manufacturer shall coordinate with the variable speed drive supplier at the time of equipment startup to address minimum speed requirements to protect both motor and equipment and to meet specified design and performance requirements. Minimum speed settings (in hertz) shall be provided to OWNER. Equipment operation over the entire the entire control range shall be completed to demonstrate successful operation and to meet specified design and performance requirements.

END OF SECTION

SECTION 11314

PROGRESSING CAVITY PUMPS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Furnish and install one pump where shown on the drawings. Pump shall be a complete pump unit consisting of pump, motor, bases, belts, guards, seal lubrication system, and fluid detection control.
- B. Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Pump SCMP-70-01 shall be able to pump secondary wastewater, floating solids, WAS, and scum.

1.03 WARRANTY

- A. The pump shall meet the following performance requirements:

Pump	Capacity (gpm)	Total Discharge Head (psi)
SCMP-701	40 gpm	70

- B. Pump shall be warranted to be free from defects in material and workmanship for a period of three years (parts and labor without prorating warranty for time of usage). This warranty shall be in printed form and shall apply to all similar units.

1.04 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. The pump shall be as manufactured by Moyno Industrial Products–A Division of Robbins & Myers, Inc., Netzsch, Inc. Nemo pump, or equal.
- B. The drawings and specifications were prepared based on Moyno pumps. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment, including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 GENERAL

- A. Pump shall be heavy-duty, progressing cavity, suitable for pumping scum and floating solids, or thickened waste activated sludge. Each pump shall be capable of passing long stringy materials. The pump shall be provided complete with guards, base, fluid/heat detection control and other appurtenances. The pumps and other appurtenances shall be furnished by the same supplier.

2.03 PUMP CONSTRUCTION

- A. Pump shall be of the heavy duty, positive displacement, progressing cavity type. Pump shall be cradle mounted to allow the normally vertical suction port to be rotated to any angle perpendicular to the centerline to facilitate piping connections. Pump shall have 2 stage rotor and stator. Maximum pump speed shall be as indicated below:

Pump	Maximum Speed (rpm)	Moyno Model
SCMP-70-01	215 @ 40 gpm	2E022G1

- B. The bearing and suction housings of the pump shall be thick walled cast iron. All cast parts shall be free of sand holes, blow holes, and other defects. The suction housing shall incorporate two rectangular inspection ports, 180° apart, to permit access to the suction housing interior without disconnecting piping.
- C. The suction and discharge connections shall be flat face flanges with bolt hole dimensions and spacing to Class 25 ANSI standards. Suction flanges shall be 6-inch with 6-inch discharge flanges. CONTRACTOR is responsible for providing reducing elbows and fittings to match with suction and discharge flanges, as required.
- D. The ASTM A331-90, grade 4150 alloy steel rotor shall be a machined and polished single helix with a nominal chrome plating thickness of 0.010 inches for maximum abrasion resistance.
- E. Stator shall be of double helix configuration with the molded 70 durometer nitrile elastomer chemically bonded to a steel tube. The stator seals shall be designed to prevent the material being pumped from contacting the stator bonding and tube. Rotor and stator shall be removable in space available without having to remove pump or suction piping.
- F. Drive shafts and Joint:
1. The gear joints shall be of the grease lubricated crowned gear type, totally enclosed and protected by a wire reinforced elastomeric seal. Mechanical components of the gear joints shall be designed to operate for 10,000 hours at the manufacturer's published maximum speeds and pressures.
 2. A rigid, splined connecting rod shall connect the gear joints of the drive shaft and eccentrically moving rotor. The connecting rod shall pass through the shaft seal area inside the hollow drive shaft quill so that no eccentric loads are imparted on the shaft seal area.

3. The drive shaft shall be of one piece construction through the bearings and shaft seal area. This design shall permit disassembly of the universal joints without affecting the alignment of the shaft in the shaft sealing area. The shaft shall be fitted with a shaft sleeve.
- G. The bearings will be of the grease lubricated, tapered roller bearing type with diverging pressure angles for maximum shaft stability. Bearings are to be designed for a minimum AFBM L-10 life of 100,000 hours under maximum operating conditions and will not require periodic relubrication. The bearings shall be protected from contaminants.
- H. The stuffing box shall be equipped with a flush-type packing gland and split Teflon lantern ring to permit repacking of the pump without removing the bearings or drive shaft components. Fittings shall be provided for water lubrication of the packing, and flush water to the flush gland. Pump design shall allow for removal and replacement of packing without disassembly of the pump or pump bearings.
- I. Each pump shall be driven through a "HTD" or "Timing" type belt and shelves, covered by a guard meeting OSHA standards. Motor shall be in the Piggyback Belt and Pulley Arrangement.

2.04 MOTORS

- A. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
 1. Physical Construction:
 - a. Copper windings with ball or roller bearings in end brackets of steel or cast iron, or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two-windings for all two-speed motors.
 - b. Motor shaft shall be high strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft run-out shall be 0.002-inch.
 - c. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be pre-lubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
 2. Mounting: Horizontal
 3. Enclosure: TEFC.
 4. Efficiency: Premium efficiency as noted in schedule below.
 5. Service Factor: 1.15
 6. Power requirements: 60 Hertz, Three phase, 230/460 volt, factory wired for 460 volt connection, $\pm 10\%$ voltage variation.
 7. Load type: Constant torque.
 8. NEMA Design: B.
 9. Insulation: Class F.
 10. Nominal operating speed: Single speed, single winding 1200 RPM.
 11. Accessories: Lifting eyes.
- B. Motor Schedule:
 1. If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Pump	Horsepower	Nominal Speed, RPM	Efficiency, %
SCMP-70-01	10	1200 rpm	90.7%

2.05 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16 and specification Section 11940.
- B. Equipment manufacturer shall review electrical wiring and control diagrams prepared by the Division 16 Contractor. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.
- C. Electrical controls and instrumentation for this equipment are prepared by Section 16480-Motor Controls and Section 16940—Controls and Instrumentation of these specifications.

2.06 BASE

- A. The pump shall be mounted on a fabricated steel base plate with grout holes. The motor shall be mounted above the pump on an adjustable mounting plate.

2.07 PRESENCE/ABSENCE DETECTOR

- A. Furnish and install on the suction line of pump a pressure/absence detector for run-dry protection. The unit shall include an electronic control unit, mounted directly to the sensor flange in the 12 o'clock position. The unit shall be provided with an adjustable delay time before pump shut down and a "start pump" push button to override the sensor. The sensor shall be heavy duty cast aluminum, rated NEMA 4.
- B. The sensor flange shall be partial-ring with the materials in contact with wetted surfaces being constructed of Teflon and 316 SS. The sensor flange shall have integrally molded flange face gaskets and lip seals. The sensor flange shall be compatible with 150-pound ANSI flanges.
- C. The control unit shall be Model L3515 and the sensor flange shall be L642 as manufactured by Princo Instruments, Inc. of Southampton, PA, or equal.

2.08 HIGH PRESSURE SENSOR

- A. Furnish and install with pump a high pressure sensor. The sensor shall utilize a pressure sensor/isolator to separate the process fluid from the pressure sensing instrumentation. The process fluid pressure shall be transmitted by liquid silicone oil sealed between a carbon steel housing and a flexible elastomer element of Buna-N. The pressure shall be monitored by nonindicating pressure switch in NEMA 4X enclosure. The pressure switch shall be set to stop the pump if a high discharge pressure occurs. Pressure switch shall be as specified in Division 16. Also provide a pressure gauge with a 4-inch face reading to 100 psi for each pump.
- B. The pressure sensing elastomer element shall have integrally molded flange face gaskets and lip seals.

- C. The pressure sensor shall be compatible with 150 pound ANSI flanges. The fluid detection control described above shall be manufactured by RKL Series W sensor, a Division of Robbins & Myers Corporation, or equal.

2.09 SEAL LUBRICATION

- A. Provide seal water system for pump described above. Provide in and out connections on stuffing box and gland. Provide the following seal water components for pump, piped as indicated: pressure regulator, Norgan Type 11-009, Cashco Type D, or equal, pressure as determined by pump manufacturer; Y strainer, maximum 60 mesh (0.01 inch opening); motorized ball valve, motorized ball valve shall be powered to close-fail open; low flow sight indicator; two-needle disc type globe valve, screwed bonnet, rising stem, bronze body and stem, rated 200 pound SWP, 400 pound WOG, Walworth Figure 120, Jenkins Figure 743, or equal; two pressure gauges with petcock; minimum 4-inch face, calibrated to read approximately mid-range at stuffing box pressure determined by pump manufacturer. Provide seal water hose. Seal water hoses shall be clear plastic tubing rated 125 psig. Route hose to drain.

2.10 FINISHING

- A. It is the intent of this specification that all equipment, supports and appurtenances shall be furnished shop primed, clean and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified, mechanical equipment and accessories (except galvanized, stainless steel, rubber, copper, PVC) shall be prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. Motors and speed reducers shall be factory primed and finished painted using the manufacturer's standard paint system for the specified application.

2.11 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be Type 316 stainless steel. Anchor bolts shall be of ample strength for the intended services. Provide anchor bolts in accordance to Division 5.

2.12 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The listing shall include a description of each spare parts, current pricing, and extend delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

PART 3-EXECUTION

3.01 GENERAL

- A. See Division 1 for requirements related to equipment installation, field quality control, testing, supervision, and start-up.

END OF SECTION

SECTION 11315

CENTRIFUGAL BOOSTER PUMPS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation two centrifugal booster pumps (NPWP-70-01 and NPWP-70-02) as shown on the drawings and specified herein. The equipment shall consist of two pumps from one manufacturer complete with motors, bases, mechanical seals, and other appurtenances. The pumps and appurtenances shall be furnished by the same supplier.
- B. Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Application: Two pumps (NPWP-70-01 and NPWP-70-02) shall be used for pumping NPW. They shall supply NPW to the plant and shall be installed in the RAS Pumping Building basement (Room 7001).
- B. Performance:
1. The pumps shall meet the following performance requirements:

Pump	Capacity (gpm)	Total Discharge Head (ft)	Pump Efficiency	Minimum Shut- off Head (ft)	Maximum NPSHR (ft)
NPWP-70-01 and NPWP-70-02	100	231	58%	257	20

2. Pump efficiency measured at the shaft input shall not be less than indicated in the above table at full speed when pumping at the maximum capacity and total dynamic head in feet, specified.
3. None of the hydraulic heads specified include any allowance for pump internal velocity head, and all specified heads shall be adjusted if required for the velocity heads applicable to the pumps. Internal pump velocity head shall not be considered effective head delivered by the pump, and shall not be included in the pump test head or performance curve and efficiency calculations.

1.03 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Pumps NPWP-70-01 and NPWP-70-02 shall be horizontal in-line, Model 3121, size 1-1/2 by 1 by 8, as manufactured by Crane-Deming of Salem, Ohio, or equal.
- B. The drawings and specifications were prepared based on Crane Deming. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 GENERAL

- A. The complete units, when assembled and operating, shall be free of cavitation and noise. Vibration shall not be in excess of Hydraulic Institute Standards over the entire range of operation specified, and be verified by supplier after start up. Pump impeller selection must compensate for slip losses or other speed variations due to final motor or control selection in order to deliver flows at head conditions specified herein. Pump supplier shall be responsible for verifying that his pump will operate properly utilizing the suction and discharge pipe sizes, valves, and fittings as shown on the drawings and with the control equipment specified in Section 16940–Controls and Instrumentation, of these specifications.

2.03 PUMP CONSTRUCTION

- A. Pumps shall be horizontal, end suction, and shall be as follows:

Pumps	Figure No.	Suction Size	Discharge Size	Nominal Speed
NPWP-70-01 and NPWP-70-02	Crane-Deming 3120	1 1/2-inch	1-inch	3,550

- B. Pump casing shall be designed for 150 psi maximum working pressure. Pump shall be “top pull-out” design to permit servicing impeller and/or wear ring without disturbing discharge piping or pump alignment. Pump casing, support head, and suction cover shall be cast iron. Casing shall be fitted with a renewable 316 stainless steel wear ring. Pump suction and discharge connection shall be Class 125 ANSI B16.1 flanges.
- C. Bearing frame shall be of cast iron, with grease-lubricated radial and thrust bearings. Frame shall be precision bored to provide rigid alignment for rotating assembly. Bearing housing shall be sealed to exclude dirt and moisture. Pump shaft shall be fitted with a turned and ground high-strength Grade 316 stainless steel shaft sleeve. Bearings shall include grease fittings.
- D. Impeller shall be statically and hydraulically balanced, securely mounted and keyed to the shaft. Impellers shall be enclosed type of bronze construction.

- E. Pressure gauges and diaphragm assemblies shall be provided on the outlet connections of the centrifugal booster pumps. Pressure gauges shall be 2-1/2 inch diameter, glycerin filled with stainless steel movement, bourdon tube and socket. Pressure gauge shall be Model 450 LFSS by H.O. Trerice, or equal. Diaphragm seals shall be Model T611-03-TS with 1/4-inch flushing connections as manufactured by H.O. Trerice. The sensor shall have an auxiliary tapped and plugged port to allow connection of other equipment. Pressure shall be transmitted to a 4-1/2 inch diameter gauge by locked in and sealed ethylene glycol. Outlet pressure gauges shall be 0-150 psi.
- F. The pump shaft shall be fitted with a stainless steel shaft sleeve and sealed against leakage by a John Crane single mechanical seal, installed in a cast iron seal housing/backhead. The seal shall be of single carbon and Ni-Resistant construction with the rotating ceramics held in place by stainless steel springs. The seal housing assembly shall be so constructed as to be readily removable from the shaft for replacement. Provide a bronze recirculation assembly from the pump discharge to the seal area.

2.04 HYDROPNEUMATIC TANKS

- A. The hydropneumatic tanks shall be factory precharged diaphragm type water tank, Amtrol-Well-X-Trol Series 450, or equal. CONTRACTOR shall furnish and install two Model WX-454-C, or equal hydro tanks to pressurize the potable water system within an operating pressure range of 60 to 80 psig. The tanks shall be located as shown on the drawings. Tanks shall be 36-inch diameter by 94 1/2 inches high, with a tank volume of 317 gallons each. Tanks shall be designed to maintain system pressures during no-flow period and constructed for maximum operating pressure at 150 psig. Tanks shall be vertical, supported with steel legs or base and shall have specially compounded, replaceable flexible butyl diaphragm securely sealed in tank to permanently separate air charge from system water and to maintain expansion capacity. Finish paint in accordance with specifications herein.
- B. Connections and features shall include water inlet and outlet through bottom, air recharge inlet, pressure gauge, plus any other features required by the control manufacturer for operation and control.
- C. Drawings showing all connections with dimensions, and descriptive data on tank and controls shall be submitted to ENGINEER for approval.

2.05 MOTORS

- A. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
 - 1. Physical Construction:
 - a. Copper windings with ball or roller bearings in end brackets of steel or cast iron, or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two-windings for all two-speed motors.
 - b. Motor shaft shall be high strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft run-out shall be 0.002-inch.
 - c. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be pre-lubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.

2. Mounting: Horizontal.
3. Enclosure: TEFC.
4. Efficiency: Premium efficiency as noted in schedule below.
5. Service Factor: 1.15.
6. Power Requirements: 60 Hertz, Three phase, 230/460 volt, factory wired for 460 volt connection, $\pm 10\%$ variation.
7. Load Type: Variable torque.
8. NEMA Design: B.
9. Insulation: Class F.
10. Nominal Operating Speed: Single speed, 3600 RPM.
11. Accessories: Lifting eyes.

- B. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Pump	Horsepower	Nominal Speed (rpm)	% Efficiency
NPWP-70-01	15	3550	91.7
NPWP-70-02	15	3550	91.7

2.06 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16 and specification Section 11940.
- B. Equipment manufacturer shall review electrical wiring and control diagrams prepared by the Division 16 Contractor. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.
- C. Electrical controls and instrumentation for this equipment are specified under Section 16480–Motor Control and Section 16940–Controls and Instrumentation of these specifications.

2.07 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.08 FINISHES

- A. It is the intent of this specification that all equipment, supports and appurtenances shall be furnished shop primed, clean and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to

a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. Motors and speed reducers shall be factory primed and finish painted using the manufacturer's standard paint system for the specified application.

2.09 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel and shall be of ample strength for the intended service. Provide anchor bolts in accordance with Division 5.

PART 3-EXECUTION

3.01 GENERAL

- A. See Division 1 for requirements related to equipment installation, field quality control, testing, supervision, and start-up.

3.02 TESTING

- A. During equipment start-up manufacturer's representative shall confirm each pump operates on the design curve. Report shall be submitted verifying test. Pump shall be modified if test conditions are not met.

END OF SECTION

SECTION 11331

SCREENING EQUIPMENT

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation one new mechanically cleaned bar screen (SSE-20-01) and one screening wash/press (SSE-20-02). This equipment will be provided in the Screening Building. Provide all labor, equipment, and material for a complete functioning system, including startup and testing of all equipment and accessories. The bar screen and screening wash/press equipment and appurtenances shall be furnished by the same supplier.
- B. Applicable provisions of Division 1 shall govern work in this section.
- C. Equipment manufacturer shall review and approve the electrical wiring and control diagrams prepared by the Division 16 contractor. Manufacturer shall provide written approval of the electrical drawing to CONTRACTOR with copy to ENGINEER and OWNER.

1.02 SYSTEM DESCRIPTION

- A. Mechanical Bar Screen Design Requirements: (SSE-20-01)
 - 1. The screen shall be used to remove debris from the raw sewage influent flow by means of fixed and moveable lamellas. The raw sewage will be conveyed to the screen via variable speed pumping facilities.
 - 2. The screen shall be designed for the following:
 - a. Number of units: One.
 - b. Normal daily flow: 1.56 mgd.
 - c. Low flow rate: 0.0 mgd.
 - d. Peak flow rate: 7.48 mgd.
 - e. Channel width: 4 feet.
 - f. Channel invert to operating floor: 4.43 feet.
 - g. Minimum debris discharge height above operating floor level: 2.8 feet (*).
 - h. Submergence downstream of screen: 1.58 feet at 7.48 mgd.
 - i. Size of clear opening between bars: 1/8-inch.
 - j. Minimum lifting capacity per cycle: 300 pounds.
- B. Screening Wash/Press Design Requirements: (SSE-20-02)
 - 1. Screenings wash/press (SSE-20-02) will be used to wash, compact, dewater and convey the screenings discharged by the mechanically cleaned bar screen to the screenings dumpster located as shown on the drawings at a rate of up to 70 cubic feet per hour.
 - 2. Compressed debris shall be reduced in volume 50% and contain less than 55% moisture. Washer unit shall remove 90% of the feed organics material contained in the screenings. Screenings shall pass the "paint filter tests."

1.03 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Mechanical bar screens shall be a model SSF HE 3500x1026x3 stair screen manufactured by Huber Technology, Inc., a rotoscreen manufactured by Westech, or equal. The screening's wash press shall be manufactured by the screen manufacturer.
- B. The drawings and specifications were prepared based on Huber Technologies, Inc. equipment. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other manufacturers' equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.
- C. Equipment shall be a standard product of the manufacturer.
- D. Screen manufacturer shall be experienced in the manufacture of similar equipment, and shall have a minimum of 50 similar installations averaging 3 years successful operation each.

2.02 MATERIALS

- A. Mechanically Cleaned Bar Screen:
 - 1. All wetted parts: Step blade package, frame, sole plate, link mechanisms, blade cross pieces, drive console and covers: Type 304L stainless steel.
 - 2. All non-wetted parts: Type 304L stainless steel.
 - 3. Fasteners: Type 304 stainless steel.
 - 4. Stainless passivation to remove all embedded iron, surface rust and weld burns.
- B. Screenings Wash Press:
 - 1. Inlet hopper, U-trough, covers, chutes, compactor, pipes, supports, drainage trough, housings: Type 304L stainless steel.
 - 2. Screw Shaft and Flights: alloy steel.
 - 3. Hardware: Type 304 stainless steel.
 - 4. Stainless passivation to remove all embedded iron, surface rust and weld burns.

2.03 MECHANICALLY CLEANED BAR SCREEN

- A. General: The lamellas shall be secured within a framework mounted within and above the wastewater channel. Easy access shall be provided for maintenance of the screen from the front and sides of the unit by way of employing a pivoting mechanism.
- B. The stair screen shall consist of an inclined grid structure formed by a series of stationary bars defining a displaceable grid, the displaceable bars alternating with the stationary bars.

- C. The stationary and displaceable bars shall have a means to retard the downward movement of solid matter on the inclined grid structure. A beam structure running transversely below the displaceable bars and positioned on the inclined grid structure shall be provided to interconnect the displaceable bars into one unit.
- D. At the locations where the moving plates approach the fixed crosspieces, the moving plates (lamellas) shall have provisions to physically cut and tear away hair and other matter that might accumulate in the close clearances. Similar provisions shall be provided on the fixed plates at the locations where the moving cross pieces approach the fixed plates. Such provisions are not required if manufacturers' testing has demonstrated it is not required.
- E. The displaceable bars shall be driven by a power source that imparts a movement to the displaceable bars so that any point the edges of the displaceable bars will perform a generally closed circuitous path of movement including at least one vertical component of movement within each path to cause solid matter collected at the grid structure to move upwardly along the displaceable bars. Fixed lamellas in the transport area shall be manufactured of an abrasion resistance synthetic material wide enough to close up the space between the lamellas.
- F. Further said closed circuit path gives a self-cleaning movement across the whole surface of the screen, in accordance with the principle of counterflow. This brings about cleaning without any additional rinsing or external cleaning equipment (wipers or brushing).
- G. Frame:
 - 1. The frame shall accommodate the stair blade package, blade cross pieces, link mechanism wires, eccentrics and drive unit including shaft, gear and motor.
 - 2. The frame shall be accurately set into position into the channel and shall be anchored securely into place through fixing the support legs to the channel top. The screen shall be set at 45° to 57° to the horizontal.
 - 3. The frame sides shall be fully bolted to the sole plate, the blade cross pieces and the drive console. The frame sides shall form the supports for removable cover panels at the sides, front and back of the screen.
 - 4. The bottom step should be designed to avoid sedimentation before the screen.
 - 5. The screen shall be mounted in the channel without the need for recesses in the channel wall.
- H. Screen Blades: The lamellas shall be accurately set and have spacers to give the proper clearance between the blades.
 - 1. Fixed lamellas in the transport area shall be manufactured of an abrasion resistance synthetic material wide enough to close up the space between the lamellas.
 - 2. The blades shall be stair shaped with easily replaceable spacers. The lower thicker parts shall be permanently attached to the fixed blades.
 - 3. The filter screen shall be provided with a ground flap at the base of the machine perpendicular to the flow and level with the lowest step on the lamellas. The ground flap shall assist in directing grit and gravel onto the lamellas to prevent a buildup of material in front of the screen. The ground flap shall be spring-loaded to prevent debris from lodging between the flap and the bottom of the lamellas. The ground flap shall be manufactured of 316 stainless steel.
- I. Linkage System (Type 1, Huber, or equal):

1. The step screen shall be designed with a linkage system on each side of the unit that transfers the rotation of the gear motor to the moveable step blade package. Each linkage system shall consist of an eccentrically rotated rectangular excenter block, a flange bearing, rocker arm assembly, moveable side plate, slewing bracket, linkage arms, and bushings. Chain or cable drives are not acceptable.
 2. The rectangular excenter block shall be made of high-tension steel and be approximately 6 inches long by 3-1/2 inches high by 2 inches thick with two 2-inch diameter clamping connections and associated keyways bored through the block. One connection is clamped to the drive shaft of the gear motor, thereby causing the rectangular block to eccentrically rotate around the drive shaft. The other connection is clamped to the flange bearing stub shaft mounted on the moveable side plate.
 3. The moveable side plate shall include an integral rocker arm assembly on the drive end that flexes if the step blades get jammed. The lateral frame shall also carry the cross member brackets that secure the moveable step blades.
 4. The rocker arm assembly shall consist of a 1/5-inch (5 mm) thick stainless steel sheet cut into a triangular shape with rounded corners. The sheet shall be fabricated with three holes to mount the central flange bearing, the rear pivoting shaft, and the front rocker guide. The flange bearing shall be connected to the rocker arm by four bolts, and shall transfer the rotation from the eccentric block to the moveable side plate. The rocker arm shall be connected to the moveable side plate by the 1-1/5-inch diameter rear pivoting shaft that is 1-1/4-inch long. The front rocker guide shall fit into an elongated hole on the moveable side plate and shall be maintained in the standard operating position by a compressed tension spring. If the step blades experience a jam, the force will cause the rocker arm to rotate around the rear pivoting shaft, compressing the tension spring. The motion shall be limited by the front rocker guide. When the rocker arm reaches the end of the controlled travel path, a proximity sensor will send a signal to the PLC causing the motor to turn off and initiating an alarm signal. The sensor shall be a 110 VAC Telemechanique proximity sensor.
 5. Each moveable side plate shall be maintained in position and connected to the step screen frame through two sets of upper and lower linkage arms. One set of upper and lower linkage arms shall rotate around stub shafts bolted to the moveable side plate on one end and shall rotate around stub shafts bolted to the slewing bracket on the other end. The second set of linkage arms shall rotate around stub shafts bolted to the step screen frame on one end and shall rotate around stub shafts bolted to the slewing bracket on the other end. Chain drives shall not be accepted.
 6. Screens whose movable blades are not lifted in a parallel movement over their entire length, particularly screens whose blades glide in a horizontal movement over the channel floor, shall not be acceptable.
- J. Screen Assemblies (Type 2, Parkson, or equal):
1. Stationary Step Assembly: The stationary step assembly will be supported at the top and bottom along its width by bolt-in-place step cradles. Both step cradles will be bolted to side plates either side of the frame, which sandwich the blade assemblies. Each blade will be accurately cut from type 304 stainless steel sheet. Each stationary blade will have plastic spacers at the toe end and discharge end to maintain spacing between the stationary and moving step assemblies.
 2. Moving Step Assembly: Bolt-in-place step cradles will support the moving step assembly. Each blade will be accurately cut from type 304 stainless steel sheet. The step cradles will allow for proper alignment and interfacing of the moving step assembly with the stationary step assembly. The moving blades will be designed to convey the solids to the point of discharge.

3. Step Cradle: Each step cradle will be slotted to maintain spacing the step assemblies. A neoprene wedge will clamp the blades within the step cradle to positively lock the blades in place. Blades will be capable of removal from each respective assembly without total disassembly of the screen.
- K. Drive Unit:
1. The drive unit shall be continuous duty explosion proof rated and shall be selected to match the duty of the particular screen. The drive unit shall be directly coupled to the screen drive shaft through the gear box.
 2. A facility shall be incorporated within the drive unit console mounting arrangement to enable the movable blade package to be correctly and accurately positioned across the screen frame and without the necessity for any special tools.
 3. The screen shall be equipped with an electronic overload protection device furnished by screen manufacturer and installed in MCC-20 by Division 16 Contractor to stop the screen and alarm on over current. Units incorporating the use of shear pins, for overload protection, are not acceptable.
- L. Cleaning Mechanism and Screen Washwater System: No cleaning shall be required since the screen shall be self-cleaning. In particular, no additional brush or flushing device at the discharge points shall be required.
- M. Screening Transport Area: The screen transport area shall be designed to prevent screenings from falling in between the blades while transported from the highest water level to the discharge level. The upper movable and fixed blade packages shall form an integral part of the screen.
- N. Cover: The screen shall be fully enclosed so that odors are retained within the channel system. Removable covers or doors shall be provided for servicing and inspection. Covers shall be stainless steel, the same as the enclosure.
- O. Safety Enclosure: If required by the equipment configuration a guard shall meet all OSHA requirements and shall be provided to prevent operating personnel from inadvertently coming in contact with screen moving parts.
- P. Drive Unit: The drive assembly shall be capable of elevating the weight of the movable lamellas plus the maximum debris load. The drive system shall be designed so that the bottom sprocket and the associated chain are located above the maximum water level. An automatic chain tensioning device shall be provided to ensure that the drive chains maintain proper tension and to eliminate the need for adjustment.
- Q. Limit Switches: Provide Class 1, Division 1, Groups C and D hazardous location SPDT limit switches.
- R. Home Position Switches: Provide SPDT switches rated not less than 10 amperes and 120 volts AC. Provide intrinsically safe barriers for home position switches such that switches are suitable for Class 1, Division 1, Groups C and D locations. Intrinsically safe barriers shall be furnished to the Division 16 contractor for installation in the MCC.

2.04 SCREENINGS WASH PRESS

- A. The unit shall be a one-chamber unit. The chamber shall be comprised of a pre-wash zone for receiving of the screenings from the inlet hopper, a wash-zone equipped with perforations for drainage of liquid, and a compaction zone.
- B. The unit shall be fitted with a wash-water system to provide final rinsing of the screenings. Clean water shall be introduced to the screenings before they enter the washing compaction area, inside the washing compaction area, and the bottom mounted drainage collection pan. Drainage holes shall be self cleaning by the wash/press mechanism.
- C. The press shall be fitted with nozzles in the housing to wash the screenings in stages as the screw transport the screenings through the unit.
- D. The screenings washer shall be equipped with a manifold to supply water to the different washing inlet locations. The screenings washer shall be provided with a minimum of three separate connections for injecting wash water into the screenings. One of the three injection locations shall be through the shaft of the screw to ensure that the wash water penetrates the entire screenings plug. The unit shall be designed to accept wash water from the plant's non-potable water system, which may be the plant's final effluent.
- E. The press shall be equipped with motorized ball valves (specified in Division 15050) to each zone and dewatering chamber. The screenings washer shall be provided with a minimum of three separate connections to the screenings washer and one to the screen. Valve motors shall be rated Class 1, Division 1, Groups C and D. All necessary piping shall be provided to connect to water system. Four globe valves (specified in Division 15050) shall be provided for each of the motorized valves in order for flow adjustments for each wash water area. Screening wash press manufacturer shall coordinate valve and piping requirements with Division 15 contractor who shall provide required valves, piping and fittings.
- F. The wash press chamber shall be a nominal internal diameter of 10-3/4 inch and be fabricated from AISI 304 stainless steel.
- G. Inside the chamber there shall be a shafted spiral with variations of shape and size of the flights during the three different stages. Minimum flight thickness shall be 1/5-inch in trough area, 2/5-inch in perforated washing zone, and 2/5-inch compression zone.
- H. The wash/press shall be equipped with a perforated plate to allow for discharge of separated water from the conveyor/compactor system. Manufacturer shall verify that perforated plate is a nonclog design. The rotation of the spiral shall maintain a free opening and discharge through the unit. Perforation shall not exceed 0.2 inches and shall prevent the return of screening material to the drain.
- I. Spiral flights shall be fabricated from stainless steel.
- J. A gland packing ring consisting of two Teflon coated packing rings or a thrust bearing assembly with shaft seals shall seal the drive shaft at its penetration through the end plate.
- K. The discharge end of the washer/press shall be flanged to accommodate the installation of a discharge pipe by bolting. A Buna-N gasket shall be provided between washer/press and discharge pipe to assure no water leakage at the bolted connection.

- L. A nominal 3-inch diameter drain connection shall be provided at the draining zone of the compactor. A flexible connection shall be provided. Route piping to equipment drain.
- M. The casing of the compactor shall be fabricated of AISI 304 stainless steel, minimum 1/8-inch thickness.
- N. A Buna-N gasket shall be provided for the entire bolted connection of the lid onto the compactor casing such that there is no water leakage through this connection.
- O. The compactor shall be constructed to be dimensionally compatible with the discharge pipe.

2.05 SUPPORT AND CHUTES

- A. A support frame consisting of AISI 304 stainless steel angles and shapes shall be provided to satisfy all mounting requirements of the wash press with respect to stability and elevation. Legs of the support frame shall include welded mounting plates and all anchoring bolts sufficient to mount the equipment on the operating floor.
- B. Trash chutes, 1/8-inch thick 304L stainless steel shall be integrally provided and compatible with the discharge chutes of the screen equipment. The trash chutes shall be adequately sized to accommodate all wet screenings and to prevent the spillage or splashing of wet screenings on the exterior of the equipment or into the operating floor area, and shall completely enclose the discharge area.
- C. The discharge of the screenings into the screenings washer shall be completely enclosed to prevent spillage, splashing and odor release at a transition point.
- D. The screenings washer shall discharge the screenings through a pipe system to the dumpster as shown on the drawings.
- E. There shall be provided a bagging unit to collect compressed screenings from the transport tube. The bagging unit shall be attached to the end of the transport tube by a stainless steel bracket. A removable cassette containing the plastic bagging shall be provided to allow easy replacement of the bagging. Each cassette shall contain at least 200 feet of bagging.

2.06 WASHPRESS DRIVE UNIT

- A. The screenings wash press shall be driven by a constant speed integral gear reducer/motor drive unit mounted to an adapter flange mounted to the end plate of the unit. The wash press motor shall be reversible type to allow for multiple changes in direction during screenings cleaning cycle. The adapter flange shall allow the leakage of any material from the unit through to drain rather than into the gear reducer/motor drive unit. Direct coupling of the gear reducer/motor drive unit to the end flange of the unit will not be acceptable.
- B. The drive shaft of the helical screws shall be fabricated from alloy steel. The drive shaft connection to the drive unit shaft shall be splined and provided with a keyway. The drive shaft shall extend through the drive end of the unit to connect with a gear reducer of the

drive unit. A wear proof and waterproof seal shall be provided with the drive shaft bearings such that there is no leakage of water from the unit to the mounted drive unit.

- C. The drive unit shall be rigidly supported so there is no visible movement under any operating condition. The drive system shall be designed, at a minimum, to start the unit from a dead stop with the unit filled throughout its entire cross sectional area and length with partially dried wastewater treatment plant screenings or other material.
- D. All gears shall be AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings. Bearings shall be designed for the thrust loads from the fully loaded startup condition and shall have an AFBMP B10 life of 30,000 hours. The reducer shall be a standard air cooled unit with no auxiliary cooling. The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.
- E. The wash press shall be furnished with an emergency trip cord and NEMA 7 safety switch. The cord shall run the full length of the unit. The safety trip switch shall immediately stop the system when the switch is actuated.
- F. Instantaneous trip current relays: In the event of the screening wash press jamming, it shall be stopped by the use of a current relay furnished with the unit installed in the MCC by the Division 16 contractor. Instantaneous trip current relays shall be as manufactured by Allen Bradley, Bulletin 809, or equal.

2.07 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.08 MOTORS

- A. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
 - 1. Physical Construction:
 - a. Copper windings with ball or roller bearings in end brackets of steel or cast iron, or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two-windings for all two-speed motors.
 - b. Motor shaft shall be high strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft run-out shall be 0.002-inch.
 - c. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be pre-lubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.

2. Mounting:
 - a. Screen Motor: Vertical (inclined).
 - b. Washpress Motor: Horizontal.
 3. Enclosure: Severe duty, hazardous location meeting the requirements of Class 1, Division 1, Groups C and D.
 4. Efficiency: Premium efficiency as noted in schedule below.
 5. Service Factor: 1.15.
 6. Power Requirements: 60 Hertz, Three phase, 230/460 volt, factory wired for 460 connection, $\pm 10\%$ voltage variation.
 7. Load Type: Constant torque.
 8. NEMA Design: B.
 9. Insulation: Class F.
 10. Nominal Operating Speed: Single speed, 1,400 RPM. Washpress motor shall be reversible.
 11. Accessories:
 - a. Provide spring loaded, electromechanical release brake (SSE-20-01 only).
 - b. Lifting eyes.
- B. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

SSE	Horsepower	Nominal Speed	Efficiency
SSE-20-01	2	1400	84%
SSE-20-02	5	1400	90%

2.09 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16 and specification Section 11940.
- B. Equipment manufacturer shall review electrical wiring and control diagrams prepared by the Division 16 Contractor. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.
- C. Electrical controls and instrumentation for this equipment are specified under Section 16480–Motor Control and Section 16940–Controls and Instrumentation of these specifications.

2.10 FINISHES

- A. It is the intent of this specification that all equipment, supports and appurtenances shall be furnished shop primed and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. All surfaces of the mechanical equipment and accessories (except galvanized, stainless steel, rubber, copper, PVC) shall be prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry

thickness. Shop Finish system shall consists of two coats of Tnemec 69 Hi-Build Epoxoline II, or equal, applied to a minimum of 5.0 mils dry thickness each. Motors and speed reducers shall be factory primed and finished painted using the manufacturer's paint system suitable for corrosive environment and for the specified application.

2.11 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel and of ample strength for the intended service. Provide anchor bolts in accordance with Division 5.

PART 3-EXECUTION

3.01 GENERAL

- A. See Division 1 for requirements related to equipment installation, field quality control, testing, supervision and start-up.
- B. A minimum of one trip and 2 days on site shall be provided for start-up and training services.

END OF SECTION

SECTION 11337

FINAL CLARIFIER COLLECTORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation two final clarifier mechanisms (FCD-50-01, FCD-50-02) with static flocculator units in new 65-foot diameter final clarifiers No. 1 and No. 2. The mechanisms and appurtenances shall be furnished by the same supplier.
- B. Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Each collector for final clarifiers No. 1 and No. 2 shall be designed for installation in a new 65-foot diameter concrete basin having a side water depth of about 14 feet 0 inches.
 - 2. Minimum center influent pier size shall be 16 inches inside diameter.
 - 3. Design flow requirements, each clarifier; both clarifiers in service:

	Current Minimum (mgd)	Design Average Daily (mgd)	Design Peak Hourly (mgd)
Surface Overflow	0.143	0.7	1.87
Return Flow	0.214	0.7	1.05
Mixed Liquor Flow	0.357	1.4	2.92

1.03 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- B. Header Hydraulic Testing:
 - 1. As a condition of approval, the manufacturer shall provide ENGINEER with acceptable performance verification data that the proposed header design does remove the proportional settled sludge volume to insure hydraulic balance in the tank and uniform sludge withdrawal for the entire tank bottom. Shop drawings will not be reviewed until this verification has been provided to the satisfaction of ENGINEER.
 - 2. A complete copy of the data and reports shall be submitted. A letter shall be submitted by the manufacturer showing how the field or laboratory data collected applies to the design and orifice sizing and location of the header for this project.
 - 3. Manufacturer shall supply calculations showing the following information for the proposed header specific for this project:
 - a. Tank diameter.
 - b. Maximum and minimum sludge flow in MGD.

- c. Header Velocities under all specified flows in fps.
 - d. Number of orifices.
 - e. Orifice spacing.
 - f. Orifice diameters across the header.
 - g. Headloss across orifice.
 - h. Headloss across header at various sections (between each orifice spacing).
 - i. Orifice flow in gpm.
 - j. Header flow in gpm at various sections (between each orifice spacing).
 - k. Tabulation of all headlosses across header.
 - l. Fluid viscosity.
- C. Design Parameters:
- 1. Tank diameter: 65 feet.
 - 2. Withdrawal sludge concentration: 5,000 to 15,000 mg/L.
 - 3. Withdrawal sludge flow rates: 0.16 to 0.79 mgd.
 - 4. Maximum header velocity: 3.0 fps at maximum withdrawal sludge flow rates.
 - 5. Minimum header velocity: 0.5 fps at minimum withdrawal sludge flow rates.
 - 6. Total headloss at maximum withdrawal sludge flow rates in header: 2.0 feet.
 - 7. This verification data can be provided based either on an existing final clarifier under the following field conditions, or under laboratory conditions.
- D. For verification based on data on an existing final clarifier under actual field conditions, the following information shall be submitted:
- 1. Envirex has developed a hydraulic computer model for the design of clarifiers equipped with "TOW-BRO" suction headers. That program was first developed in based on theoretical fluid mechanics formulas.
 - 2. In 1979, Envirex conducted a field test on a full size header designed for an 85-foot diameter basin at the Racine, Wisconsin Wastewater Treatment Plant. This test was to verify assumptions utilized during the design of the header against field conditions. The test also determined data to calibrate some of the cumulative headloss coefficients. These headlosses are the friction losses, momentum losses due to the convergence of flow in the duct at the orifice locations, and pressure recovery that occurs in the duct between the orifice locations. This test also confirmed that the computer model would accurately predict the parameters required to design a suction duct that would provide uniform withdrawal across the width of the basin and also predict the total headloss through the duct.
 - 3. Envirex's hydraulic computer design model for the type "TOW-BRO" suction header is assumed to accurately predict the hydraulic characteristics and design parameters of the duct as demonstrated by these field tests.
 - 4. The manufacturer shall provide a letter of certification stating that Envirex's hydraulic computer design model for the type "TOW-BRO" suction header:
 - a. Has been applied successfully in the design of numerous mechanisms equipped with tow-bro header.
 - b. Is equally applicable to the Washington, Illinois Sewage Treatment Plant project.
 - c. Has been utilized for the design of the 65-foot diameter clarifier with the tow-bro suction headers.
 - d. Provides predictions of headlosses and uniform sludge withdrawals that will occur under the Washington project field conditions, including the specified mixed liquor concentration and withdrawal flow rates.
- E. For verification based on data collected in a laboratory conditions, the following information shall be submitted:

1. Eimco Water Technologies has developed a hydraulic computer model for the design of clarifiers equipped with "C3D" suction ducts. That program was first developed in 1974 based on theoretical fluid mechanics formulas.
2. In 1985, Eimco Water Technologies conducted a laboratory test on a full size header designed for a 43.5-foot diameter basin at their R&D Facility in Salt Lake City, Utah. This test was used to improve the accuracy of the computer model by using the laboratory data to calibrate some of the cumulative headloss coefficients. These headlosses are the friction losses, momentum losses due to the convergence of flow in the duct at the orifice locations, and pressure recovery that occurs in the duct between the orifice locations. This test also confirmed that the computer model would accurately predict the parameters required to design a suction duct that would provide uniform withdrawal across the width of the basin and also predict the total headloss through the duct.
3. In 1992, a test was conducted by an independent laboratory to validate the current Eimco Water Technologies type "C3D" hydraulic design model. The test was conducted at the Utah State University Water Research Laboratory under the supervision of Dr. Roland Jeppson, Professor of Civil and Environmental Engineering. The test was conducted in a laboratory on a suction header specifically designed for the 142.5-foot diameter type "C3D" clarifiers for the West Point–Seattle, Washington Wastewater Treatment Plant. The results of this test provided a verification of the flow distribution and headloss characteristics of the Eimco Water Technologies duct design and allowed Eimco Water Technologies to further refine the headloss coefficients as well as other parameters used in the model.
4. Therefore, it can be concluded that Eimco Water Technologies' latest version of the hydraulic computer design model for the type "C3D" suction header accurately predict the hydraulic characteristics and design parameters of the duct as demonstrated by these laboratory tests.
5. The manufacturer shall provide a letter of certification stating that Eimco Water Technologies' latest version of the hydraulic computer design model for the type "C3D" suction header:
 - a. Has been applied successfully in the design of numerous "C3D" mechanisms.
 - b. Is equally applicable to the Washington, Illinois Sewage Treatment Plant project.
 - c. Has been utilized for the design of the 65-foot diameter clarifier with type "C3D" suction headers.
 - d. Provides predictions of headlosses and uniform sludge withdrawals that will occur under the Washington project field conditions, including the specified mixed liquor concentration and withdrawal flow rates.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Clarifier collectors including drive mechanisms and static flocculator units shall be by Siemens/Envirex, Inc. of Waukesha, Wisconsin, designated as Type 1 drive mechanism and Type 1 flocculator; Eimco Water Technologies, Salt Lake City, Utah, designated as Type 2 drive mechanism and Type 2 flocculator; or equal.
- B. The drawings and specifications were prepared based on Siemens/Envirex, Inc. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural,

mechanical, and electrical work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 GENERAL

- A. Clarifier mechanisms shall be the center feed, suction header type. The clarifier mechanism shall include a drive mechanism complete with reducer, motor, and overload device, influent feed well and supports, static flocculator, access bridge including handrail and toe plate, center influent pier, center cage and suction arm and counter balance arm, surface skimmers with scum trough and skimmer blade ramps, and associated attachment bolts and anchor bolts.
- B. Each clarifier mechanism shall consist of a center pier supporting a center drive mechanism rotating a center cage. One suction header arm with counter balance arms shall be supported and rotated by the center cage. The slowly revolving mechanism shall remove sludge on the tank bottom to a shroud located near the center of the tank.
- C. Each mechanism shall be designed so there shall be no field welding required, except for the bridge splice.

2.03 DRIVE MECHANISM—TYPE 1 (Siemens/Envirex, Or Equal)

- A. The drive mechanism, completely factory assembled, shall consist of a primary gear reduction unit, an intermediate reduction unit, plus a final reduction unit consisting of a pinion and internal gear enclosed in a turntable base. All gearing shall be enclosed in Class 40B grey iron housings. Fabricated steel, exposed gearing and the like shall not be acceptable. The primary reduction unit shall be a helical gear, heavy duty speed reducer. All bearings shall be anti-friction type and running in oil in a cast iron housing.
- B. The primary reduction unit shall drive the intermediate reduction unit through a chain and sprocket arrangement. The drive chain shall be # 80L self-lubricated roller chain and shall be covered with an OSHA approved removable guard of molded polyethylene. Proper chain tension shall be provided for by an adjustable steel base mounted on the intermediate reduction unit.
- C. The intermediate reduction unit shall be a heavy-duty, worm gear speed reducer, cast iron housed, with grease and oil lubricated, anti-friction type bearings. The unit shall be mounted on a machined face on the top of the final reduction unit and properly registered to maintain accurate centers for the final reduction gearing.
- D. The overload device shall be mounted on the drive head at the thrust end of the worm shaft and consist of: A plate spring assembly, a plunger, indicator dial, two NEMA 7 micro-switches (each with one normally open and one normally closed contact for alarm and control), and a terminal block, all enclosed in a weather-tight, gray cast iron or stainless steel housing, gasketed and mounted to the gear housing. The end thrust of the worm shaft against the plate spring shall actuate the plunger, which in turn shall move the indicator dial, thus indicating the pressure on the spring.
- E. The visual torque dial indicator shall be provided and oriented so it may be read from the walkway.
- F. The micro-switches shall be factory set to:

1. Sound remote alarm at the supervisory control center when the load on the mechanism reaches 100% of the continuous operating torque capacity of the drive.
 2. Stop the motor when the load reaches 120% of the continuous operating torque capacity.
- G. A shear pin device set for 130% of the continuous operating torque capacity shall be provided.
- H. The internal final gear shall be driven by a heat-treated steel pinion from the slow speed shaft of the intermediate gear reduction unit. The internal gear, with a minimum pitch diameter of 38 inches shall be split for easy removal, shall be of ductile iron, and shall be designed to support the center cage and collector.
- I. The turntable base shall have an annular raceway to contain balls upon which the internal gear rotates. The ball race shall be a minimum of 42 inches in diameter to ensure a low unit ball load, long life and stability, without the necessity of guide shoes or steady bearings. The balls shall be minimum 1-inch diameter alloy steel and shall bear vertically and horizontally on four renewable special hardened (38-42 Rockwell C) steel liner strips force fitted into the turntable base and internal gear. The liner strips shall be 3/8-inch thick by 3/4-inch wide. The internal gear, pinion and ball race shall run in an oil bath and be protected by a felt seal and steel dust shield.
- J. The turntable base shall be bolted to the center column and be designed to support the internal gear with the rotating mechanism (in both dry or wet configuration) and the access bridge. An oil filling and level pipe, along with a drain plug and sight gauge, shall be furnished as part of this unit. A pipe with petcock shall be attached to the bottom of the turntable base for purposes of condensate removal. The oil piping shall terminate within the center of the base for easy access. Housing shall be provided with a deep oil reservoir extending a nominal 2 inches below the main/pinion gear and bearing. This is necessary for the accumulation of moisture/condensate away from bearings and gears. Housing shall also be fitted with oil level sight gauges, oil fill and valved drain connections, and valved condensate drain connections from low points of oil reservoir.
- K. The turntable assembly shall be so designed such that the split internal gear, balls and strip liners may be removed without removing the access bridge.
- L. The drive mechanism shall be designed in accordance with AGMA Section 2001-B88 (September, 1988)–Fundamental Rating Factors and Calculation Methods for Involute and Helical Gear Teeth; and AGMA Section 6034-B92 (February, 1992)–Practice for Enclosed Cylindrical Worm Gear Speed Reducers and Gear Motors; for 24 hour continuous duty, and 20-year design gear life based on the AGMA rated torque. All bearings shall be designed for a minimum B-10 life of 200,000 hours.
- M. At twice the run torque rating of the drive mechanism, the material stress shall not exceed the material yield strength.
- N. The drive mechanism torque ratings for the clarifier mechanism shall be:
1. Running Torque: 21,900 ft. lbs.
 2. Alarm Torque (AGMA): 21,900 ft. lbs.
 3. Motor Shutoff: 26,200 ft. lbs.
 4. Shear Pin Shutoff: 28,400 ft. lbs.

- O. The clarifier mechanism shall be designed to operate at a continuous speed of approximately 0.04 rpm to limit tip speed to a maximum of 10 fpm.

2.04 DRIVE MECHANISM—TYPE 2 (Eimco Water Technologies, or Equal)

- A. The center assembly shall consist of the drive-unit with main bearing, suitable lubrication fittings, support points for the drive unit with main bearing and attachment points for the rotating center cage. The drive unit shall consist of a primary speed reducer which is driven by the electric motor, a No. 60L self-lubricated roller chain, an intermediate gear set consisting of a worm and worm gear, and a low speed gear set consisting of a pinion and internal spur gear. The work gear assembly shall be driven by a through roller chain and sprockets enclosed in a fabricated steel guard.
- B. The drive mechanism shall be designed in accordance with AGMA Section 2001-B88 (September, 1988)—Fundamental Rating Factors and Calculation Methods for Involute and Helical Gear Teeth; and AGMA Section 6034-B92 (February, 1992)—Practice for Enclosed Cylindrical Worm Gear Speed Reducers and Gear Motors; for 24 hours of continuous duty, and 20-year design gear life based on the AGMA rated torque. All bearings shall be designed for a minimum B-10 life of 200,000 hours.
- C. The gear box shall have an AGMA Class II rating. Planetary gear input arrangements directly connected to the pinion will not be allowed.
- D. At twice the run torque rating of the drive mechanism, the material stress shall not exceed the material yield strength.
- E. The drive mechanism torque ratings for the clarifier mechanism shall be:
- F. Running Torque: 21,900 ft. lbs.
 - 1. Alarm Torque (AGMA): 21,900 ft. lbs.
 - 2. Motor Shutoff: 26,200 ft. lbs.
 - 3. Shear Pin Shutoff: 28,400 ft. lbs.
- G. The clarifier mechanism shall be designed to operate at a continuous speed of approximately 0.04 rpm to limit tip speed to 10 fpm.
- H. The main gear and worm assembly shall be enclosed in a ASTM A48 cast iron housing and provided with adequate seals to protect the interior of the housing. Fabricated steel housings are not considered equal. Housings shall be machined with precision tolerance bearing pilots (shoulder diameters) a minimum of 3/8-inch deep to register and restrain all bearings. This feature ensures rigid alignment of mating gear components. Housings shall be designed such that gears and bearings are oil bath lubricated. For spur gear teeth which are not fully submerged in oil, the tooth mesh shall be designed to force lubricant to the upper portion of the tooth face. Housings shall be provided with a deep oil reservoir extending a minimum of 2 inches below the main/pinion gear and bearing. This is necessary for the accumulation of moisture/condensate away from bearings and gears. Housings shall also be fitted with oil level sight gauges, oil fill and valved drain connections and valved condensate drain connections from the low points of the oil reservoir.
- I. The main gear housing shall be bolted to the top of the stationary influent column and shall be capable of transmitting the mechanical design strength. The rotating center cage to which the rake arms are attached shall be bolted to the main gear.

- J. The main gear shall be cast iron of ASTM A536 grade 80-55-06 minimum and shall have a minimum pitch diameter of 29 inches and shall be supported by and rotated upon the main bearing. Spur gear surface area shall be a minimum of 430 square inches. Spur gear surface area is defined as the spur gear pitch diameter multiplied by the spur gear face width multiplied by 3.14.
- K. The main gear shall be of solid one-piece construction.
- L. The main gear bearing shall be a radial-thrust type ball bearing with renewable strip liner races. The strip liner design shall be such that the B-10 life of the liner is a minimum of 20 years based on the specified mechanism speed and a uniformly distributed load on the rotating mechanism. Drives which do not use carbon corrected, vacuum degassed, high carbon steel liners (B10 Life 250,000 hours) shall provide two complete spare bearing assemblies with the necessary seals as spare parts. Drives using integral bearing and gear assemblies are not acceptable. Bearing balls and liner must be independent of the gear.
- M. The main bearing life shall be based upon the life to initial pitting of the liner element and have a diameter of not less than 35 inches.
- N. The complete drive shall be assembled in the clarifier manufacturer shop and tested to assure the drive is running properly and to calibrate the drive control. A complete test report shall be sent to ENGINEER verifying that the drive meets the quality assurance of Manufacturer.
- O. The pinion shall be constructed of steel, heat treated and precision cut to provide adequate tooth mesh for the values used in the calculations. The pinion must rotate in a lower taper roller bearing assembly and similar upper bearing encasement machined into the worm gear housing. The lower bearing pocket shall not be the collection point for condensation. Pinion shafts shall be one piece extending through the worm gear without intermediate couplings.
- P. The secondary reducer unit shall be constructed using ASTM A48 cast iron housing with a minimum pitch diameter worm gear of 21 inches. The worm shall be made of AISI 4143 heat treated steel ground and polished, driving a centrifugally cast manganese bronze worm gear.
- Q. The drive unit shall be equipped with an electrical-mechanical overload control device. The device shall be activated by thrust from the worm shaft. A calibrated spring shall react to the worm thrust and allow axial movement of the worm shaft to activate a pointer. The pointer shall be covered by a plexiglass window providing a visual reading of the relative main gear output torque on a 0-100% graduated scale. The device shall also activate an alarm switch and motor cut-out switch. Exposed linkage bars, rods, or revolving secondary worm gear housings shall not be considered for this application.
- R. The alarm and motor cut-out switches in the control device shall be factory calibrated and set to the required torque.
- S. The pointer, control switches, and electrical terminals shall be mounted in a NEMA 7 rated enclosure that is integral to the worm gear housing. The enclosure shall be sealed to the housing to prevent moisture from entering either the overload device or drive device specified.

2.05 MOTORS

- A. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
1. Physical Construction:
 - a. Copper windings with ball or roller bearings in end brackets of steel or cast iron, or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two-windings for all two-speed motors.
 - b. Motor shaft shall be high strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft run-out shall be 0.002-inch.
 - c. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be pre-lubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
 2. Mounting: Vertical
 3. Enclosure: TEEP, Hazardous location meeting the requirements of Class 1 Division 1 Groups C and D.
 4. Efficiency: Premium efficiency.
 5. Service Factor: 1.15
 6. Power requirements: 60 Hertz, Three phase, 230/460 volt, factory wired for 460 volt connection, $\pm 10\%$ voltage variation.
 7. Load type: Constant torque.
 8. NEMA Design: B.
 9. Insulation: Class F.
- B. Motor Schedule:
1. If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Drive	Horsepower
FCD-50-01	0.5
FCD-50-02	0.5

2.06 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16 and specification Section 11940.
- B. Equipment manufacturer shall review electrical wiring and control diagrams prepared by the Division 16 contractor. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.
- C. Electrical controls and instrumentation for this equipment are specified under Section 16480–Motor Control and Section 16940–Controls and Instrumentation of these specifications.

2.07 STATIC FLOCCULATION BAFFLES–TYPE 1 (Siemens/Envirex, Or Equal)

- A. The influent well shall be baffled to promote effective mixing and tapered flocculation. Flow exiting the center pier shall impinge a succession of three overlapping vertical target baffles with a series of four increasing port areas designed to provide a "Gt" (t in seconds) value in the well not exceeding 5,000 with a velocity gradient "G" within the flocculation well not exceeding 65 fps/ft at a minimum water temperature of 10±C at maximum influent flow. Horizontal shelf baffles shall prevent downward movement in the flocculation zone. Baffles shall bolt to the center cage and well support beams. The influent baffles shall be fabricated from minimum 3/16-inch-thick steel plate.

2.08 ENERGY DISSIPATING INLET (EDI)–TYPE 2 (Eimco Water Technologies, Or Equal)

- A. The clarifier shall be equipped with an energy dispersion well located inside the rotating flocculation feedwell. The dispersion well shall be designed to dissipate the energy of the incoming flow and provide flocculation by way of multiple baffled inlet ports equally spaced around the dispersion well.
- B. The center dispersion well shall be a minimum of 6 feet in diameter by 3 feet–0 inches side depth including a bottom plate sealed to the center column with a neoprene seal. The well shall be constructed of 3/16-inch plate. Eight (8) EDI outlet ports shall be equally spaced around the periphery and sized for a maximum inlet velocity of 1.5 feet per second. The outlet ports shall impart a tangential flow into the outer flocculating feedwell and shall have bottom plates to prevent short circuiting.
- C. The bottom plate of the EDI shall be provided with properly sized drain holes.

2.09 STRUCTURAL DESIGN CRITERIA

- A. Pier and center cage shall be designed for a minimum of 200% of AGMA continuous torque (alarm torque). Each arm shall be designed for a minimum of 100 percent of AGMA continuous torque (alarm torque).

2.10 CENTER PIER

- A. A cylindrical steel center pier shall support the drive, collector mechanism, and access bridge including influent well. The top of the pier shall have a drive mechanism mounting plate which shall be set plumb with the centerline. The drive mechanism shall be positioned, shimmed, leveled, and grouted in place with a non-shrink grout. The center pier shall be fabricated of 1/4-inch thick steel plate and shall be anchored to the concrete base with a minimum of eight 1-inch diameter stainless steel anchor bolts. The Equipment Manufacturer shall provide a steel template to accurately locate these anchor bolts. The center pier shall serve as an influent pipe and shall have a series of large ports at its upper end to direct the flow into the influent well. The influent port opening shall be a minimum of 175% of the internal center pier area. Bottom of ports shall be a minimum of 2 feet 0 inches above bottom of influent flocculation well and shall be designed with additional bracing as required by structural design criteria. Minimum pier diameter shall be 14 inches.

2.11 INFLUENT FLOCCULATION WELL

- A. The influent flocculation well, fabricated of minimum 3/16-inch steel plate sections with bolted connections, shall be supported from the gear and drive mechanism and shall not be supported from the center platform. The well shall be minimum 14.75-foot diameter with minimum 5-foot side depth. Ports shall be cut in the influent well to permit the escape of

entrapped scum. The ports shall have baffles to prevent short circuiting. The inner and outer scum blades shall be attached to well to prevent short circuiting of scum around blade at well wall.

2.12 HEADER

- A. The header of rectangular-shaped full tapered section shall uniformly vary in size from a maximum near the tank center to a minimum at the outer end to provide uniform sludge draw-off velocities throughout and shall be fabricated of 1/4-inch thick steel plate, hot-dipped galvanized after fabrication. Sludge withdrawal by means of individual riser pipes or stepped manifold construction will not be acceptable.
- B. Following fabrication and galvanizing, header handling storage and assembly procedures shall be used to hold any damage to the galvanized surface to an absolute minimum. Any repairs to damaged galvanized material shall be performed in accordance with ASTM A780 using organic zinc rich paint and as Galvanox Type 1, or equal.
- C. The longitudinal cross sectional axis of the header shall be mounted at an angle of 45° with the tank bottom to provide a peaked top. The leading edge of the header shall extend downward 2 inches to provide fluidizing vanes as an integral part of the header and to direct the sludge into the area of influence of the orifices. The distance between the bottom of orifice and the tank floor shall be minimized and shall not exceed 4-1/2 inches. Attached to this vane shall be a neoprene squeegee with a steel backing plate. The squeegee shall have slotted holes for one inch vertical adjustment. At the inner end of the header, a flange shall be provided for bolting to the center outlet manifold. The header shall have a scraper of 1/4-inch steel plate with a neoprene blade to clean the tank bottom around the manifold directing the sludge to the first orifice.
- D. At regular intervals, not to exceed 30 inches, inlet orifices, varying in size from a minimum diameter near the tank center to a maximum at the outer end, shall be accurately located in the header. Minimum diameter of orifice shall be 1.625-inch diameter. The design of each orifice shall be proportionate to the volume of sludge withdrawn and the design of the orifices and header shall be such as to insure hydraulic balance in the tank and uniform sludge withdrawal from the entire tank bottom at all flows.
- E. The header support shall consist of a truss arm of all-welded steel construction with members having a minimum thickness of 1/4-inch. The connections between the truss and header shall be of 1/4-inch steel plate.

2.13 CENTER CAGE AND MANIFOLD

- A. The center cage shall be of an all-welded construction with structural steel members having a minimum thickness of 1/4-inch.
- B. The manifold shall be constructed of 1/4-inch minimum thickness steel and fitted with two sealing rings. A bottom plate shall be securely anchored to the concrete floor and grouted in place after proper aligning. The equipment manufacturer shall furnish a template to accurately locate the anchor bolts.
- C. Opposite the header, a truss arm shall be provided, supported from the center cage and manifold, and used for the skimmer support and heavy solids scraping. The arms shall be of truss construction and shall be all-welded steel construction with members having a minimum thickness of 1/4-inch. Scraping blades shall be spaced to scrape the tank bottom once for each revolution.

2.14 SKIMMER

- A. The equipment manufacturer shall furnish a full surface skimmer system consisting of anti-rotational scum baffle, rotating scum blade with pivoted skimmer assembly and wipers, "A" frame supports, counterweight balance plates, and submerged shelf scum trough.
- B. The stationary anti-rotational scum baffle shall be designed to trap scum as the rotating skimmer blade approaches and direct the trapped scum outward toward the scum trough. The scum baffle shall consist of a structural steel support angle hung from the bridge, a minimum 3/8-inch thick by 12-inch wide neoprene baffle and minimum 1/4-inch thick steel backing bar.
- C. Two rotating scum blades shall extend radially out from the influent well to the scum trough. Scum blades shall be located at 180° opposite from one another. The "A" frame supports shall be bolted to the rotating arms and shall provide a minimum 3-inch vertical adjustment for the blade.
- D. A skimmer assembly shall be bolted to the outer end of the scum blade to form a pocket for trapping scum. The skimmer assembly shall consist of support tube, skimmer blade, two pivoted blade support brackets, spring loaded guide bar, and neoprene wipers. The support tube shall be minimum 3-inch square structural steel tube. The skimmer blade shall extend across the full width of the scum trough fabricated from minimum 1/4-inch thick steel plate. The blade shall be provided with a wearing strip on the outside edge that contacts the scum baffle and minimum 1/4-inch thick neoprene wipers on the lower and inner edges. Wipers shall be attached with a minimum 1/4-inch thick backing bar.
- E. Skimmer blade support brackets shall consist of structural steel angles attached to the support tube by pivot pins. A spring loaded guide bar shall be provided to direct scum from the main scum blade to the skimmer blade. Support brackets shall be provided with a means for locking the assembly up and out of the liquid. The manufacturer shall furnish sufficient steel plates to counterbalance the skimmer assembly.
- F. Skimmers which rely on support from the scum baffle will not be acceptable.
- G. The scum trough, beach, and submerged shelf shall be fabricated from minimum 1/4-inch thick steel plate, adequately supported from the tank wall. The scum trough shall be 6-foot

wide with a 4-foot by 9-inch length along the scum baffle. The beach shall slope at a nominal incline of 1-3/4 inch per foot to a point 5 inches below the maximum water level. The submerged shelf shall continue on a horizontal run for an additional 4 feet. An inner radius baffle, extending 9 inches below and 3 inches above the maximum liquid level, shall run from the trough to the end of the submerged shelf. A 6-inch standard pipe flange shall be provided for connection to the scum discharge piping. A 2-inch manual ball flushing valve and pipe with extension stem to walkway level shall be provided to allow for manual flushing of scum.

- H. All springs, pivot points, and threaded fasteners shall be constructed of 18-8 stainless steel. Carbon steel components of the skimmer assembly shall be hot-dip galvanized.
- I. The flocculation well shall be provided with a skimmer and baffle arranged to move scum inside the flocculation well to the scum discharge port. The rotating skimmer blade shall be supported at a cage corner and extend, at an angle of 45° to the cage, to this scum port in the well wall. Scum blade shall be a minimum 3-inch by 5-inch steel angle.
- J. The flocculation well skimmer scum baffle shall be supported from the bridge, parallel to the bridge axis, and extend from the outer perimeter of the flocculating baffle to the flocculation well. Scum baffle shall consist of support tube and neoprene blade.

2.15 BRIDGE

- A. An all-welded structural steel access bridge consisting of two wide flange beams shall extend from the tank wall to the bridge drive base. The bridge shall consist of a minimum 4-foot walkway with aluminum grating. The bridge shall be designed to support, in addition to the dead load, a live load of 50 pounds per square foot with a deflection not exceeding 1/360 of the span. Bridge beams and grating shall be coordinated with clarifier dome manufacturer to clear dome tension ring. See drawings.
- B. Center platform shall be sized to allow access for maintenance on clarifier components as required. Minimum platform size shall be 9 feet by 8 feet.
- C. Aluminum railing and grating shall be provided by Division 5 Contractor, but shall be detailed by the equipment supplier.

2.16 WEIR, BAFFLE AND MISCELLANEOUS

- A. Effluent weirs and scum baffles complete with anchors and brackets shall be furnished by Division 5 (or Division 6 Bid Alternative No. 1) Contractor. Details of the weirs and baffles to show locations and elevations required by the equipment, including scum beach connecting shall be provided by the clarifier manufacturer to Division 5 Contractor. The weirs shall be as shown on the drawings. CONTRACTOR shall coordinate between clarifier equipment, weir and baffle as well as aluminum dome cover manufacturers.
- B. All parts of the mechanism shall be amply proportioned for all stresses that may occur during fabrication, erection, and intermittent or continuous operation. Workmanship shall be of high grade in all respects.
- C. Clarifier manufacturer shall provide minimum 6-inch diameter drain plug and drain fitting on RAS piping at the bottom of each clarifier. Drain plug shall be removable from bridge.

2.17 FINISHES

- A. It is the intent of this specification that equipment supports and appurtenances shall be furnished shop primed, clean and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. Motors and speed reducers shall be factory primed and finished painted and using the manufacturer's standard paint system for the specified application.
- B. In addition, the following parts shall receive two shop finish coats of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, (5.0 DMT ea.) paint as specified in Division 9 under submerged steel: a) center pier bolt template, b) bottom seal ring, c) scraper rake truss assembly, and d) center pier (both inside and outside of tube). Paint manufacturer and product reference number shall be the same as that provided by CONTRACTOR under Division 9 for compatibility and touch-up in the field.

2.18 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be Type 316 stainless steel and shall be of ample size and strength for the intended service. Provide anchor bolts in accordance with Division 5. All anchor bolts shall be set by CONTRACTOR in accordance with the manufacturer's instructions.

2.19 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The listing shall include a description of each spare parts, current pricing, and extend delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

PART 3-EXECUTION

3.01 GENERAL

- A. See Division 1 for requirements related to equipment installation, field quality control, testing, supervision, and start-up.

3.02 FIELD TESTING

- A. One collector mechanism shall be field tested after erection and in the presence of ENGINEER to confirm and verify the structural and mechanical compliance to the torque requirements specified by loading each collector mechanism with 100% and 120% of rated AGMA continuous torque specified. Also, this field test shall substantiate operation of warning and drive shutdown circuitry.
- B. Complete test procedures shall be submitted to ENGINEER for approval prior to testing; however, testing shall be accomplished with the machine in operation. Loads shall be applied to the mechanisms' structural arms through cables or be applied by means of a hydraulic cylinder.
- C. All labor, materials, and test apparatus necessary for conducting the above tests shall be furnished by this CONTRACTOR and included in the Lump Sum Bid.
- D. No static tests shall be acceptable.

END OF SECTION

SECTION 11349

CHEMICAL PHOSPHORUS REMOVAL EQUIPMENT

PART 1-GENERAL

1.01 SUMMARY

A. Work Included:

1. This section includes providing and placing into successful operation two chemical feed systems including all accessories. Provide all equipment and material for complete and proper installation. The pumps and appurtenances shall be furnished by the same supplier.
2. The phosphorus removal chemical (PRC) schematic included in the drawings is only intended to show the minimum level of equipment, piping, etc., required to provide complete feed systems. The chemical feed system supplier shall verify that this schematic has been reviewed and indicate any additional equipment that may be required. Any equipment that is not shown on the schematic but is required shall be included in the Bid and submitted with the shop drawings. Shop drawings, including piping drawings drawn to scale and a bill of materials, shall be submitted for review. Supplier shall provide a complete, to-scale layout drawing of the chemical feed systems. Supplier shall verify that drawing is complete with respect to required system components and dimensions of equipment supplied.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Two chemical pumps (PRCP-20-01 and PRCP-20-02) shall be used for pumping of either 37-42% ferric chloride (FeCl_3), $\pm 30\%$ ferrous chloride (FeCl_2) solution, or 50% Alum to the phosphorus removal locations as indicated on the drawings. Only one pump will normally be in operation. These pump will be installed in the chemical feed room of the Screening Building.
2. Chemical feed system equipment shall be rugged with all components designed for long and continuous operation under corrosive working conditions. All wearing parts and items requiring adjustment shall be readily accessible.
3. Each unit shall be completely enclosed and dust-tight when in operation. All parts which are exposed to the chemicals shall be manufactured of materials resistant to the chemicals being pumped in any concentration. Individual parts furnished, which are alike in all units, shall be alike in workmanship, design, and materials and shall be interchangeable.
4. To provide redundancy, only one pump shall be required to be in operation at the maximum required chemical demand rate.
5. Chemical metering pumps shall be provided with the necessary piping, unions, valves, and appurtenances so that either pump in the pair shall be able to operate in its intended service by simply turning the pump on without operating any valves manually. Pumps and appurtenances shall be prewired for ease of installation.

B. Performance Requirements:

1. Chemical metering pumps shall be of the positive displacement, electronic diaphragm-type.
2. Pumps shall meet or exceed the following performance criteria:

Service (% by weight)	Flow Rate Range (gal/hour)	Maximum Pressure (psi)
37%–42% Ferric Chloride (FeCl_2) $\pm$ 30% Ferrous Chloride (FeCl_2) 50% Alum	20	25

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Chemical metering pumps and appurtenances shall be as manufactured by LMI Milton Roy, or equal.

2.02 PUMP CONSTRUCTION

- A. Pumps shall be of the positive displacement, electronic diaphragm-type.
- B. Pumps shall be constructed as follows:

LMI Model No.	Pump Head Material	Ball Material	Fitting Material	Diaphragm Material	Seal Ring Material	Solution Tubing O.D.(Inches)
C941-36	PVC	Ceramic	PVC	Teflon Faced	Teflon	1/2

- C. Pump housing shall be chemically resistant glass fiber-reinforced thermoplastic, with a glass fiber-reinforced polypropylene EPU carrier.
- D. The pump drive shall be totally enclosed with no exposed moving parts. All electronics shall be housed in chemical-resistant enclosure at the rear of the pump for maximum protection against chemical spillage.
- E. All exposed metal fasteners and hardware shall be Type 316 stainless steel.
- F. All materials of construction shall be chemically resistant to the material being pumped.
- G. The pump head shall have machined construction. A molded pump head is unacceptable.

2.03 ACCESSORIES

- A. All of the subsequent accessories shall be fabricated of materials resistant to 37-42% ferric chloride, $\pm$ 30% ferrous chloride, and 50% alum solution.

- B. Provide the following accessories:
1. One calibration chamber in system piping. Chamber shall have a minimum volume of 2 liters, bottom inlet fitting, and a top vent connection. Calibration chamber shall be as manufactured by Koflo Corporation, LMI, or equal, and shall be mounted on wall next to pumps.
 2. Four-function valves (antisiphon, primary aid, pressure relief, and back pressure) in discharge line of the pumps as shown on the drawings.
 3. Heavy-duty wall mounting bracket assemblies or mounting shelves. Shelves or brackets shall be polypropylene, FRP, or equally resistant materials as manufactured by LMI, or equal. All exposed hardware and metal fasteners shall be stainless steel.
 4. One transparent splash guard per pump by pump manufacturer.
 5. One PVC 2-inch-diameter orifice-type diffuser suitable for use with either FeCl_2 or FeCl_3 . Diffuser headloss shall not exceed 5 psi at 10 gpm. Equipment manufacturer shall verify diameter of diffuser at all existing and anticipated future flow rates.
 6. Provide one sight flow indicator for each pump which will allow indication that the pump is primed and running.
 7. One set of rubber gloves, dust mask, acid-resistant apron, and protective goggles.
 8. Provide all tubing, piping, connectors, couplings, fittings, valves, strainers, compression connections, and unions necessary for a complete installation.

2.04 CONTROL

- A. Metering Pumps Control:
1. Manual pump output adjustment shall be made using readily accessible dial knobs; one for changing stroke length and the other for changing stroke frequency. Pump output volume per stroke and strokes per minute shall be adjustable from 0% to 100% capacity by means of the stroke length and stroke frequency dial knobs while pump is in operation.
 2. Control of the chemical metering pumps shall be selectable between internal and external control by means of a three-position Manual-Off-Auto switch. When in "Auto" mode, the pumps shall accept a 4 to 20 mA signal. External pulse circuit voltage shall not exceed 16 volts.
 3. The minimum capacity of the pumps shall be 0.0 gph in the "Automatic" mode, and shall correspond to an input of 0 pulses per minute. Maximum pulses shall not exceed 100 pulses per minute.

2.05 FINISHES

- A. Surface prepare, prime, and finish paint pumps by the manufacturers according to the manufacturer's Standards for Service Environment.

2.06 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be Fibrebolt, or equal, manufactured by Morrison Molded Fiberglass Company and shall be of ample strength for the intended service.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install all necessary tubing, hose, piping, coupling, fittings, and valves for a complete installation. Point of application for the phosphorus removal chemical shall be as shown on the drawings.
- B. Install equipment according to supplier's and manufacturer's instructions.

END OF SECTION

SECTION 11376

CARROUSEL® SYSTEM SLOW SPEED MECHANICAL AERATORS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation two low speed, fixed, mechanical surface aerators, two submersible mixers, and one flow control gates suitable for operation in the Carrousel® denit IR® System basin shown on the drawings. Each aerator shall consist of a drive motor, gear reducer, coupling, shaft, an open-type vane surface impeller, and a submerged, radial pumping impeller and appurtenances, including the Exel™ velocity enhancer. The aerators, mixers, flow control gates and appurtenances shall be furnished by the same supplier.
- B. Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
- Flow Rates (Plant Totals):
 - Average Design Flow: 1.09 MGD
 - Peak Hourly Forward Flow: 3.70 MGD
 - RAS Rate: 15 to 100% of 1.09 MGD
 - Weir Length: Oxidation Ditch No. 1: 10 ft (5-ft fixed, 5-ft adjustable)
 - Loading Rates (Plant Totals):

	Average	Max Month
BOD ₅	1,185	1,528 lbs/day
TSS	1,142	1,496 lbs/day
TKN	193	218 lbs/day

- B. Performance Requirements:
- The aeration equipment shall provide sufficient mixing to maintain an average channel velocity of no less than 1.0 fps with two aerators operating at reduced speed drawing no greater than 20 Hp per aerator. An average velocity of at least 0.7 fps must be maintained with one aerator operating at full speed at minimum impeller submergence drawing no greater than 22 horsepower. Channel velocity shall be measured in the presence of ENGINEER as specified under paragraph 3.02.
 - The aeration equipment shall be capable of operating at the specified liquid levels of mixed liquor in the Carrousel® basin so that oxygenation and power draw will vary as desired to respond to load variations to the plant.
 - The aeration equipment shall be capable of delivering an oxygen transfer efficiency of no less than 3.5 lb. O₂/HP-hr based on motor output power to the surface impeller at standard transfer conditions.
 - The mixing equipment within the anoxic zone shall provide sufficient mixing of this zone.

1.03 SUBMITTALS

- A. In addition to the submittal requirements listed in Division 1, the following information shall be provided with the shop drawings:
 - 1. Certified oxygen and horsepower data from a minimum of two separate installations demonstrating that the mechanical aerators are capable of providing 3.5 lb O₂/HP-hr based on the motor output power at standard transfer conditions. Oxygen transfer data shall be provided from a full scale aeration basin operating as an oxidation ditch. Tests from basins that are not operating as an oxidation ditch shall not be acceptable.
 - 2. Written certification from Eimco Water Technologies and from DHV Water BV that the proposed aerators are approved for use on this Project, and are guaranteed to meet the specified velocity requirements. Shop drawings will not be reviewed without these certifications.
 - 3. The mechanical surface aerators will be mounted on fixed platforms and specifically designed for application in the Carrousel® System shown on the drawings to both oxygenate and mix the basin contents.
 - 4. The Licensor and DHV must provide a review of aeration equipment submittals and guarantee that proper Carrousel® System performance and velocity is maintained. Do not begin construction of the Carrousel® basins until aerator approval has been obtained.
 - 5. Provide horsepower versus impeller submergence curve and oxygen transfer versus impeller submergence curve specific for this project.
 - 6. Provide a certified installation list and start-up date of the manufacturer's aeration equipment of the same or similar size as that specified herein currently operating in the United States in an oxidation ditch basin geometry as shown on the plans.

1.04 QUALITY ASSURANCE

- A. Consideration will be given only to the aerators of well established and reliable manufacturers who are regularly engaged in such work and thoroughly experienced in the design and manufacture of aerators for the type of aeration basin geometry shown on the drawings. The manufacturer shall certify to successful operating installations in the United States using the same or similar size equipment as specified herein and must be approved by ENGINEER and IEPA.
- B. CONTRACTOR shall provide Carrousel® System aerators which have been tested by and approved by DHV Water BV, and of a design approved by DHV for use in this Carrousel® System described on the contract drawings. The aerators shall be the Hubert aerator of Eimco Water Technologies or DHV-approved equal. CONTRACTOR shall not propose aerators from a manufacturer which does not supply DHV-approved aerators.
- C. CONTRACTOR shall be responsible for coordinating the review of aeration equipment submittals by the Licensor/DHV to verify that proper performance is achieved. CONTRACTOR shall submit a letter from the Licensor/DHV, certifying that the proposed aerators are approved for use in the Carrousel® System designed for this project and are guaranteed to meet the velocity requirements as specified under paragraph 1.02B.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. The aerators and mixers shall be as manufactured by Eimco Water Technologies, Salt Lake City, Utah; or DHV Water BV-approved equal.
- B. The drawings and specifications were prepared based on Eimco Water Technologies. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 AERATOR GEAR REDUCER

- A. Each gear reducer shall be of the helical gear type and shall be sized with a minimum service factor of 3.0 times the motor nameplate horsepower rating in accordance with applicable American Gear Manufacturers' Association (AGMA) standards 2001-C95, when each unit is operating at full load motor horsepower, 24 hours a day continuous running under moderate shock loads. The minimum AFBMA B₁₀ bearing design life shall be 100,000 hours of the input shaft. The efficiency shall not be less than 94 percent based on the gear reducer input horsepower. The gear reducer shall be specifically designed for the loading associated with aerators and/or mixers and shall have an independent lower bearing. The bearing shall be external to the gear box housing to accommodate an oversized shaft/bearing assembly capable of handling external axial and radial forces associated with the longer overhung loads. The distance between the output shaft upper and lower bearing shall be a minimum of 18 inches. Flame hardened gears will not be acceptable. All gears shall be made from alloy steels with sufficient hardenability to obtain case and core properties meeting the requirements for Grade 2 material in accordance with ANSI/AGMA 2001-C95. The steel alloy shall be selected, and the heat treatment shall be controlled, to obtain a microstructure that meets all the requirements for Grade 2 material in accordance with ANSI/AGMA 2001-C95.
- B. The gear reducers shall be designed for vertical input and output shaft operation and the housing shall be cast iron construction with provisions for the attachment of suitable lifting devices. Each reduction unit shall have gearing of the helical gear type. Worm gearing will not be acceptable. The units shall be designed to AGMA Service Classification III. Pinion and gear materials shall be left to the discretion of the manufacturer provided they are rated according to appropriate AGMA durability and strength requirements. The helical gear teeth shall be machined and then surface-hardened; pinion teeth shall be machined, case-carburized and then ground. All shafts shall be supported on tapered roller or double spherical roller bearings. The gear reducer housing shall be sealed with a corrosion resistant paint to provide maximum protection against moisture and contaminants. The speed reducer shall be designed in accordance with AGMA 6010-E88, and related AGMA standards referenced herein, except as modified or supplemented by this specification.
- C. Gears and pinions shall be made of alloy steels. Shafting shall be made out of medium carbon steel. The gear teeth shall be through-hardened or carburized. Flame hardened gears will not be acceptable. All gears shall be made from alloy steels with sufficient hardenability to obtain case and core properties meeting the requirements for grade 2 material in accordance with ANSI/AGMA 2001-C95. The steel alloy shall be selected, and

the heat treatment shall be controlled, to obtain a microstructure that meets all the requirements for grade 2 material in accordance with ANSI/AGMA 2001-C95.

- D. All gears shall meet the accuracy requirements for AGMA quality No. Q12 in accordance with ANSI/AGMA 2001-B99. Pitting resistance and bending fatigue resistance shall be rated in accordance with ANSI/AGMA 2001-C95. The gear lives shall be calculated using full load motor horsepower. Gear life calculations shall be based on a reliability of 99% and the lower curves for life factor from Figure 16.1 or 16.2 of ANSI/AGMA 2001-C95. As an independent calculation, the gear pitting and bending fatigue lives shall be a minimum of 175,200 hours. Scuffing resistance shall be rated in accordance with Appendix A of ANSI/AGMA 2001-C95. The risk of scuffing shall be less than 5%.
- E. All bearings incorporated within the gear reduction unit shall have a rating-life expectancy (B_{10}) of 100,000 hours, except those bearings attached directly to the output shaft which shall have a rating-life expectancy (B_{10}) of 250,000 hours. All bearings shall be of the antifriction type. Bearing life shall be rated in accordance with ANSI/AFBMA Std. 11-1990 based on operating continuously at the rated full load horsepower and speed.
- F. The lubrication of the speed reducer shall conform to AGMA 9005-E02. A reliable lubrication system, externally accessible, shall be provided for the gears and bearings. Lubrication systems which rely wholly or in part upon an oil circulating pump or internal splash lubrication shall incorporate a proven reliable pressure or level switch device which will immediately stop the driving motor and transmit an alarm signal to the motor control center in the event of insufficient lubrication. Pressure indicating devices influenced by changes in oil viscosity will not be acceptable. Each electrical switch shall be wired to its respective aerator motor starter. Also, each unit incorporating an oil pump shall have an external oil-pressure gauge so that gradual decreases in oil pressure can be observed. External oil cooling will not be permitted. The unit shall be provided with a dipstick or sightglass to observe oil levels. Oil fill and drain extension lines shall be sufficient size and shall be located on the gear unit in a position which is easily accessible from the bridge platform. The oil drain piping shall be installed so that a container may be placed under the drain discharge. CONTRACTOR shall provide a valve and screw plug on drain lines. CONTRACTOR shall supply the first change of oil.
- G. All grease lubricated bearings shall have seals to retain the grease. The low-speed shaft shall have grease lubricated bearings and shall have a dry well to prevent oil leakage. The dry well shall fully enclose the output shaft and extend into a groove on the underside of the output gear. The well shall be sealed to prevent oil intrusion by both a v-ring and an oil seal. Additionally, the output end of the well shall include the upper and lower bearing seals and a separate oil seal. All grease lubrication pressure lines shall be fed from fittings accessibly located above the platform supporting the mechanism.
- H. The housing shall be constructed of high tensile strength gray cast-iron conforming to ASTM A48 class 30 minimum with integral dry well construction to eliminate oil leakage at the output shaft and prevent loss of lubrication in the event of a seal failure. The housing for vertical installation shall be of two-piece construction with ground matching surfaces or liquid gasket for oil retention. Housing components shall be of adequate strength and rigidity to withstand all loads imposed on it from operation of the equipment. The housing shall be designed and constructed to prevent harmful distortions resulting from thermal deformation, mechanical deformation or both. Housing shall be stressed relieved prior to machining. The housing bores shall be machined to an accuracy that ensures that all gearsets and all bearings contact correctly. The housing shall be tested to preclude casting

porosity or weld defects that could result in oil leakage. Lifting lugs shall be provided on the housing suitably located to enable safe removal of the combined electric motor and gear unit from the supporting platform. Removable inspection covers or inspection ports shall be provided.

- I. The gear reducer shall be factory run at full speed with no load for a minimum of two hours after the oil temperature has stabilized. The motor and gear reducer assembly shall be trial fit at the factory and the reducer shall be run under no load conditions for four hours. The test shall be monitored for heat buildup, excess noise, vibration, and overall assembly/fit. The coupling halves shall be factory mounted and aligned, and matchmarked for ease of on site installation. CONTRACTOR shall be responsible for assuring proper alignment and gap tolerance as set forth in the installation instructions.
- J. Each gear reducer shall be equipped with a suitable oil-immersion-type heater for pre-heating the lubrication oil prior to start-up after prolonged periods of shut-down in cold weather. The heaters shall have automatic thermostatic control and shall operate on the control voltage (120 volt). Provide a NEMA 4 enclosure to house the electrical controls.

2.03 AERATOR IMPELLERS, SHAFT, COUPLING

- A. The impeller assembly shall consist of a surface and submerged impeller connected to a common aerator shaft. The surface impeller shall provide oxygenation and propulsion of the mixed liquor in the oxidation ditch. The submerged radial impeller shall provide additional propulsion of the mixed liquor at the bottom portion of the oxidation ditch. The impeller assembly shall operate at a maximum output speed of 33 rpm and a maximum surface impeller tip speed of 17.5 fps. The surface impeller shall present a minimum amount of edge perpendicular to the flow to prevent any attachment of solid materials.
- B. Each impeller shall be an open-vane type with eight equally spaced blades and constructed of 1/4-inch minimum steel plate. The impeller shaft shall be a hollow pipe of sufficient size and thickness to safely withstand the torque and hydraulic side forces imposed on the aerator impeller. The impeller blades and shaft shall be an integral, shop-welded unit requiring no field welding. The impeller shall be stable over the full design range of operation.
- C. The submerged radial impeller shall be positioned above the basin floor and a horizontally adjustable wall extension adapter plate shall be fastened to the concrete partition wall. The adapter plate shall be constructed of Type 316 stainless steel plate, configured to simulate the thickness of the partition wall, and shall be rigidly secured to the concrete partition wall with stainless steel fasteners. The Exel™ velocity enhancer will come in two pieces of fabricated steel, each weighing approximately 600 pounds for each dual impeller aerator. CONTRACTOR shall finish paint each piece in accordance Division 9, fasten two pieces together with the fasteners provided by Eimco Water Technologies, and fasten the assembly to the floor with approximately 10 epoxy anchors and filet both sides of the bottom with approximately 2 inches of grout.
- D. The aerator shaft shall be attached to the gear reducer by a rigid, cast iron, flange-type coupling. A retainer plate shall be provided for mounting to the end of the gear reducer output shaft to provide protection against disengagement of the coupling from the gear reducer output shaft to provide protection against disengagement of the coupling from the gear reducer output shaft. The split coupling shall be assembled with grade 5 galvanized

bolts. The flange connections shall be assembled with hot dipped galvanized A325 high strength bolts only. Stainless steel fasteners are not acceptable.

- E. All structural steel used in the fabrication of the aerator shall conform to the requirements of "Standard Specifications for Structural Steel" ASTM Specification A-36. All shop welding shall conform to the latest standards of the American Welding Society (AWS). Fabricated assemblies shall be shipped in convenient sections as permitted by carrier installations.

2.04 AERATOR MOTORS

- A. Each aerator shall be driven by a single-speed, 50 hp, totally enclosed, fan-cooled (TEFC), constant torque premium efficiency motor. Motor shall be factory wired for 460 volt connection, 60 cycle, 3 phase current and suitable for VFD application with a 2:1 speed turndown. The motors shall be rated at 40°C ambient with Class F insulation and shall have a Class B temperature rise at full load. The motor shall have a service factor of 1.15 on sine wave power and 1.0 on VFD supplied power and shall comply with the applicable provision of the Standards of NEMA. Motors shall be inverter duty rated meeting the requirements of NEMA MG1, Part 31 and be so labeled. The minimum AFBMA B₁₀ bearing life shall be 200,000 hours. The nominal motor speed shall be 1800 rpm.
- B. The motors shall be cast iron construction, Mill & Chemical or Corro-duty, and shall have a LP-base for flange mounting to the gear reducer. They shall be mounted in a vertical position to the gear reducer and furnished with a canopy cap (drip cover) and suitable lifting lugs. The motor to gear reducer connection shall be accomplished by the use of a flexible coupling.
- C. Motors shall be suitable for operation in a moisture-laden atmosphere. The conduit boxes shall be gasketed with neoprene or equivalent material, so as to prevent moisture from entering the stator through the conduit box. Stainless steel condensation drains shall be suitably positioned in the lower external surface, so that any accumulation of moisture can drain from the complete motor housing. Ball bearings shall be supplied and shall be grease-lubricated. Grease reservoirs shall be ample and provisions shall be made for regreasing with a lubrication system where grease is flushed through the bearings. The winding end turns shall be dipped and baked with a nonhygroscopic varnish, the stator bores and rotor cores shall be coated with epoxy paint. The entire enclosure shall be finish painted by the motor manufacturer at the factory with a corrosion-resistant paint to provide additional protection against moisture and contaminants. The nameplates shall be stainless steel.
- D. Each motor shall be equipped with a suitably-sized 120 volt space heater to keep condensation from forming when the motor is not running.
- E. Each motor shall be equipped with a normally closed thermostatic heat protection device in the motor windings to protect the motor from overheating during operation. The unit shall immediately stop the aerator drive motor in the event of excessive heat build-up. Manual reset shall be required to restart motor.

2.05 VARIABLE SPEED AERATOR CONTROLS

- A. Variable speed drives are specified in Division 16 of these specifications. Care shall be taken in sizing the drive to insure adequate starting torque is available for the aerator. This information shall be provided to the variable speed supplier specified in Division 16.
- B. Aerator controls are specified in Division 16, Section 16940—Controls and Instrumentation of these specifications. Aerator manufacturer shall review these controls and coordinate with Division 16.
- C. Aerator manufacturer shall perform a vibration analysis and harmonics frequency test of the installed units to determine the actual, field defined range of VFD speeds that should be locked-out and where the VFD should be ramped across (not operate) in this range to limit harmonic frequencies. This shall be performed and repeated at high submergence, zero submergence and at low submergence.

2.06 SUBMERSIBLE MIXER ASSEMBLIES

- A. The submersible mixers shall be supplied by the same manufacturer, and shall be of the identical model. Each mixer shall be constant speed driven by a squirrel cage induction motor. Each mixer shall be mounted in the basin using a mast or rail retrieval system. Each mixer shall be submersible provided with a nonclogging propeller, designed for mixing raw or processed sewage and furnished by Eimco Water Technologies.
- B. The submersible mixers shall be nonclogging, with backward curved propeller blades of a cross section which reduces drag while eliminating fibrous build up. A gear section connected to an integral squirrel cage, electric induction motor, shall drive the mixer's propeller. Each mixer shall include a motor, gear reduction section, bearings, mechanical seals, stainless steel shafts, A48 class 30 Cast Iron housing, and machined fits for circular cross section O-rings.
- C. The mixers shall be the submersible type and shall be installed in the location shown in the plans. The manufacturer shall design the mixer motors for full load continuous operation. All major components of the mixing unit shall be manufactured from close-grained ASTM A48 class 35 or 40 cast iron. All nuts, bolts, washers, and other fastening devices supplied with the mixers shall be AISI Type 304 stainless steel. All mating surfaces of the major castings requiring a watertight seal shall be machined for fit and fitted with O-rings. Mixers shall be furnished with polyurethane propellers. Mixer support frame (including angular adjustment brackets) shall be manufactured from 316 stainless steel.
- D. Mixer Stator and Seal Casings: Casings shall be manufactured from ASTM A48 Class 35 or 40 close-grained cast iron. The outside contours of the mixer(s) shall be shaped to reduce hydraulic losses and to aid in mixing efficiency. Each casting shall be free from porosity, voids, casting fins, and other casting quality defects. The surface shall be smooth to the touch and free from all sharp edges. Corners shall have smooth radius contours to avoid sharp edged corners and surfaces.
- E. Propellers:
 - 1. Mixer propellers shall be PUR (polyurethane resin) that is resistant to chemical effects and provides the highest mixing efficiency due to the blade cross section. The propeller vanes shall be smooth, finished throughout, and shall be free from sharp edges. The surface of the propeller shall be free from defects and surface protrusions

- and shall be smooth. The outer periphery of the propeller shall be designed and manufactured, as required to meet performance specifications without adversely affecting surface finish, microstructure, hardness, dimensional tolerance and other special requirements. All sharp edges and corners shall be deburred and radiused. Minor surface defects of the propeller may not be sealed by impregnation with a sealing medium, or coated.
2. Propellers shall be statically and dynamically balanced after assembly to the rotor. Propellers shall be securely held to the shaft and the arrangement shall be such that the propeller cannot unscrew or be loosened by torque from either forward or reverse rotation.
- F. Shafts: Mixer shafts shall be stainless steel. Shafts shall be supported by bearings for axial and radial thrust and shall be designed to provide minimum B10 bearing life of 100,000 hours at design flowrate. All shafts shall be dynamically balanced and shall be amply sized to minimize shaft deflection.
- G. Sealing Devices: Each submersible mixer shall be provided with two separate seal oil chambers. Each mixer shall be provided with two sets of independent mechanical seals running in an oil bath. The two mechanical seals shall be interchangeable from one location to the other. The metal components of the mechanical seal case shall be constructed of 316 stainless steel. A moisture sensor shall be furnished in both of the seal oil chambers of each mixer. The sensor shall be wired to the control panel or motor control center and wired to shut down the motor if moisture is sensed. Manufacturers shall furnish relay required to interface with moisture sensor to Division 16 Contractor for installation in the MCC.
- H. Power and Control Cables: Power and control cables shall be furnished in lengths to run continuously from the mixer to the mixer control panel as shown on the drawings and as specified herein. Cables shall terminate with conductor sleeves. Cables shall be of the "NSSHOU" type and shall conform to industry standards for loads, resistance under submersion against sewage, and be of stranded construction. The cables shall enter the mixer through a heavy-duty entry assembly that shall be provided with an internal grommet assembly to protect against tension once secured and must have a strain relief assembly as part of standard construction.
- I. Motors: Each mixer shall be furnished with a squirrel cage, 2.3 hp induction motor enclosed in a watertight housing. Motor shall be factory wired for 460 volt connection, 60 cycle, 3 phase current. The motors shall be furnished with moisture resistant Class F insulation treated to be moisture resistant, NEMA B design, 1.13 service factor, designed for continuous duty and shall be nonoverloading throughout the entire mixer range of operation without utilizing the motor service factor. Motors shall be capable of sustaining 15 starts per hour at a minimum ambient temperature of 40°C. Motors shall be capable of uninterrupted operation with a voltage drop of 10%. The motor shall have a nominal speed of 1,100 rpm. The power cables entering the motor housing shall prevent the moisture from gaining access to the motor even in the event of complete power or control cable break while under water. The motor rotor and stator, as well as all bearings shall be located in an air filled chamber that is isolated from the seal chamber. Motor cooling shall be accomplished by submergence in the mixed liquid. Thermal switches shall be furnished to monitor stator temperatures. The stator shall be equipped with two (2) thermal switches, embedded in the end coils of the stator winding. Thermal switches shall automatically de-energize the motor and activate a remote alarm when its temperature exceeds a preset

limit. The mixer manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor casing with stainless steel screws or drive pins.

- J. Gear Reduction Drive System: The motor shall drive the submersible mixer propeller through a gear reduction drive system. The motor shaft shall be fitted with a gear that uses high efficiency teeth to engage the gear section. The gear system shall be custom matched to allow for propeller speed changes by ordering and installing new gearing. The gear section shall be designed to withstand 100 % lock stress from the propeller without gear or bearing damage. Each gear shall be supplied with precision bearings, which are lubricated by the gear lubricant in the gear chamber. The gear section shall be fitted to the output propeller shafting by the use of a straight spline connection. The gear section design shall be such that with regular oil changes, no further maintenance should be required during the life of the submersible mixer in the installation. Nominal propeller speed shall be 351 rpm .Gear oil changes shall be easily made using external stainless steel pipe plugs that are sealed via nylon washers. Standard 80 to 90-weight gear oil either normal or synthetic shall lubricate the gear section.
- K. Mixer Mount Assembly:
 - 1. Each mixer shall be provided with a 316 stainless steel mixer mount assembly to serve as a guide for the mixer during installation and to guide the mixer for removal from the liquid for service. The assembly shall consist of a minimum 4-inch by 4-inch tube and an upper and lower bracket constructed of 316 stainless steel. The assembly shall also contain a 316 stainless steel floor-mounted bracket to support and securely hold the mast assembly.
 - 2. The mast assembly shall be capable of proper operation with the mixer operating in any direction. The mixer mast shall be designed in such a way that the mixer can be lowered onto and off of the mast.
 - 3. Each mixer shall be provided with a crane assembly permanently located at the top of the basin over each mixer. The boom arm of the mixer shall be designed to properly reach and locate the mixer and to alter the angle of the mixer to assure proper mixing angles. The boom shall include a rotational turning handle and shall be capable of rotating a minimum of 270 degrees. The entire assembly shall have a minimum load carrying capacity of 1000 lbs. Each crane assembly shall include a winch and a minimum 1/4-inch 316 stainless steel lift cable with proper length to remove and set the mixer on the walkway. The winch assembly shall be capable of manual lift. All anchor bolts for the rail, mast and crane assembly shall be 316 stainless steel.

2.07 FLOW CONTROL GATES

- A. The equipment furnished for each flow control gate mechanism shall include: stand, gear reducer, rotating shaft, positioning plate/arm and lock pin, guide bearings, flow vane, stops, fasteners and anchor bolts.
- B. All plates and structural members designated for submerged service shall be 1/4-inch minimum thickness and reinforced as required. Stainless steel 303 anchor bolts and 304 fasteners with necessary hex nuts and washers, shall be provided for all parts of the gate assembly.

- C. Each gate shall be constructed from 1/4" steel plate properly stiffened with rib extensions and end flares. Each gate shall include a revolving shaft assembly fixed between three guide bearings mounted to the floor and stand. The floor bearing shall be a thrust type alignment bearing, supporting the entire weight of the unit. The upper guide bearing shall be an integral part of the support stand and shall be mounted just below the worm gear reducer. The center guide bearing, if required by the shaft length, shall be mounted just above the water surface on the lower part of the shaft and shall be field aligned after installation of all other components, assuring proper rotational capability.
- D. The revolving shaft shall be supported at each end in such a manner that a slight vertical or horizontal misalignment shall not interfere with the smooth operation of the gate. The shaft shall revolve from the turning of the gear unit.
- E. Each gate shall be designed to operate smoothly under the flow conditions existing in the Carrousel® system aeration basin. The gate shall include a position lock, lock pin with retention chain and shall be adjustable in 22.5 degree increments over a 112.5 degree range. The gate shall include a wall stop bracket, complete with 303 stainless steel wall anchors.
- F. The worm gear operator shall be of heavy duty construction, totally enclosed in a cast iron housing and provided with adequate seals to protect the interior of the housing. The housing shall be designed so that all gears and bearings are grease packed and factory sealed to prevent condensate formation. The gear shall be designed to operate under the full load as applied from the rotating gate. The reducer shall be equipped with a 20-inch steel hand wheel and require no more than 25 revolutions to rotate the gate a full 112.5 degrees in one direction. The gear reducer shall be of the worm gear type design and have the ability to backdrive without locking of the worm.
- G. The reducer mechanism shall be fitted to the gate shaft with a sleeve and key for ease of assembly and disassembly. The reducer shall be supported on a steel stand that is anchored to the concrete floor or side wall by cinch type 303 stainless steel anchors. The stand shall be of proper height to allow the operator a convenient grip on the handle for clockwise or counter clockwise turning.

2.08 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.09 FINISHES

- A. It is the intent of this specification that all equipment, supports and appurtenances shall be furnished shop primed, clean and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming

shall be with one coat of Tnemec 69-1255 Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. Aerator gear reducer and aerator motor may be prepared to SSPC-SP-6 standard. The submersible mixer shall be painted and prepared per the manufacturer's standard.

2.10 ANCHOR BOLTS

- A. Each gear reducer shall be mounted on a steel baseplate with hot dipped galvanized steel bolts. The baseplate shall be mounted on four zinc-plated jack studs inserted in the platform structure and designed to withstand all normal operating loads. The jack studs shall have the capability to provide a total vertical adjustment of minimum 3 inches or as recommended by the manufacturer. Anchor bolts for other locations are as specified.

2.11 SHOP TEST

- A. Aerators: Prior to assembly, all gear teeth shall be coated with hard, blue lacquer (DYKEM) and the speed reducer shall be assembled and prepared for testing. The speed reducer shall be run at full speed with no load for a minimum of two hours after the oil temperature has stabilized. The overall sound pressure level and lubricant temperature shall be recorded during steady-state operation. The following requirements shall be met for all speed reducers:
 - 1. The speed reducer housing and shaft seals shall be checked for leakage of lubricant. Any leaks shall be corrected.
 - 2. The overall sound level shall be recorded in accordance with ANSI/AGMA 6025-C90. The sound level shall not exceed 85 dBA when measured at 5 feet from the speed reducer.
 - 3. The temperature rise of the oil lubricant in the oil sump of the speed reducer shall not exceed 100°F above ambient. After successful completion of the shop tests and while the speed reducer is at operating temperature, the lubricant shall be drained and the speed reducer shall be flushed with filtered SAE 10 straight mineral oil containing no additives. The flushing oil shall be drained and the speed reducer shall be prepared for shipment.
- B. Submersible Mixers:
 - 1. Each submersible mixer shall be given a performance test during which the mixer shall be run at normal rated speed over the specified range of flow for a minimum of four hours. Tests shall show that the mixer has the general characteristics of efficiency, horsepower, and such other properties as appear on the approved submersible mixer shop drawings without overheating, cavitation, and excessive vibration. Vibration readings shall be taken during in-air testing of the submersible mixer and the results recorded and submitted. Any detectable vibration shall be traced to the cause and corrected prior to installation in the basin. The mixer manufacturer shall furnish all electrical starting and other control equipment necessary for testing.
 - 2. Certified copies of all test data shall be submitted with the O&M manuals. As a minimum, shop test results shall include input power KW, brake horsepower, vibration readings, velocity readings, and amperage draw.

PART 3-EXECUTION

3.01 GENERAL

- A. See Division 1 for requirements related to equipment installation, field quality control, testing, supervision and start-up.

3.02 INSPECTION AND TESTING

- A. The manufacturer of the mechanical aerators and submersible mixers shall furnish the services of a factory representative who has complete knowledge of proper operating and maintenance to inspect the final installation and supervise a test run of the equipment.
- B. The test runs on the mechanical aerators and submersible mixers shall be undertaken with water in the aeration tanks and anoxic basins filled up to the high water elevation shown on the drawings. CONTRACTOR shall be responsible for providing sufficient water, or treated wastewater for filling the tanks for the test runs on the aerators. The test runs on the aerators shall determine channel velocity, acceptable normal running noise, vibration, speed and direction. The test runs on the submersible mixers shall determine the mixing characteristics of each unit, noise and vibration.
- C. In the event of improper installation, CONTRACTOR and the manufacturer shall be responsible for supervising the correction of the work and subsequent test runs until the defects are corrected.
- D. Average channel liquid velocity shall be measured for each test condition. A velocity meter shall be used to measure velocity at 16 points in a cross-section of the channel that is unaffected by flow disturbance from the aerators or turning sections. The 16 points shall be developed from a matrix of 4 points equally spaced across the channel width and 4 points equally spaced from one foot below the liquid surface to one foot above the basin floor. The 16 points shall be averaged. When operating in clean water, velocity readings specified in paragraph 1.03 are an indication that the aerators can provide the necessary mixing capacity to maintain the mixed liquor solids in suspension.
- E. The following data and test specimens for items tested shall be available at the gear reducer manufacturer's factory for up to 24 months after shipment, for examination by the ENGINEER:
 - 1. Purchase specifications for all materials and components.
 - 2. Certifications and test reports.
 - 3. Results of all quality assurance tests.
 - 4. Results of all performance tests.
 - 5. All test specimens and heat treat coupons generated.
- F. Certified inspection documents generated for all gears and shafts shall be available at the gear reducer manufacturer's factory, upon request, for 2 years after shipment. These documents shall include:
 - 1. Available records of test reports and certifications for raw material.
 - 2. Chemical and physical data from specimens made and heat treated with the components that are heat treated.
 - 3. Records of heat treatment components, including any charts or reports.
 - 4. Test reports of hardness measurements on the sample coupon.
 - 5. Vendor's in-house quality assurance inspection reports.

6. Records certifying that all gears conform to the requirements for grade 2 gears in accordance with ANSI/AGMA 2001-C95.
7. Records certifying that all gears conform to the requirements for AGMA quality No. Q11 in accordance with ANSI/AGMA 2000-C95.
8. Vendor's statement of compliance that the gearbox meets the requirements contained within this specification.

3.03 WARRANTY

- A. The equipment supplier shall warrant that its equipment shall be free from defects in material and workmanship; and that it will replace or repair, any part or parts returned to it which examination shall show to have failed under normal use and service by the user or 12 months following operation start-up.

END OF SECTION

SECTION 11384

AEROBIC DIGESTION AERATION EQUIPMENT

PART 1—GENERAL

1.01 SUMMARY

A. Work Included:

1. This section includes furnishing, installing, and placing into successful operation a fine bubble membrane disc aeration system in Gravity Thickeners No. 1 and No. 2 and Aerobic Digesters No. 3, No. 4, No. 5, and No. 6.
2. The equipment shall include stainless steel drop pipes submerged air manifolds and supports, distribution headers and supports, factory installed diffuser element holders and diffuser element retainers, gaskets, and orifice and membrane diffuser elements. The equipment shall also include fixed joints, bolts, nuts and gaskets for flanged joints, stainless steel anchor bolts for supports, and drain line, sump, and airlift purge system.
3. All equipment shall be furnished by the same supplier.
4. The aeration equipment shall be installed in the existing tanks as shown on the drawings.
5. The diffuser layout shall be built around the existing columns, walls, pipes, pipe supports, and the concrete fillet inside the tanks.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

A. Application:

1. During normal gravity thickener operation, the thickeners will receive waste activated sludge (WAS) at 0.5% to 1.0% solids concentration and scum. During normal aerobic digestion operation, the digesters will receive gravity thickened WAS at 0.5% to 3.0% solids concentration and scum.
2. The two aerobic digesters will be operated in series on a fill and draw basis. Thickener No. 1 and No. 2 will normally operate at a variable water level and air supply. During decanting operations, the air supply to the thickeners may be periodically turned off. Solids will be allowed to settle. Supernatant will be collected from the top of the tank. After decanting, air will be applied to thickeners.
3. Digesters No. 3, No. 4, No. 5, and No. 6 will be operated.
4. Digested sludge shall be drawn off during aeration or after decantation. Digested sludge from the gravity thickeners shall be pumped with an air lift pump to the Aerobic Digester.
5. The aeration system shall be provided to accommodate high blower discharge air temperature. The aeration system manufacturer shall provide an adequate length of stainless steel drop pipe and offset feed pipe to cool the air prior to the manifold. The aeration system manufacturer shall also provide aeration equipment materials, suitable for operation at higher air temperatures (such as CPVC), if necessary to meet operating requirements. The manufacturer shall also provide heat loss calculations to demonstrate that at maximum blower discharge temperatures and aerobic digester

content temperatures (assuming future tank covered condition) the mean wall pipe temperature will not exceed 135°F at the stainless steel/PVC transition.

- B. Design Requirements: Air diffusion piping and diffusers shall be capable of delivering 200% of the design air rate specified. The proposed aeration system shall be designed with provisions for expansion and contraction in all members.
- C. Performance Requirements (Gravity Thickeners): The aeration equipment manufacturer shall furnish diffuser elements to meet the following requirements:
1. SWD–Range from 0 to 11 feet.
 2. Maximum Diffuser Submergence = 10.19 feet.
 3. Transfer the following pounds of O₂ per day per tank at 14.7 psia, 0 mg/L D.O., 20°C, clear water (standard conditions), and the parameters as contained in this section.

	Aerobic Digestion
SCFM/Tank	200
Diffuser Submergence–feet	10.19
Oxygen Transferred–pounds per day per tank	1,046

4. Aeration system shall be designed to completely mix and maintain in suspension TSS of 6% solids by weight.
5. Aeration system shall be designed to operate at a minimum of 300 scfm/tank when one blower is operating at minimum speed and discharging to two tanks.

Item	
Diameter of each tank	32'–0"
Maximum air per tank	200 scfm
Maximum air per diffuser	4.5 scfm
Grids per tank	1
Diffuser holders per grid	112
Diffusers per grid installed	112
Total diffuser holders	224
Total diffusers installed	224
Maximum headloss per diffuser (psi) (DWP and orifice loss) @ 4.35 scfm	1.757

- D. Performance Requirements (Aerobic Thickeners): The aeration equipment manufacturer shall furnish diffuser elements to meet the following requirements:
1. SWD–Range from 0 to 15 feet.
 2. Maximum Diffuser Submergence = 14.19 feet.
 3. Transfer the following pounds of O₂ per day per tank at 14.7 psia, 0 mg/L D.O., 20°C, clear water (standard conditions), and the parameters as contained in this section.

	Aerobic Digestion
SCFM/Tank	260
Diffuser Submergence–feet	10.1
Oxygen Transferred–pounds per day per tank	1,390

4. Aeration system shall be designed to completely mix and maintain in suspension TBS of 6% solids by weight.
5. Aeration system shall be designed to operate at a minimum of 260 scfm/tank when one blower is operating at minimum speed and discharging to two tanks.

Item	
Dimensions of each tank	35'0" x 21'4.5"
Maximum air per tank	260 scfm
Maximum air per diffuser	1.8 scfm
Grids per tank	1
Diffuser holders per grid	144
Diffusers per grid installed	144
Total diffuser holders	576
Total diffusers installed	576
Maximum headloss per diffuser (psi) (DWP and orifice loss) @ 4.35 scfm	0.33

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. The diffuser element shall be membrane disc; Sanitaire Silver Series 9-inch diameter, or equal. Use of smaller diameter diffusers than those listed above, if proposed as a substitute, shall require more total diffusers based on an equivalent horizontal projected surface area of diffuser.

2.02 DROP PIPE AND MANIFOLD

- A. The drop pipe shall extend from the air main piping to the submerged air manifold.
- B. Each section of the submerged air manifold shall have a minimum of two new supports. Maximum support spacing in the aerobic digesters shall be 6 feet. Manifold supports shall meet the expansion-contraction system requirements as described in these specifications. The diameter and the invert elevation of the submerged air manifold shall be the same throughout the tank. Each end of the submerged air manifold shall have a welded end cap.
- C. Connections between sections of the submerged air manifold shall be special joints. These joints shall be designed such that individual manifold sections can be rotated independently of adjacent manifold sections for alignment purposes.

- D. The submerged air manifold shall include an expansion-contraction system consisting of guide supports, fixed supports, and positive locking joints. The fixed supports shall ensure no movement, guide supports shall allow longitudinal movement. The entire system shall allow for expansion and contraction over a range of 125°F.
- E. Manifold supports shall include manifold hold-down, adjusting and locking mechanism, cradle, and supporting structure. Stainless steel cinch type anchor bolts shall secure the stainless steel stand to the tank floor.
- F. Each manifold support shall have a cradle with a bearing surface contoured to fit a minimum of the bottom 90° of the air distribution manifold. The cradle surface shall be a minimum of 2 inches wide. All supports shall include a mechanism to provide for a minimum of ± 2 inches vertical and $\pm 1/2$ -inch lateral adjustment for alignment of the manifold. All adjusting devices and mechanisms shall lock to maintain the manifold in position after the final adjustments have been made.
- G. Connections shall be provided along the bottom centerline of the submerged air manifold for connection to the air distribution headers.
- H. The new stainless steel drop pipes shall extend to within 3 feet above the manifold. The remainder of the drop pipe and the manifold shall be PVC of the material specified for the distribution system. Aeration equipment supplier shall furnish stainless steel connectors between stainless and PVC drop pipe.
- I. All welded parts and assemblies, including drop pipes, fabricated supports, flanged joints and expansion joints, shall be fabricated from sheets and plates of 304L stainless steel with a 2D finish conforming to AISI 304L and ASTM A240-78a. Other non-welded parts and pieces such as bolts, washers, and follower flanges shall be made of 304 stainless steel. The nuts shall be 18/8 stainless steel. All anchor bolts shall be 304 stainless steel.
- J. The connection between the new stainless steel portion of the drop leg and the new PVC portion of the drop leg shall be by a stainless steel clamp type coupling supplied by the aeration equipment manufacturer.
- K. Drop leg gaskets shall be 45 to 55 durometer neoprene. All 304L material shall conform to the chemical requirements of ASTM 240-78a and AISI 304L, except that the maximum carbon content shall be limited to 0.030%.
- L. The drop pipe shall be a minimum of 12 gauge wall thickness and dimensional tolerances shall conform to ASTM A554-72 and ASTM A530-72. Drop legs in the aerobic digesters shall be provided as shown on the drawings and shall be a minimum of 6-inch diameter.
- M. All welding shall be completed in the factory. Field welding shall not be permitted. All welding shall be by the shielded arc, inert gas, MIG or TIG method. Filler wire shall be added to all welds to provide for a cross-section of weld metal equal to, or greater than, the parent metal. Butt welds shall have full penetration to the interior surface and gas shielding shall be provided to the interior and exterior of the joint. Flanges and face ring welds shall be continuous on both sides.
- N. Interior weld beads shall be smooth, evenly distributed with an interior projection not exceeding 1/16-inch beyond the I.D. of the air header or fitting.

- O. The outside weld area shall be wire brushed. Brushes shall be of stainless steel and used only on stainless steel. All discoloration and deposits left by welding shall be removed by pickling.
- P. After fabrication, all stainless steel assemblies and parts shall be passivated by immersion in a pickling solution of 10% nitric acid and 3% hydrofluoric acid at 140°F for a minimum of 15 minutes in water. Parts shall be free of iron particles or other foreign material. A complete wash in hot water shall be required.

2.03 DISTRIBUTION SYSTEM

- A. The distribution headers shall include header piping support stands, factory installed diffuser element holders, positive fixed threaded union joints or flanges, drainage system, and anchor bolts.
- B. The distribution headers shall connect to the bottom centerline of the manifold at the connections provided for that purpose. The headers shall be fabricated in sections not to exceed 25 feet in length. Joints between sections shall permit rotation of each header section independently of adjacent header sections.
- C. Each header section shall be anchored in place by either fixed or intermediate supports. Intermediate supports shall allow longitudinal and rotational movement of the header section. In the aerobic digesters, maximum support spacing shall be 5 feet. Stands shall be adjustable to permit leveling and rotating of the distribution header. All adjusting devices shall lock in place after the headers have been installed and leveled. Each support shall be secured to the tank floor by means of an expansion type anchor bolt designed for four times the calculated normal uplift forces. All header supports shall have a vertical adjustment of $\pm 1\frac{1}{2}$ inch.
- D. The polyvinyl chloride (PVC) air distribution system shall be designed for expansion-contraction over a minimum temperature range of 125°F.
- E. The fixed supports shall be designed to anchor the PVC header against longitudinal movement at the supports. The fixed support shall be attached to the header in such a manner to prevent movement at this point. Any expansion-contraction must take place through the guide supports.
- F. Diffuser assemblies shall be installed along the top centerline of the distribution header. Each diffuser assembly shall consist of a holder, gasket, retainer ring, orifice control, and diffuser element.
- G. The entire system shall be designed, manufactured and installed in such a manner that all the diffuser elements are within $\pm 1/8$ -inch of a common horizontal plane. Air distribution shall be uniform throughout the entire system and shall be uniform over the entire horizontal projected surface of each diffuser element. Air diffusion equipment in both aerobic digestion tanks shall be installed with top of diffusers at a maximum elevation difference of $\pm 1/8$ -inch.
- H. The diffuser element holder shall be factory bonded to the distribution header. The diffuser element shall fit into the diffuser element holder and shall be secured by a retainer ring which shall be screwed onto the element holder. A gasket integral to the membrane diffuser, shall be fitted into an annular space formed by the diffuser base plate and the

base plate holder. The gasket shall form a seal between the diffuser base plate and the diffuser holder.

- I. Air shall enter the diffuser assembly from the distribution header through the orifice control. The orifice control shall be of a size to ensure adequate air distribution throughout the system and the air release of the orifice shall be designed such that air entering the diffuser assembly shall be distributed under the surface of the diffuser element.
- J. The diffuser element shall be a Silver Series membrane disc, or equal, and shall diffuse the air in a fine bubble form into the thickened biosolids. Diffusers shall provide uniform distribution and release of air bubbles across the active surface of the diffuser element when submerged through precision die-formed slits. Membrane diffuser shall not require a center bolt to limit membrane deflection. Membranes shall collapse and seal to base plate when no air is passing through the diffuser.
- K. A water purge system shall be provided to drain each submerged aeration grid piping system. The vertical purge system piping shall be PVC.
- L. Distribution headers, joints, diffuser holders and retainer rings in the aerobic digestion tanks shall be manufactured of UPVC with a minimum of 2% TiO₂ added for ultraviolet protection.
- M. Headers shall be nominal 4-inch (gravity thickener) or 6-inch (aerobic digester) diameter and shall conform to ASTM D-3034 and shall have a minimum standard dimensional ratio of 24. Fixed joints, diffuser holders and retainer rings shall have a minimum wall thickness of 0.173 inches. Header sections shall not exceed 25 feet in length and shall have a minimum nominal wall thickness of 0.173 inches. Fixed joints and diffuser element holder shall be factory installed on the distribution header. No field solvent welding shall be permitted. Supports shall be of stainless steel and shall meet the material requirements specified for manifold supports.
- N. Maximum spacing between diffuser laterals shall not exceed 4 feet.

2.04 DIFFUSER ELEMENTS

- A. Circular membrane diffuser discs shall be manufactured of EPDM synthetic rubber compound with precision die formed slits. Thermoplastic materials such as plasticized PVC or polyurethane shall NOT be acceptable.
- B. Maximum spacing between diffuser elements shall not exceed 4 feet.
- C. Diffuser shall be a one-piece compression molded part with a minimum thickness of 0.080-inch for nominal 9-inch diameter unit. This part thickness shall limit the maximum tensile stress of the rubber membrane to 10 psi when operating at 2.4 scfm per square foot of membrane media. Larger disc diffusers shall be proportionately thicker to limit the maximum tensile stress at the specified air rate.

- D. The EPDM rubber compound shall have the following minimum characteristics:

Durometer	58 Points ± 5
Tensile Strength:	1,200 psi
Elongation:	400%
Specific Gravity	1.25 or Less
Base Polymer	EPDM
UV Resistance:	Carbon Black

- E. In addition to the above characteristics, the compound shall be "oven aged" for 70 hours at 70°C per ASTM D573 and the durometer shall not change by more than 10 points; the tensile strength shall not change by more than 25%; and the elongation shall not change by more than 25%. Maximum allowable compression set of the compound shall be 50% or less in accordance with ASTM D395 Method B. The compound shall also pass the low temperature brittleness test, ASTM D2173 and the ozone resistant test, ASTM D1171. Submit laboratory results of the EPDM compound to show compliance with these requirements.
- F. Furnish diffuser membranes with uniform distribution of air bubble release across the active surface of the diffuser element when submerged in water. Membrane discs shall be manufactured with integral sealing gaskets.
- G. Furnish diffuser membranes to meet or exceed the following criteria:
1. Membrane shall collapse and seal when aeration system air is turned off.
 2. Membrane shall be able to collapse onto support base when air is not being diffused.
 3. Join sections of distribution headers shall be provided with fixed threaded union or flange type joints to prevent blow apart. Push on or bell in spigot type joints will not be acceptable.
 4. Distribution headers shall be fabricated with diffuser element holders factory solvent welded to the crown of the header. Diffuser element holders shall be attached to distribution headers to resist a dead load of 200 pounds applied vertically to the outer most edge of the diffuser holder.
- H. Furnish diffuser assemblies consisting of a diffuser membrane with integral gaskets, diffuser holder, air flow control orifice and retaining device. Diffusers utilizing ceramic or plastic type diffusion media elements will not be acceptable as alternatives to the membrane disc design. Diffusers that require a center bolt to limit membrane deflection will not be allowed.
- I. Furnish PVC diffuser element holders with an air plenum chamber below the diffuser support plate. Provide a mechanism to attach the diffuser to the holder.
1. Element holders shall provide complete peripheral edge support for the membrane diffuser element.
 2. Solvent weld element holders to the distribution headers in the factory to resist dead load of 200 pounds applied vertically to the outer edge of the diffuser unit.
 3. Furnish retaining device to securely hold and seal the membrane diffuser to the holder.
 - a. Design diffuser assembly and retaining device to prevent air escape at the diffuser element-sealing gasket interface. Make gasket integral with diffuser membrane.

- b. Provide a method to vary the applied sealing force between the sealing gasket and membrane diffuser. Sealing method or retaining device shall generate a minimum of 50 pounds per inch of circumference of the sealing gasket to provide a long-term positive seal and prevent air escape except through the active area of the diffuser membrane.
- 4. Provide screw on retainer rings with a positive "o" ring seal and a minimum of 2-1/2 complete threads for engagement. Threads shall have a minimum cross section of 1/8-inch. Alternatives utilizing a threaded nipple design for attaching diffuser to header must use stainless steel nipples and stainless steel inserts molded into the PVC headers.

2.05 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.06 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be of ample strength for the intended service. Provide anchor bolts in accordance with Division 5.

PART 3-EXECUTION

3.01 PREPARATION

- A. Equipment shall be installed in aerobic digestion tanks while tanks are empty. CONTRACTOR shall coordinate with OWNER to schedule work in each tank. CONTRACTOR shall also coordinate equipment installation with the construction sequence.

3.02 FIELD QUALITY CONTROL AND DEMONSTRATION

- A. Provide manufacturer's services for the following:
 - 1. Start up for each item of equipment prior to being placed in service.
 - 2. Field testing for each item of equipment prior to being placed in service. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report.
 - 3. Operator training and final adjustment.
- B. Supervision and Start Up: Installation of all equipment furnished under this contract shall be supervised as required by a qualified representative of equipment manufacturer. All equipment shall be placed in operation by a qualified representative of the equipment manufacturer and the plant staff shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to his satisfaction.

- C. Where items of equipment are placed into service at different times or sequence, manufacturer's services for start up, field testing, and supervision shall be provided for each time or sequence. Training shall be provided prior to or at the time the first similar item of equipment is placed in service.
- D. Field Tests: CONTRACTOR shall conduct field tests in each aerobic digestion tank once the diffused air system has been installed. The equipment manufacturer shall be present. At least ten days prior to the performance of field tests, CONTRACTOR shall notify ENGINEER in writing when these tests are to be performed. CONTRACTOR and ENGINEER shall agree upon the actual time the tests are to be performed. CONTRACTOR shall furnish all labor, equipment, and materials required to perform the tests. CONTRACTOR shall provide necessary piping from existing plant water system to flood aerobic digestion tank. All defects shall be corrected by CONTRACTOR and all required retesting shall be performed by CONTRACTOR at no additional cost to OWNER.
- E. Level Test: Each aerobic digestion tank shall be flooded with water to the tops of the diffusers. The level of the diffusers shall then be checked to ensure that they are at the same elevation within ± 0.125 -inch.
- F. Uniformity and Leakage Tests: Each aerobic digestion tank shall be flooded with water to a depth of approximately 1 foot above the tops of the diffusers. Process air shall be supplied evenly to all headers in each tank. The surface of the water above the diffusers shall then be visually inspected to ensure that air flow is uniformly distributed; the diffusers shall then be visually inspected to ensure that air flow is uniformly distributed across the tank.

END OF SECTION

SECTION 11396

PLANT WATER STRAINERS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installation, and placement into successful operation one self-cleaning plant water strainer (STR-70-01).
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Strainer shall be capable of handling 0 to 200 gpm of final clarifier effluent with a maximum pressure drop of 0.5 psi.
 - 2. Strainer shall be designed for a working pressure of 20 psig to 100 psig and a design temperature of 60°F to 150°F.
 - 3. Strainer shall have a maximum pressure drop of 20 psi during the backwash cycle.
- B. Performance Requirements:
 - 1. Strainer shall not require an external backwash source during the self-cleaning cycle.
 - 2. Strainer shall be capable of automatic self-cleaning without interrupting the flow of plant effluent through the strainer. Manual operations shall also be provided. Dirt and debris shall be flushed from the screen, out from the strainer, and into the backwash piping.
 - 3. Strainer shall be capable of handling plant effluent with an average of 30 mg/L suspended solids.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. The nonpotable water strainer shall be self-cleaning automatic strainer Model 596 as manufactured by Eaton Filtration, of Elizabeth, NJ, or equal.
- B. The drawings and specifications were prepared based on Eaton Filtration. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 STRAINER

- A. Strainer Body:
 - 1. The strainer body shall be of cast iron.
 - 2. All components of the strainer shall be of ASTM designed materials suitable for the operating conditions.
 - 3. Pipe suction and discharge connections shall be 4-inch flanged in accordance to ANSI B16.1 Class 150.
 - 4. Backwash discharge port shall be 1-inch NPT.
- B. Screen Element:
 - 1. The screen element shall be a vee-shaped profile wire type. The opening size of the screen shall be No. 40 mesh.
 - 2. The screen material shall be stainless steel Type 316.
 - 3. The screen shall be of one piece design for ease of removal and cleaning.
 - 4. Stainless steel cap rings shall be provided at both ends of the screen to prevent bypass of dirty fluid. Reinforcing circumferential bends shall also be provided for structural strength of the screen.

2.03 MOTORS

- A. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
 - 1. Physical Construction:
 - a. Copper windings with ball or roller bearings in end brackets of steel or cast iron, or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two-windings for all two-speed motors.
 - b. Motor shaft shall be high strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft run-out shall be 0.002-inch.
 - c. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be pre-lubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
 - 2. Mounting: Horizontal.
 - 3. Enclosure: TEFC.
 - 4. Efficiency: Premium efficiency as noted in schedule below.
 - 5. Service Factor: 1.15.
 - 6. Power Requirements: 60 Hertz, Single phase, 120 volt, factory wired for 120 volt connection, $\pm 10\%$ variation.
 - 7. Load Type: Constant torque.
 - 8. NEMA Design: B.
 - 9. Insulation: Class F.
 - 10. Nominal Operating Speed: Single speed, 1800 RPM.
- B. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER. The motor for STR-70-01 shall be 1/4 horsepower.

2.04 CONTROL SYSTEM

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16 and specification Section 11940.
- B. Components:
 - 1. A NEMA 4X control panel shall be provided with push-to-test indicating lights for "Power On" (white), "Motor Failed" (red), "Motor Running" (green), Backwash Valve Open" (green), and "High Differential Pressure" (red). NEMA rated starter and controls shall be provided within the control panel.
 - 2. An H-O-A selector switch shall be provided to control the backwash valve.
 - 3. Adjustable timers shall be provided to automatically cycle the backwash cleaning cycle.
 - 4. A diaphragm type differential pressure switch shall be provided, capable of initiating backwashing at a set differential pressure.
 - 5. An electrically actuated ball valve shall be provided to control the backwash flow.
 - 6. A terminal strip and auxiliary (dry) contacts shall be provided for remote indication of H-O-A selector switch in auto, motor failed, motor running, backwash valve open, and high differential pressure.
 - 7. Provide a nonfusible disconnect for the panel.
 - 8. Provide motor starter and controls.
- C. Modes of Operation: By operating the selector switch, the controls can be easily switched to either of two modes: automatic intermittent (auto) or continuous backwashing (hand).
 - 1. Automatic intermittent mode shall be adjustable by setting the timer that controls the frequency of backwashing and the "Open" time of the backwash valve. Field adjustments should be made to dictate the optimal settings.
 - 2. The continuous backwashing mode shall be initiated by placing the backwash switch in the "Hand" position. Manual operation can be controlled with this switch, opening or closing the backwash valve as desired. By returning the switch to "Auto" shall restore the set intermittent cycling.
 - 3. The differential pressure switch shall be capable of overriding the time cycle should the differential pressure rise exceed the programmed setting, such as during sudden high solids loadings. A secondary delay timer will continue cleaning, variable from 1 to 150 seconds, once the backwash cycle is initiated.

2.05 FINISHES

- A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish paint by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. Motors and speed reducers shall be factory primed and finished painted using the manufacturer's standard paint system for the specified application.

2.06 PRESSURE GAUGES

- A. Provide pressure gauge on inlet and outlet side of each self-cleaning strainer.
- B. Pressure gauges shall be 4 1/2-inch diameter, glycerin filled with stainless steel movement, bourdon tube and socket. Pressure gauge shall be model 450 LFSS by H.O. Trerice, or equal. Diaphragm seals shall be Model T611-03-TS with 1/4-inch tapped and plugged port to allow connection of other equipment. Pressure shall be transmitted to a 4 1/2-inch diameter gauge by locked in and sealed ethylene glycol. Outlet gauges shall be 0 to 160 psi.

2.07 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

PART 3-EXECUTION

3.01 GENERAL

- A. See Division 1 for requirements related to equipment installation, field quality control, testing, supervision, and start-up.

3.02 INSTALLATION

- A. Provide manufacturer's recommended clearance to allow removal of strainer cover.
- B. Provide extra slack in the electrical connection to the strainer to facilitate future disassembly of the motor.

END OF SECTION

SECTION 11940

CONTROLS AND INSTRUMENTATION EQUIPMENT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Controls and instrumentation equipment provided with equipment in Division 11.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. UL labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures. Electrical equipment shall include, but not be limited to, control panels, power supplies, controllers, relays, wire, selector switches, pilot lights, overcurrent devices, and connectors. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels which have individual components which are UL labeled, but do not have UL approval as an assembled unit are not acceptable.
- B. NEMA/ANSI Compliance: Comply with National Electrical Manufacturer's Association, American National Standards Institute and other standards pertaining to material, construction and testing, where applicable.
- C. Code Compliance: Comply with the National Electric Code (NFPA 70) and any and all local codes as applicable to construction of electrical wiring devices, material, and equipment herein specified.

1.03 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01300—Submittals.
- C. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.

1.04 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01300—Submittals.
- B. Include spare parts data listing, source, and current prices of replacement parts and supplies, recommended maintenance procedures and intervals.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store in a clean dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to equipment components, enclosure, and finish.

PART 2-PRODUCTS

2.01 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 12 gauge steel, continuous hinged doors, rotating lockable handle 3-point latch on each equipment compartment door (not screws or bolts) with top and bottom bolts actuated by one rotating handle on large doors. Quick opening hasps may be substituted for rotating lockable handle latch where approved by ENGINEER. Panels shall include door stop kit, data pockets for panel wiring diagrams and minimum 18-inch fluorescent light and switch. Panels shall include non-fused, main disconnect with interlock to prevent opening the panel with switch in "On" position. A defeater shall be provided to bypass this interlock, with handle lockable in "Off" position. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust inhibiting enamel, white interior, and OWNER-selected exterior color. All doors and panels shall be gasketed, and panels installed outdoors or nonconditioned spaces shall be insulated. All louvers shall be filtered with forced air cooling as necessary by the supplier for conditions where installed. Enclosures shall be as manufactured by Hoffman, Lehman, or Saginaw. Enclosure rating shall be as follows unless noted otherwise on the drawings or in the associated specification section.
 - 1. Indoor and/or dry locations: NEMA 12.
 - 2. Corrosive and/or damp locations including chemical rooms, below-grade nonconditioned spaces, and outdoor locations: NEMA 4X, stainless steel.
 - 3. Hazardous locations: NEMA 7, cast iron.
- B. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations.
 - 1. All wiring within control panels shall be insulation-type THHN, minimum size 16 AWG. Wiring within the enclosure shall be routed through plastic wiring troughs with removable covers. Maximum fill for wiring troughs shall be 60%. Terminal strips located adjacent to wiring troughs shall have a minimum of 2-inches between terminal strip and trough. All wiring in control panels not in wiring troughs shall be bound with continuous-type spiral windings.
 - 2. All I/O devices shall be wired to rail mounted terminal blocks. Plastic wiring duct shall be Electrovert "Electro-duct," Panduit, or equal. Terminal blocks shall be Electrovert 9700 Series, Square D, Class 9080 Type G, or equal.
 - 3. Field wiring in dry locations shall be insulation-type THHN, minimum size 14 AWG. Field wiring in damp or wet locations shall be insulation type XHHW-2, minimum size 14 AWG. All field wiring shall terminate at the rail mounted terminal blocks. Field wiring terminals shall be clearly identified as to which I/O terminals they are wired. Wire markers shall be permanently attached, wraparound adhesive, or heat-shrink type

markers. Wire numbering preprinted on the conductor and individual wraparound numbers are not acceptable.

4. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer.
 5. All panels with DIN rail mounted equipment shall include a minimum of 25% spare DIN rail space.
 6. In addition to spare IO specified herein, provide a minimum of 25% spare hot and neutral terminals, wired to terminal strips. Spare terminals shall be provided for all voltage sources within the panel (e.g. 120V, 24V).
- C. Tubing and instruments containing water shall be in separate compartments, located and constructed so that leakage or spray at 100 psi pressure cannot touch electrical conductors or devices. Leakage shall be conducted to the floor in duct or pipe.
- D. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal blocks shall be mounted either at the bottom or at the top of the enclosure, depending where the I/O conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. All wiring shall be labeled at each end with corresponding numbers. This numbering shall be shown on the shop and record drawings.
- E. All door-mounted devices shall be furnished flush-mounted, and an exterior engraved phenolic nameplate worded by the manufacturer and reviewed by OWNER (upon receipt of shop drawings) shall be provided for each compartment, device, light, etc. All components within the enclosures shall be identified with interior mounted engraved labels. Labels shall be installed on the enclosure back-panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.
- F. Equipment enclosures that include motor controllers shall have a main disconnect for the enclosure.

2.02 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.
- B. Power supplies shall be protected against short circuits and contain their own overcurrent and overvoltage protection. 12 and 24 VDC power supplies shall be provided and installed in the enclosures for powering all analog input signals where required.
- C. All motor control power shall be 120 volt with suitable circuit protection fuses or breakers. Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- D. Devices powered at 120 volts from control panels shall be fused. This shall include, but not be limited to, solenoid valves, motor operated valves, motorized ball valves, flow meters, scales, transducers, etc.
- E. Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays if necessary to obtain supervisory power. Lightning protection shall be completely

solid state, self-healing, and not require the use of fuses. Lightning protection shall be as manufactured by Citel, Model M18-120, or equal.

- F. Each panel shall have a GFI, duplex, 20 ampere, 120 volt receptacle.
- G. Control panels that include programmable or electronic controllers (PLCs) shall be provided with an Uninterruptible Power Supply (UPS) sufficient to power the control panel for 30 minutes. In panels with a UPS, control power shall be through the UPS and shall be plug connected. UPS power shall be provided, at a minimum, to the following components: PLC and I/O racks, power supplies for PLCs and I/O, indicating lights, and devices associated with power fail and communication alarms, and power supplies for loop-powered instruments. UPS' provided in control panels with a PLC shall be provided with a relay card that provides a dry contact output to the PLC in the event that the UPS battery needs replacement. UPS shall be APC with relay IO module, or Liebert, GXT2 with relay card. Provide a stand or shelf for the UPS such that the UPS does not sit on the bottom of the enclosure.
- H. Where PLC's or Operator Interface Panels (OIPs) are installed in control panels, two copies of all programs with associated passwords shall be turned over to OWNER at final completion. Copies shall be a bound hard-copy and electronic compact disk.
- I. If enclosure and panel space is needed for future installation of devices, lights, etc., the enclosure and panel shall be constructed for such installation. Supports shall be provided for future equipment, and panel openings shall be made and covered with neat cover plates matching the panel.
- J. Control panels that include PLCs shall have an exterior panel-mounted receptacle and programming port, mounted to the front or side of the panel as applicable to the installation. Receptacle and programming port shall be provided to allow for PLC programming via laptop without opening the panel door. Programming port shall match that of the network being installed (e.g., Ethernet, data highway, etc.).
- K. CONTRACTOR shall furnish one complete extra set of fuses and similar parts which may need replacement in normal service, and an identification list of all component parts and where they may be obtained for operating the system for three years from startup.
- L. Where a certain accuracy of sensing and transmitting levels or flows and controlling operations are called for, means must be provided to read or determine that the levels or flows are within the limits or accuracy specified of the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of levels is necessary to set operating points, an indicating device of accuracy consistent with the operation of the system is required.
- M. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and Timing Out LEDs.
- N. All internal wiring shall be color coded and numbered, and each wire shall be terminated on terminal strips. Schematic and wiring layout drawings, following the requirements of Section 16941-Controls and Instrumentation Drawings, which show all connections to external devices, a complete bill of materials, interior and exterior panel layouts, and a detailed description of operation shall be submitted for each control panel.

- O. Each analog signal entering or leaving a supervisory control panel and leaving a building shall be provided with a surge protection device as manufactured by Citel, Model No. DL-24, or equal. Each transmitter shall be provided with a surge protection device as manufactured by Citel, Model No. TSP-10 on the output and Citel, Model No. M18-120 on the power supply, or equal.
- P. A condensation heater shall be provided in all control panels located outdoors. Condensation heater shall be as manufactured by Hoffman, Model D-AH, X000 Series, sized as required.

2.03 CONTROL PANEL DEVICES

- A. Manual, magnetic, solid state motor starters, and Variable Frequency Drives (VFDs) shall comply with Section 16480–Motor Control.
- B. Overcurrent protection and disconnecting means for equipment shall be provided as specified in the specification section for the associated equipment. Molded case thermal-magnetic circuit breakers shall include integral thermal and instantaneous magnetic trip in each pole. Motor controllers shall include molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Nonfusible switch assemblies shall consist of quick-make, quick-break load interrupter enclosed knife switch with externally operable handle.
- C. Pushbuttons shall be heavy-duty, oil-tight, 30mm, flush-head-style.
- D. Indicating lights shall be heavy-duty, oil-tight, 30mm, push-to-test-type. Color shall be as indicated in the specification section for the associated equipment.
- E. Selector switches shall be heavy-duty, oil-tight, 30mm.
- F. Elapsed time meters be 3 inches round, capable of reading up to 99,999.9 hours, nonreset-type, and flush door mounted, Engler Model 10NG7, or equal.
- G. Programmable Logic Controllers (PLCs) shall comply with Section 16940–Controls and Instrumentation.

PART 3–EXECUTION

3.01 INSTALLATION

- A. All control panels and equipment enclosures shall be cleaned of debris and wires neatly arranged with surplus length cut off. Spare wires shall be labeled as “spare” and where the wires terminate.
- B. Where louvers are provided in enclosures or control panels, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in enclosures or control panels, all filters shall be replaced with new at the time of final completion.
- C. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

- D. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment during construction, the equipment shall be refinished by CONTRACTOR to the satisfaction of ENGINEER. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

END OF SECTION

SECTION 12692

FLOOR MATS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Switchboard mats.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2—PRODUCTS

2.01 DIAMOND PLATE SWITCHBOARD MATS

- A. Switchboard mats shall be diamond-plate, high-performance, nonconductive, switchboard matting. Matting shall conform to ANSI/ASTM D-178-01, Type II, Class 2.
- B. Acceptable manufacturers shall include the following, or equal: Wearwell Carpet, No. 701. Mats shall be 3 feet wide and extend the full length of the equipment.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install mats after cleaning of finish flooring.
- B. Provide mats for all motor control centers, distribution panelboards, and any other freestanding or pad-mounted electrical equipment.

END OF SECTION

SECTION 13031

PARSHALL FLUME LINERS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placement into successful operation one Parshall flume liner as shown on the drawings and specified herein.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. U.S. Department of Agriculture Circular 843.

1.03 SYSTEM DESCRIPTION

- A. Application:
 - 1. The Parshall flume liner shall be used to measure wastewater flow.
 - 2. The Parshall flume liner shall be designed for continuous exposure to municipal wastewater slurries containing solids such as hair, grit, rags, grease, paper products, and organic solids. The liquid is expected to contain water, domestic wastes, industrial solvents, petroleum products, up to 30 ppm of ferric chloride, small amounts of aluminum sulfate, and dissolved hydrogen sulfide gas in concentrations up to 20 mg/L. Oxygen may be either present or absent. During the normal life of the laminants, they may be left in the dry condition for protracted periods. It is likely that dilute sulfuric acid will be present and will collect on any surface. Wastewater temperatures are expected to vary between 45°F and 85°F, and ambient air temperatures may range between -30°F and 100°F.

1.04 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01300–Submittals.
- B. Submit O & M manuals under provisions Section 01300–Submittals.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Parshall flume liners shall be Plasti-Fab, Inc., or equal.

2.02 FLUME CONSTRUCTION

- A. Parshall flume liners shall be molded, fiberglass-reinforced polyester with sanitary satin finish on all surfaces exposed to flow. Liner shall be reinforced with not less than 30% fiberglass by weight.

- B. Flume shall be molded in one piece with ample wall thickness and reinforcing ribs to prevent distortion during shipment, installation, and operation. The flume shall be self-supporting and require no external supporting structure. Flume shall be equipped with removable top cross ties to facilitate installation. Flume shall include 2 1/2-inch flanges on bottom and sides to facilitate connection to concrete.
- C. Parshall flume liners shall have a throat width and height as indicated. Other dimensions of the Parshall flume liners shall conform with the standard design dimensions for flumes of the specified throat width stated in the U.S. Department of Agriculture, Soil Conservation Service, Circular No. 843.
- D. The Parshall flume liners shall have a stainless steel or fiberglass scale calibrated in feet, tenths, and hundredths of feet and in million gallons per day (mgd), tenths, and hundredths of mgd. Scale shall be embedded in the side of the flume to allow for local calibration of instrumentation.

2.03 FLUME SIZING

- A. The aeration basin influent Parshall flumes shall be of the following sizes:

Location	Throat Width	Height
Oxidation Ditch Influent Splitter Box	12 inches	3 feet 0 inches

2.04 FINISHING

- A. Flume shall have coloration and protective coating built into flume construction and shall require no field finishing.

PART 3-EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. The equipment specified in this article shall be installed by CONTRACTOR in accordance with the manufacturer's recommendations and under the guidance of the manufacturer's field representative. After completion of installation, CONTRACTOR shall submit a written certification by the manufacturer that the installation is in accordance with the manufacturer's recommendations.
- B. The Parshall flume liners shall be installed so that the entire floor of the converging section (crest) shall be within $\pm 1/8$ -inch of perfect level and the walls shall be within $\pm 1/4$ -inch of perfect vertical.
- C. CONTRACTOR shall grout flume into place. Flume shall be adequately braced to prevent distortion during pouring of grout. Grout shall be nonshrink-type as specified in Division 3.
- D. CONTRACTOR shall install ultrasonic liquid level device, as specified in Division 16, at location recommended by flume manufacturer.

3.02 FIELD QUALITY CONTROL AND DEMONSTRATION

- A. Provide manufacturer's services for the following:
 - 1. Start-up.
 - 2. Field Testing. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start-up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report.
- B. Minimum Service Requirements: Start-up and Field Testing: One full day on-site for each flume.

3.03 ADJUSTING, CLEANING AND PROTECTION

- A. CONTRACTOR shall provide final adjusting, cleaning, and protection in accordance with Division 1. CONTRACTOR shall make all final adjusting on equipment as required by manufacturer. CONTRACTOR shall leave equipment in a clean condition.

END OF SECTION

SECTION 14600

HOISTS AND CRANES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Hoists.
 - 2. Trolleys.
 - 3. Cord reels.
 - 4. Electrical system controls.
 - 5. Portable davit crane bases.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. CMAA–Crane Manufacturers Association of America.
- B. MHI–Material Handling Institute, Inc.
- C. ANSI–American National Standard Institute.
- D. HMI–Hoist Manufacturers Institute.
- E. MMA–Monorail Manufacturers Association.

1.03 SYSTEM DESCRIPTION

- A. Monorail System: Monorail system shall include monorail beam(s) furnished under Division 5 and items specified in this section (excluding bridge cranes and portable cranes) as appropriate and all other specified accessories necessary to provide a complete functioning system.

1.04 DESIGN REQUIREMENTS

- A. Underhung monorail systems shall be designed and manufactured in accordance with ANSI MH 27.1–1981, “Monorail Manufacturers Association Specifications for Underhung Cranes and Monorail Systems.” Where design standards of the CMAA and MMA conflict, the CMAA standards shall govern.
- B. Hoists shall be designed and manufactured in accordance with the standards of the Hoist Manufacturers Institute.

1.05 PERFORMANCE REQUIREMENTS

- A. Monorail Systems: CONTRACTOR shall conduct start-up and testing of monorail systems to demonstrate that load capacity and total system operation meet the requirements and intent of the Contract documents.

1.06 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01300–Submittals.
- B. Submit type, brand, and thickness of primer paint to be furnished on bridge cranes, runway beams, and monorails.

PART 2–PRODUCTS

2.01 HOISTS

- A. Hoists shall be Coffing, Yale, or equal, motorized electric chain hoists. Motors shall be 460 volt, 3 phase, 60 Hz. Provide chain container with hoists.
- B. Hoist schedule is as follows (Coffing Model Numbers are shown):

Building	Model	Load Capacity	Motor Size	Speeds	Lift Height
RAS Pumping Building	ECMT-2012	1-ton	3/4 HP	12 FPM	30

2.02 TROLLEYS

- A. Trolleys shall be Coffing, or equal. Trolley motors, where required, shall be 460 volt, 3 phase, 60 Hz.
- B. Trolley schedule is as follows:

Building	Model	Load Capacity	Motor Size	Speeds
RAS Pumping Building	ECMT-2012	1-ton	1/4 HP	35 FPM

2.03 CORD REELS

- A. Cord reels shall be provided.

2.04 ELECTRICAL SYSTEM CONTROLS

- A. Hoist and trolley motors and all wiring and controls shall be NEMA 4X.
- B. The hoists and trolleys shall be controlled by pushbutton pendant.
- C. Provide reduced voltage transformers for 115 volt power at the pushbutton pendant. Enclosure for pendant station and transformer shall be rated NEMA 4X.
- D. Pendant shall reach to within 3 feet 6 inches of the operating floor. Provide control of all motions plus emergency stop button that will disconnect power to all motor circuits. “Start” button shall serve as reset.
- E. Hoist and trolley motions shall be controlled by means of magnetic contactors mounted on shockproof mountings.

- F. All electrical panels and enclosures shall be NEMA Type 4X.
- G. Provide magnetic main contactor for power circuit disconnect with control from emergency start-stop buttons in pushbutton station.
- H. Provide a fused disconnect located on the trolley which shall disconnect power to all motors and control devices on the unit.

2.05 PORTABLE DAVIT CRANE BASES

- A. Portable davit crane bases shall be Thern, Inc. Model 524W wall mounted socket bases and Model 524 pedestal socket bases, or equal. Provide Model TK4P socket base cover for each base.
- B. Portable hoist schedule is as follows:

Building	Hoist Capacity	No. of Hoists	No. of Bases (Model #)	Cable Length
40-Oxidation Ditch	2000#	N/A	2 (524)	N/A
60-Chlorine Contact Tank	2000#	N/A	4 (524W))	N/A

2.06 HAND WINCHES

- A. Hand winches shall be Thern, Inc. spur gear hand winch, Model M4042PBSS, or equal.

2.07 FINISHES

- A. Hoists and trolleys shall be factory-finished painted with the manufacturer's epoxy paint finish system.

PART 3—EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Install equipment as indicated and according to supplier's and manufacturer's instructions.
- B. CONTRACTOR shall inspect the units after delivery to the site for any damage to the units during shipping.

3.02 FIELD QUALITY CONTROL AND DEMONSTRATION

- A. Provide manufacturer's services for the following:
 - 1. Start-up.
 - 2. Field Testing. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start-up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report.
 - 3. Operator training and final adjustment.
- B. Supervision and Start Up: Installation of all equipment furnished under this Contract shall be supervised as required by a qualified representative of equipment manufacturer. All equipment shall be placed in operation, and the plant operator shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentation given by manufacturer's representatives.

3.03 FINISHING

- A. CONTRACTOR shall provide finish paint as required by Section 09900–Painting.

3.04 ADJUSTING, CLEANING, AND PROTECTION

- A. CONTRACTOR shall provide final adjusting, cleaning, and protection in accordance with Division 1. CONTRACTOR shall make all final adjusting on equipment as required by manufacturer. CONTRACTOR shall leave equipment in a clean condition.

3.05 LUBRICATION

- A. CONTRACTOR shall furnish a one-year supply of grease and oils for all items of equipment requiring lubrication. Lubricants for all items of equipment shall be the same brand, when available, as recommended by the manufacturer to meet both warm and cold weather requirements.

END OF SECTION

SECTION 15000

GENERAL REQUIREMENTS FOR MECHANICAL WORK

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All material, piping and installation for piping and appurtenances, mechanical insulation, plumbing, heating, ventilating, and air conditioning.
 - 2. Concrete foundations and anchor bolts for all equipment furnished under this division.
 - 3. Connections to all equipment whether furnished under this division or not.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.
- C. Work of Other Divisions: CONTRACTOR for this work shall coordinate its work with that of any other contractors working in the same construction area. The contractors shall make a mutual agreement as to when piping and appurtenances shall be installed so as to minimize interference with each other's work.
- D. Finishes: Unless otherwise specified, valves, piping, and mechanical equipment items shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC, and underground piping) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9.
- E. Electrical Controls: All electrical controls shall be furnished and installed under Division 16, except for those items specified to be furnished with the equipment. Where electrical controls are specified to be furnished with the equipment, electrical controls shall be in accordance with Division 16 unless otherwise specified.
- F. Equipment Foundations: CONTRACTOR shall construct concrete foundations for all equipment and control panels under this Contract unless noted otherwise. Foundations shall generally be at least 4 inches high, shall consist of six-bag mix concrete, anchor bolts, reinforcing rod dowels into building concrete, and grouting with nonshrink element (containing no iron filings) where required. More specifically, concrete and grout shall meet the requirements found in Division 3.
- G. Concrete: All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 3.

1.02 SUBMITTALS

- A. See Section 01300–Submittals for shop drawing submittal procedures.
- B. Applicable provisions of Section 01300–Submittals cover requirements for Operation and Maintenance Manuals.
- C. Applicable provisions of Section 01700–Contract Closeout govern requirements for record drawings, operation and maintenance data, and warranty information.

1.03 DELIVERY STORAGE AND HANDLING

- A. Applicable provisions of Section 01600–Materials and Equipment govern the handling, storage, and protection of materials and equipment.

1.04 SEQUENCING

- A. Applicable provisions of Section 01010–Summary of Work govern construction sequencing.

1.05 WARRANTY

- A. Applicable provisions of Section 01700–Contract Closeout govern product warranties.

1.06 SYSTEM START-UP

- A. Applicable provisions of Section 01650–Starting of Systems govern start-up and testing.
- B. Installation of all equipment furnished under this contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- C. All costs of supervision, operator training, and start-up shall be included in the Bid.

1.07 MAINTENANCE

- A. CONTRACTOR shall furnish a one-year supply of grease and oils for all items of equipment requiring lubrication. Lubricants for all items of equipment shall be the same brand, when available, as recommended by the manufacturer to meet both warm and cold weather requirements.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 15050

PIPING AND APPURTENANCES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All piping and valves of every description except as specified in Division 2.
 - 2. Concrete foundations and anchor bolts for all equipment furnished under this section.
 - 3. Piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Applicable provisions of Section 01300—Submittals cover requirements for shop drawings and Operation and Maintenance Manuals.
- B. General arrangement drawings including support system of 3-inch or larger interior and 3-inch or larger exterior (aboveground) ductile iron, stainless steel and welded steel piping shall be submitted to ENGINEER for approval. Shop drawings for all interior and aboveground exterior piping shall be two line drawings drawn to scale. Drawings shall include proposed length, location and elevation of pipe, fittings, and valves and appurtenances.

PART 2—PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. Materials of Construction: All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used.
- B. Size and Type:
 - 1. All materials shall conform to the size and type shown on the drawings or called for in the specifications.
 - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER.

2.02 PIPE AND PIPE FITTINGS

A. Ductile Iron Piping and Ductile and Cast Iron Fittings:

1. Unless otherwise shown or specified, all piping 3 inches in diameter or larger shall be ductile iron conforming to AWWA C151/A21.51, with flanged or grooved joints as shown on the drawings. Unless otherwise shown or specified, all piping shall be minimum special thickness Class 53 with a minimum rated working pressure of 250 psi for flanged pipe. Pipe wall thickness shall be furnished as required by: AWWA C115 for flanged piping; AWWA C606 for grooved piping; special thickness Class 53 minimum unless otherwise shown or specified.
2. All flanged sections of pipe shall be made up in strict accordance with AWWA C115 specifications. No field make-up flanges will be allowed unless strictly conforming to AWWA C115 with facing done after turning pipe through flange.
3. Flanged joints shall conform to AWWA C110, C111, and C115 and shall be compatible with ANSI B16.1 Class 125. Flanges shall be ductile iron or cast iron. Flanged gaskets shall be minimum 1/8-inch full face rubber ring gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerance. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressure and installation conditions specified or shown. Flanged bolts and nuts installed in wet wells shall be Type 316 stainless steel.
4. Flanged fittings shall be of ductile iron with ductile iron flanges. Flanged fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
5. All ductile iron fittings shall be American, Clow, Griffin, Tyler, U.S. Pipe, or equal. No compact fittings are allowed.
6. See Section 02600 for ductile iron wall pipe requirements.
7. The words "Ductile Iron" and the weight and class of pipe shall be plainly marked on each piece of pipe.
8. Unless otherwise specified, all ductile iron piping and fittings shall be cement mortar lined and asphaltic coated inside. Cement mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Exterior exposed and interior piping shall be furnished with outside surfaces prepared by abrasive blasting in accordance with NAPF 500C-03. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all piping, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9.
9. Unless otherwise specified, piping and fittings in manholes and wet wells areas shall be asphaltic coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
10. Grooved Piping System:
 - a. A grooved piping system may be used in place of flanges where approved by ENGINEER (valves shall remain flanged). Housing shall be manufactured from malleable iron conforming to ASTM A47 or ductile iron conforming to ASTM A536. The bolts and nuts shall be of track design, and unless otherwise required, shall be made of steel to conform to or exceed the requirements of ASTM A183. Gaskets shall conform to the requirements of ASTM D2000. Grooves cast or subsequently cut into ductile pipe, fittings, or other components shall conform to AWWA Standard C606. All pipe used in a grooved piping system shall be gauged and shall pass a

roundness test. A rigid joint system shall be used unless otherwise approved by ENGINEER.

- b. Fittings shall be ductile, ASTM A536, conforming to the requirements of AWWA-C110 for center to end dimensions, AWWA-C153 for wall thickness, and AWWA-C606 rigid radius grooving dimensions for end preparation.
11. All ductile iron piping and fittings designated SCM (Scum), and all piping conveying a combination of these sludges such as SCM/WAS, etc., shall be glass-lined and shall receive exterior coating as specified above. The glass lining shall be fused to the inside metal base prepared by blasting by placing the pipe or fitting into a furnace at the appropriate maturing temperature above 1,400°F. The entire coating shall be from 0.008-inch to 0.012-inch-thick. It shall have a hardness of from 5 to 6 on the Mohs Scale, and a density of from 2.5 to 3.0 grams per cubic centimeter. The glass lining shall be capable of withstanding a thermal shock of 350°F without crazing, blistering, or spalling. It shall be resistant to corrosion by solutions of between pH-3 and pH-10 at 125°F. There shall be no visible loss of surface gloss on the glass lining after immersion of a normal production run sample in an 8% sulfuric acid solution at 148°F for a period of ten minutes. In addition, when tested according to ASTM C283-54, it shall show a weight loss of not more than 3 milligrams per square inch.

B. Copper Piping:

1. Copper piping shall conform to the requirements of the "Specifications for Seamless Copper Water Tube," ASTM B88.
2. All interior or aboveground potable and nonpotable water supply piping smaller than 3 inches shall be Type K hard copper except in Screening Building. Fittings shall conform to ANSI B16.22 wrought copper and be soldered or sweated on. No lead-based solder may be used. Flux for potable water systems shall meet NSF 61. Piping shall run exposed in buildings, except in finished areas.
3. All underground water supply piping 2 inches and smaller shall be Type K soft copper with compression fittings. Joints shall not be used under floor slabs.
4. Shutoff valves shall be placed on each branch for all underground, aboveground, or interior piping.
5. Pump vent and drain lines, seal water supply and other small-diameter interior piping from the PW or NPW source, and manometer lines shall be rigid, Type K, hard copper. An ample number of unions shall be provided for disassembling. Pump vents shall be valved.

C. Galvanized Iron Piping: Unless otherwise shown or specified, all piping smaller than 3 inches shall be extra strong galvanized iron pipe, with Class 300 galvanized malleable iron fittings. An ample number of unions shall be provided for disassembling pipe. Pipe shall conform to the "Specifications for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses," ASTM A53.

D. PVC Piping:

1. Except as otherwise specified, all CLS, SDG, and Screening Building NPW piping, etc., shall be constructed of PVC.
2. PVC material shall conform to ASTM D1784, Class 12454-B. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact pipe conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467, and for threaded, ASTM D2464.
3. All piping shall be approved for use by the National Sanitation Foundation. All pipe delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be

solvent weld, except where flanges are required or as shown on the drawings or where transition to another pipe material is required. Underground gravity pipe shall be installed in compliance with ASTM D2321 except as otherwise specified herein. Underground pressure piping shall be installed in compliance with ASTM D2774.

4. All exterior exposed or PVC piping in open tanks shall be formulated with sufficient ultraviolet-light screeners to provide for long-term outdoor exposure with no deleterious effects.

E. Drain, Waste, and Vent (DWV) Piping:

1. All building drain, waste, and vent (DWV) piping and aboveground conductor, and Clearwater piping located in or within 2 feet of buildings or buried under slabs may be PVC pipe as specified herein or cast iron soil pipe as specified below.
2. Sanitary and storm drain, waste, and vent piping shall be Schedule 40 PVC conforming to Class 12454-B, ASTM D1785, and ASTM D2665. Fitting patterns shall conform to ASTM D3311; primers shall conform to ASTM F656, and solvent cement shall conform to ASTM D2564.
3. Sanitary and storm building sewers that penetrate exterior foundation walls shall be ductile iron from 2 feet beyond the exterior wall.
4. Aboveground PVC shall not be used where smoke generation, noise transmission, or physical abuse/durability are an issue.

F. Cast Iron Soil Pipe:

1. All building drain, waste, and vent (DWV) piping in or within 2 feet of buildings or buried under slabs may be cast iron soil pipe as specified herein or PVC as specified above.
2. All building drain, waste, and vent piping shall be first quality, service grade cast iron hub and spigot pipe, tarred inside and outside, free of flaws and defects, and conforming to ASTM A74. Joints shall be rubber gasket joints conforming to ASTM C564 below ground. "No hub" joints may be used aboveground provided that they conform to the Plumbing Code.
3. No bends shall be sharper than 1/8. Ends of all runs and stacks shall have cleanouts and screwed brass plugs.
4. All buried cast iron drainage, waste, and vent piping shall be polyethylene encased in accordance with AWWA C105. Polyethylene encasement shall be Class C (black) and shall be minimum 8 mil thickness.

G. CPVC Piping:

1. Phosphorus Removal Chemical (PRC), Chlorine Solution (CLS), and aboveground exterior PVC chemical piping shall be CPVC.
2. CPVC material used in manufacturing piping and fittings shall conform to ASTM D1784, Class 23447.
3. CPVC piping shall be CPVC 4120, Schedule 80, high-impact conforming to ASTM F441. Piping and fittings shall be approved for use by the National Sanitation Foundation. All pipe delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided as required. In general, all joints shall be solvent weld, except where flanges are shown on the drawings. All piping shall be supported at spacing not exceeding that recommended by the manufacturer.
4. CPVC Schedule 80 pressure fittings shall meet requirements of ASTM F437 (threaded-type) and ASTM F439 (solvent weld socket-type). All internal threads shall be machine taped to the requirements of ANSI/ASME B1.20.1. The quick burst strength of the fittings shall be equal to or greater than the burst strength of the

equivalent Schedule 80 CPVC pipe. Fittings shall be made of CPVC 23447-B or better.

5. All exterior or CPVC piping in open tanks shall be formulated with sufficient ultraviolet-light screeners to provide for long-term outdoor exposure with no deleterious effects.

H. Stainless Steel Air Piping:

1. Air piping where shown on the drawings as being "SS" shall be 304L stainless steel with a 2D finish conforming to AISI 304L and ASTM A240-72a, minimum gauges as follows: Up to and including 12-inch-diameter: 12 gauge.
2. Bolts, washers, and follower flanges shall be made of 304 stainless steel. The nuts shall be low silicon bronze per QQ-C-591, Alloy 651. All anchor bolts shall be 304 stainless steel. Follower flanges on interior piping may be galvanized ductile iron.
3. Connections between sections of pipe shall be by special flanged joints. These joints shall be designed so that individual pipe sections can be rotated independently of adjacent sections for alignment purposes. Flanged joints shall be of the face ring follower flange-type with through bolts. Gaskets shall be 45 to 55 durometer neoprene. Expansion joints shall be provided where necessary. Where connections are made to ductile iron or PVC piping, flanges shall be compatible with the mating pipe. As an alternative to flanged connections between sections of stainless steel interior piping, a grooved pipe connection with stainless steel or galvanized steel couplings and fasteners as previously specified will be allowed where approved by ENGINEER. All connections to valves or equipment shall be flanged.
4. All 304 L material shall conform to the chemical requirements of ASTM 240-72a and AISI 304L, except that the maximum carbon content shall be limited to 0.030%.
5. Flanges shall be shop welded to the pipe. All welding shall be by the shielded arc, inert gas, MIG, or TIG method. Filler wire shall be added to all welds to provide for a cross section of weld metal equal to, or greater than, the parent metal. Butt welds shall have full penetration to the interior surface, and gas shielding shall be provided to the interior and exterior of the joint.
6. Interior weld beads shall be smooth and evenly distributed with an interior projection not exceeding 1/16-inch beyond the pipe I.D. The outside weld area shall be wire brushed. Brushes shall be of stainless steel and used only on stainless steel. All discoloration and deposits left by welding shall be removed by pickling.
7. After manufacture of pipe and fittings, all stainless steel shall be passivated by immersion in a pickling solution of from 5% to 25% of nitric acid (65% strength) and 1% to 3% hydrofluoric acid (60% strength), both by volume, in water at a bath temperature of 120°F to 140°F for a minimum of 10 to 15 minutes, as determined by test. Scrubbing shall be completed as required. Immediate final thorough rinsing shall be completed in clean hot water followed by drying. Parts shall be free of iron particles or other foreign material.
8. The exterior finished weld and heat affected zone on stainless fabrications shall be cleaned utilizing a pickle paste solution. All interior welds where accessible shall be cleaned with Scotch Brite EXL, or equal, deburring wheel. All weld spatter on the entire fabrication shall be removed.
9. All field welding of stainless steel pipe shall be minimized and subject to the approval of ENGINEER. Field welding shall be shielded metal arch welding (SMAW). All field welding shall be accomplished by certified welders and using procedures in accordance with ASME Section 9. All field welds shall be wire brushed after completion, and grinding shall be provided as required. All field welds shall be passivated with Oakite 33, or equal solution. Upon request, QW 484 forms shall be submitted to ENGINEER.

2.03 VALVES

A. Gate Valves:

1. Shutoff valves in cast or ductile lines containing nonpotable water lines or DSL lines serving Sludge Drying Beds 4-inch-diameter and larger shall be AWWA C509, cast iron, resilient seat, nonrising stem, 150 psi working pressure with O-ring packing box, American, U.S. Pipe, or equal.
2. Shutoff valves in nonpotable water lines 4-inch-diameter and larger shall be cast iron, double disk, parallel seat, bronze trimmed, O-ring packing box with nonrising stem; manufactured to AWWA C500 specifications, Class 150.
3. Underground valves shall have extended stem, cast iron telescopic valve box, and key. Valves not in reach of the floor (7 feet to centerline or greater) shall have chain wheel operator. All other valves shall have handwheels. Right angle operators shall be provided, if required, because of valve position.
4. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated as specified in Division 9. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9.

B. Plug Valves:

1. Shutoff valves in cast or ductile iron lines containing wastewater and all sludge (including RAS and WAS) lines, scum lines, sample lines, and drainage lines shall be DeZurik Series PEC Eccentric, Valmatic Cam Centric Series, or equal.
2. Valves shall be of the nonlubricated eccentric-type with resilient faced plugs and end connections as shown on the drawings. The plug profile shall be of a cylindrical eccentric shape so that the vertical face of the plug is straight and the horizontal face is eccentrically curved in relation to the plug shafts. Segmented ball valves with spherical plugs shall not be acceptable. Port areas shall be at least 80% of full pipe area. Valve bodies shall be of ASTM A126, Class B cast iron. Resilient plug facings shall be of chloroprene or Buna-N, suitable for use with wastewater.
3. Valves shall be furnished with corrosion-resistant seats, replaceable oil-impregnated permanently lubricated 316 stainless steel sleeve-type bearings and grit shaft seals which comply with the latest edition of AWWA Standards C507 and C504. Bodies of 3-inch and larger valves shall be furnished with a minimum 1/8-inch-thick machined smooth welded overlay seat of not less than 90% nickel. Seat area shall be raised surface completely covered with weld to ensure that the plug face contacts only nickel. Screwed-in seats are not acceptable. Valve shaft seals for valves 4 inches and larger shall be of the type utilizing a stuffing box and pull-down packing gland. Shaft seals shall be designed for replacement with the line pressurized at design pressure with the plug in both the open and closed position. For submerged service, valves shall have stainless steel bolts.

4. The design of the valve and stuffing box assembly shall be such that the packing can be adjusted or completely replaced without disturbing any part of the valve or operator assembly except the packing gland follower. Stuffing boxes shall have a depth sufficient to accept at least four rings of packing. Valve seating adjustment shall be accomplished without removing the valve from the pipe line and with pressure in the line. For lever operated valves, the plug position retention friction device shall consist of an adjustable phenolic cone which clamps on the plug shaft. Metal to metal friction devices shall not be acceptable.
5. Valve working pressure ratings shall be 175 psi for valves through 12-inch and 150 psi for valves in sizes 14-inch through 24-inch. Valves shall provide drip-tight shutoff up to the full pressure rating.
6. All plug valves for buried service, all plug valves 6 inches in diameter or larger, and all plug valves with reverse differential pressure greater than 25 psi, shall have worm gear actuators. Lever operated valves shall be supplied with a friction device to maintain the plug in position. Friction device shall be a non metallic material and have the capability of adjusting the frictional force on the plug shaft. Friction devices that utilize a metal to metal contact on the plug shaft are not acceptable. All gearing shall be enclosed in a semisteel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall indicate valve position. Buried or submerged valves shall be supplied with actuators suitable for direct burial or submergence, shall be mounted on a gasketed and totally enclosed actuator mounting bracket, and shall have a totally enclosed and gasketed cover. All other valves shall be furnished with lever actuators. Supply one lever for every four valves furnished. All valves 3 inches and smaller shall have individual levers. Valves not in reach of the floor (7 feet to centerline or greater) shall have chainwheel worm gear actuators. Right angle actuators shall be furnished, if required, because of valve position. Supply sufficient galvanized or electroplated chain with chainwheel so loop through chainwheel is within 3 feet of floor. All underground valves shall be equipped with cast iron telescopic adjustable valve boxes and covers. Buried or submerged service valves shall be supplied with Type 316 stainless steel bolts and hardware for both valve and actuator.
7. Extension stems and other accessories shall be provided as shown on the drawings. Extension stems for quarter-turn plug valves shall be fabricated from 2-inch pipe, and extensions stems for gear operated valves shall be fabricated from steel or stainless steel rod. Extension stems, stem guides, and related hardware and accessories for submerged valves shall be stainless steel. Stems shall be provided with 2-inch operating nut or other mechanism as shown on the drawings. Stem guides shall be provided as recommended by the manufacturer. Maximum unsupported length of stem shall be limited to an l/r ratio of 200.
8. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated as specified in Division 9. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valves once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, one coat of Tnemec #141 PotaPox 80 epoxy primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish

painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9.

C. Check Valves:

1. Except where noted, check valves in ductile iron lines carrying liquid shall be GA Industries Figure 230-DS, Clow Style 106SL (2-inch to 12-inch) or 259-02 (14-inch to 30-inch) (outside lever and spring), GA Industries Figure 220-DS Clow Style 106WL (2-inch to 12-inch) or 159-02 (14-inch to 30-inch) (lever and weight), or equal, 150 psi, iron body, bronze trimmed, swing check. Two levers and springs and heavier springs. Additional weights shall be used if necessary to stop slamming.
2. Check valves in ductile iron FM lines carrying liquid shall be GA Industries 250-DXH, or equal, air cushion check valves. The swing check valves shall be constructed with a heavy cast iron or cast steel body, a bronze or stainless steel seat ring, an extra heavy noncorrosive shaft for attachment of lever and necessary weights to close valve, and a complete noncorrosive air cushion chamber. The valve shall be tight-seating and shockless in operation. The seal ring shall be renewable and shall be securely held in place by a threaded joint. The air cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any slamming action. Shock absorption shall be by air. The valve disk shall be of cast iron or cast steel and shall be suspended from a noncorrosive shaft which shall pass through a stuffing box to be connected to the chamber on the outside of the valve.
3. Miscellaneous:
 - a. Check valves in other than ductile iron, cast iron, PVC, polyethylene, or compressed air lines shall be Class 150, Milwaukee Valve 510, Nibco T-433, or equal, screwed end, bronze, bronze disk, swing check for water and air.
 - b. Check valves in PVC lines shall be ball check-type of PVC construction.
4. Asphaltic varnish and coal tar coating not allowed on check valves. Exterior of cast iron or steel valve body shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, one coat of Tnemec #141 PotaPox 80 epoxy primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9.

D. Butterfly Valves:

1. Except as otherwise specified, shutoff valves in air lines 3 inches or larger shall be Sartell Valve and Controls BOS, or equal, 150 psi, ductile iron body, EPDM-resilient seat suitable for air at a temperature of 250°F, wafer butterfly valves. Valves shall have ten position levers. Valves larger than 8 inch shall be provided with rotary manual handwheel operator. Valves not in reach of the floor (7 feet to centerline or greater) shall have chain wheel operators. Right angle operators shall be provided, if required, because of valve position.
2. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be epoxy coated. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in

- E. Telescopic Valves: Telescopic valves shall be as manufactured by Vulcan Industries, Watt Telescopic Valve as manufactured by Latanick Equipment Co., or equal. Valve sizing and travel shall be as shown on the drawings. Valves shall consist of type RP (pack and pinion), rising stem floor stands. Valves shall be constructed of stainless steel throughout, including valve stem and nut, extension stem, floor stands, telescoping tube, tube rails, and all assembly bolts. Telescoping tube shall be 6 inches longer than travel. Indicator shall be clear plastic stem cover with ruled scale marked off in 1/2-inch increments. Receiving pipe, companion and back-up flanges, and 1/4-inch neoprene gasket shall be provided as part of the complete assembly. Receiving pipe shall be constructed of minimum 12 gauge rolled and smooth welded stainless steel and shall be approximately 1/2-inch-diameter and 6 inches longer than telescoping tube. Flanges shall be constructed of galvanized steel. Anchor bolts shall be included and shall be constructed of stainless steel.
- F. Plug Drain Valve: Plug drain valves shall be flanged end, nonrising stem, Clow F-3075, M & H 140-02, or equal. Valve body shall be cast iron. The stem, stem nut, disk ring, and seat shall be bronze. The plug seat shall be a seamless molded ring of Buna-N tapered to accurately mate with the seat ring to form a positive seal. Drain valves in channels shall be provided with extension stem, stem guide, and operating nut to below grating. Painting and surface preparation shall be as specified for plug valves.
- G. Motorized Valve Operators:
1. The following valves shall be provided with motorized valve operators as listed and be Limitorque, AUMA, or equal.

Equipment Number	Valve Service	Valve Type	Valve Size (Inch)	Open/ Close Time, Sec	Rating	Control Service
MOV-70-01	WAS	Plug	6	10	NEMA 4X	Modulating
MOV-75-01	A	Butterfly	4	10	NEMA 4X	Open/Close
MOV-75-02	A	Butterfly	4	10	NEMA 4X	Open/Close

2. The motorized valve operators shall be 460 volt, 3 phase, and 60 Hz. Motorized valve operators shall be sized for a minimum of 1.5 times the valve manufacturer's torque requirements. The minimum pressure for determining torque requirements for valve operator shall be based on pipe service test pressure or 25 psi, whichever is greater.
3. Automatic control shall be through a remote panel as listed in Section 16940—Controls and Instrumentation. Where control service is listed as "modulating" in the table above, provide positioner board and position feedback board internal to the actuator which will receive a 4-20 MADC control signal and output a 4-20 MADC position feedback.

4. Each actuator shall be supplied with an integral pushbutton station containing three buttons (open/stop/close), three indicator lights, one green (closed), one amber (fault), and one red (open), and three position selector switch, lockable in each of the three positions (Hand/Off/Auto). In the "Hand" position, the actuators shall be operated from the local pushbutton station. In the "Auto" position for modulating service, the actuators shall be controlled by a remote 4-20 MADC signal or from open-close dry contacts, and for open/close service, the actuators shall be controlled from open/close dry contacts from the remote panel. An auxiliary contact shall be provided for "In Auto" indication.
5. The electric valve actuators shall include the motor, motor heater, actuator unit gearing, reversing motor starter package with control power supply transformer, phase discriminator, interface board with optically isolated input signals and monitor relay for collective fault signal, position limit switches, torque switches, declutch lever, and handwheel as a self-contained unit. The actuator shall meet the latest revision of the applicable AWWA specification.
6. The motors shall be specifically designed for valve actuator service and shall be of high starting torque, totally enclosed, nonventilated construction. Motor insulation shall be a minimum NEMA Class F, with a maximum continuous temperature rating of 155°C (rise plus ambient) for one complete open-to-close (or reverse) cycle.
7. The motors shall be of sufficient size to open or close the valve at the maximum stated torque. The motor shall be capable of operating at plus or minus 10 of nominal voltage. The motor duty rating shall be sufficient for one complete cycle (open-close-open or reverse) without exceeding its temperature rating. Motor bearings shall be of the antifriction type and permanently lubricated.
8. The motors shall be an independent subassembly so that the power gearing shall not be an integral part of the motor assembly to allow for motor or gear changes dictated by system operation changes.
9. The motors shall be equipped with internal thermal contacts to protect against motor overload.
10. The actuator shall be a multiple reduction unit with power gearing consisting of spur or helical gears and worm gearing. There shall be a self-locking worm gear set in the drive train to maintain valve position. The spur or helical gearing and worm shall be of hardened alloy steel, and the worm gear shall be alloy bronze. All power gearing shall be accurately cut; nonmetallic, aluminum, or cast gearing shall not be allowed. Antifriction bearings with caged balls or rollers shall be used throughout.
11. All rotating power train components shall be immersed in grease with provisions for inspection and relubrication without disassembly. Lubricants shall be suitable for ambient conditions of minus 20°F to 150°F.
12. The actuators shall have a built-in device which allows the motor to reach full speed before engaging the valve load when required by unseating applications.
13. A handwheel shall be provided for manual operation of each motor-operated valve with arrow to indicate "open" rotation. The handwheel shall not rotate during motor operation. A fused motor shall not prevent manual operation. When in manual operating mode, the actuator will remain in this mode until the motor is energized, at which time the actuator will automatically return to electric operation. Movement from motor operation to handwheel operation shall be accomplished by a positive, padlockable declutching lever, which mechanically disengages the motor and related gearing. It shall be impossible for simultaneous manual and motor operation to occur. Friction-type declutch mechanisms are not acceptable.
14. Position limit switches and associated gearing shall be an integral part of the valve actuator. Limit switch gearing shall be of the intermittent type, made of bronze or stainless steel, grease lubricated, and totally enclosed to prevent dirt and foreign

matter from entering the gear train. Limit switch contacts shall be heavy duty and silver plated with wiping action. The actuator shall have 16 contacts, 4 contact/4 rotor type, all of the same basic design. As an alternative, a limit switch assembly may be directly coupled to the valve stem, eliminating the need for intermittent gearing, and providing 6 single pole, double throw (SPDT) contacts. Contacts shall be convertible from N/O to N/C or reverse.

15. Switches shall be adjustable, allowing for trip points from fully open to fully closed positions of valve travel. They shall not be subject to breakage on slippage due to over-travel. Limit switch design shall permit visible verification of switch position without disassembly.
16. Each valve actuator shall be equipped with a switch that will interrupt the control circuit in both the opening and closing directions when valve torque overload occurs. Contacts shall be silver plated. The torque switch shall have graduated dials for both open and close directions of travel and each shall be independently adjustable. The torque switch shall include a positive means to limit adjustability so as not to exceed the actuator output torque capability. The activating spring pack shall be of the Belleville spring design. Switch design shall permit visible verification of switch position without disassembly.
17. Enclosures shall be NEMA 4 for general areas. For high moisture areas or areas below grade, provide watertight compartment between terminal compartment and the balance of the actuator and shall be submersible to IP68 standard of 20 feet for 72 hours.

H. Small Motorized Ball Valves:

1. Ball valve on 2-inch and smaller lines requiring motorized valve shall be Dura Valve Model V3000, or equal.
2. Ball valve shall be full port, brass, 600 WOG rated, and with an integral ISO 5211 actuator mounting pad. Body and body end shall be forged brass. Stem and ball shall be brass with chrome plating or stainless steel. Seats and thrust washer shall be RTFE. Stem seal shall be Viton O-rings.
3. Operator shall be Dura Valve rotary electric actuators. Operator shall be sized for 1.5 times maximum valve torque for each valve size. Enclosure shall be NEMA 4 with NEMA 7 operator provided in explosion rated spaces (see electrical drawings). Locked rotor current shall not exceed 1.0 amp. Motor shall be 115 VAC, 60 Hz, 1 phase. Fasteners and shaft shall be stainless steel. Operator shall include manual override. Operator shall be wired for open/close control. Unit shall be permanently lubricated. Valve shall be powered to open and powered to close.

I. Miscellaneous Valves, Strainers, Hose Bibbs, and Valve Boxes:

1. Shutoff valves in potable and nonpotable water lines, pump vent, and drain lines smaller than 2 1/2 inches shall be Nibco T-585 (threaded), Nibco S-585 (solder joint), or equal, full port ball valves.
2. Shutoff valves in PVC piping shall be hand-operated 150 psi union-type PVC ball valves, Chemtrol TU Series Tru-bloc, Walworth Series 8927, or equal. Valves and all components including O-rings shall be compatible with chemicals in piping. PVC valves and union shall not be painted. Valves in sodium hypochlorite and sodium bisulfite piping shall be fitted with a relief hole from center port to high pressure side of valve.
3. Y-strainers in potable water piping shall have stainless steel 20 mesh screens, Watts, or equal. Y-strainers in chemical lines shall be transparent PVC, Asahi, or equal, Trueunion strainer. Provide 20 mesh PVC mesh screens. Strainers used for hypochlorite service shall have Teflon O-rings.

4. All valves for use on chemical waste lines shall be chemically compatible with the liquid to be carried.
5. Pressure Relief Valves in Tanks:
 - a. Pressure relief valves in concrete tank wall shall be Clow F-1494-T wall type with flanged connection, and flanged by mechanical joint, or equal, wall pipe.
 - b. Pressure relief valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the pressure relief valves once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all valves shall be furnished shop primed, clean and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified by Division 9.
6. As shown on the drawings, supply curb stop shutoff valves for NPW yard piping. Curb stops in NPW yard piping shall be Ford B44-777M ball valves with Minneapolis-type curb boxes complete with lid and 6-foot stationary rod, or equal. Provide two 4-foot shutoff keys to operate valves. Lids shall have the word "WATER" cast into the top of the covers or shall be blank. Curb stops shall be placed on minimum 3 cubic feet of concrete laying on undisturbed earth.
7. Hose Bibbs:
 - a. Hose bibbs providing nonpotable water shall be provided with a removable key handle.
 - b. Exterior hose valves shall be Woodford Model 65, Ken-Ray Model 120, or equal, freezeless wall hydrants with integral Nidel 34HA vacuum breaker, permanent valve seat, and brushed chrome exterior face with 3/4-inch garden hose threads. Provide separate interior shut off valves as specified herein.
 - c. Interior hose valves shall be Woodford Model 24, Jenkins 112, or equal, 3/4-inch garden hose thread. Interior hose valves on the potable water system shall be equipped with state-approved vacuum breaker, Watts 8A, Nidel Model 34H, or equal.
8. Valves in NPW piping used for fluid control as shown on the drawings shall be Nibco, or equal, globe valves rated for 200 psi WOG. Valves shall be bronze with TFE disk.

9. Valve Boxes:
 - a. Valve boxes shall be provided for all buried valves.
 - b. Valve boxes shall be made of cast iron conforming to ASTM A48, Class 20. Valve boxes shall consist of a base section, tubular mid and top sections, both with cast threads by which one can be telescoped on the other, extension sections if required, and a circular drop cover. The castings shall be free from blowholes, porosity, hard spots, shrinkage defects or cracks, or other injurious defects and shall have a normal smooth casting finish. The castings shall be thoroughly coated with a 1-mil minimum thickness bituminous coating. Valve boxes shall be 5-1/4 inches in diameter. Valve boxes shall have a maximum length of 7 feet when extended without extension sections. Extensions shall be provided for deeper mains.
 - c. The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.

2.04 PIPING APPURTENANCES AND MISCELLANEOUS MATERIALS

- A. General: Piping appurtenances shall be made of the materials specified and to the satisfaction of ENGINEER. All appurtenances not designated as to type shall be subject to approval of ENGINEER.
- B. Nonpotable Water Signs: Place nonpotable water signs permanently mounted at every hose bibb, hydrant, or faucet on the nonpotable water system. Sign shall include as a minimum the wording "NOTICE, NONPOTABLE WATER, DO NOT DRINK." Signs shall be Brady Safety sign, or equal, minimum size 6 inches by 10 inches, constructed of fiberglass. Mount signs on building wall or structures with stainless steel screws or fasteners. At yard hydrant, provide post-mounted signs on steel U-channel posts.
- C. Valve Tags:
 1. All new valves on lines designated shall be tagged. All stop plates, slide gates, and sluice gates shall also be tagged. CONTRACTOR shall furnish and install on valves, engraved 2 1/2-inch by 2 1/2-inch plastic laminated tags, Seton "Setonply Series M4550-H," or equal. Nomenclature for tagging (letters and numbers) will be provided by ENGINEER. Colors to be selected by ENGINEER. CONTRACTOR to affix tags to valves with stainless steel wire with brass clamp, Brady 23310 and 23312, or equal.
 2. Valve tags shall be fastened next to valve box cover on valve manholes with stainless steel fasteners. Each stop plate and slide gate and each stop plate and slide gate grooves shall both be labeled with tags using stainless steel fasteners.
- D. Rubber Expansion Joints: Rubber expansion joints shall be furnished and installed where shown on the drawings and where required to eliminate vibration from equipment to piping. Expansion joints shall be the single-filled arch-type as manufactured by the Mercer Rubber Company, Series 450 or 500; General Rubber Corporation; or equal. Unless otherwise specified, expansion joints shall be provided complete with control rods and rubber washers as required. Control rods shall be provided to prevent over-stress on coupling at a minimum of twice the system test pressure, 2 rods minimum. Expansion joints shall have integral duck and rubber flange with split backup rings and have a minimum rated working pressure of 150 psi and 20 inches Hg vacuum. Joints shall be provided with higher rated working pressures if required to meet specified test pressures. Joints shall have a nominal

laying length of 6 inches up to 8-inch, 8 inches up to 20-inch, and 10 inches up to 24 inches. Tube and cover shall be of butyl rubber.

- E. Unrestrained Flanged Coupling Adapters: Flanged coupling adapters for drain or gravity flow piping shall be furnished and installed as shown on the drawings. Flanged coupling adapters shall be of cast iron construction, complete with Buna N coupling gasket and O-ring flange gasket. Flanged coupling adapter for drain or gravity flow piping shall be Smith-Blair International 912, or equal.
- F. Restrained Flanged Coupling Adapters: Restrained flanged coupling adapters shall be furnished and installed as shown on the drawings. Restrained flanged coupling adapters shall be of ductile iron construction, complete with Buna N coupling gasket, O-ring flange gasket, and gripping wedges and torque limiting actuating screws. Restrained flanged coupling adapters shall be Series 2100 MEGAFLANGE by EBAA Iron, or equal.
- G. Quick Hose Disconnect: Quick hose disconnects for chemical service shall be 2-inch CPVC, F-adapter type with dust cap.
- H. Pipe Coupling: Pipe couplings identified on the drawings shall be Dresser Type 38, Rockwell 411, or equal, steel coupling. CONTRACTOR shall provide tie ears and tension ties where necessary to restrain pipe.
- I. Tension Ties: All tension ties, rod ties, and control rods shall be provided to resist a minimum 150 psi 250 psi pressure in the pipe line. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary. Rods shall be provided with nuts and washers on both sides of tie ears. All nuts shall be carbon alloy steel conforming to ASTM A563 and washers shall be hardened steel conforming to ASTM F436. Rods shall be ASTM A36 steel at a minimum. Tie rods shall be equally spaced around pipe. The following tables lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

Pipe Size (inches)	150 psi Pressure		250 psi Pressure	
	Minimum Number	Minimum Size (inches)	Minimum Number	Minimum Size (inches)
4-10	4	5/8	4	5/8
12	4	5/8	4	3/4
14	4	3/4	4	7/8
16	4	3/4	4	1
18	4	7/8	4	1 1/8
20	4	1	4	1 1/4
24	4	1 1/8	4	1 1/2
30	4	1 3/8	7	1 3/8
36	8	1 1/4	8	1 1/2
42	12	1 1/8	12	1 1/2
48	11	1 3/8	22	1 1/4
54	11	1 1/2	22	1 3/8

- J. Floor Boxes: Provide floor boxes in concrete floors or slabs and as shown on the drawings. Floor boxes shall be Neenah R-7506-B, Clow F-5690, or equal. CONTRACTOR

shall verify that all floor boxes are large enough to accommodate all operating nuts and wrenches. Provide one "Tee" valve key operator for each valve manhole and one for each tank with tank or channel drain.

- K. Mechanical Seals: Mechanical seals shall be 316 stainless steel Link Seal, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners. Sleeve diameter shall be provided and mechanical seals installed as recommended by the manufacturer.
- L. Pressure Gauges: Provide a pressure gauge on each new pump discharge piping. Pressure gauges shall be Ashcroft, or equal, and shall have scale in psi with a maximum range equal to twice the normal operating pressure indicated in the pump equipment specifications. Gauges shall have 4-inch minimum diameter stainless steel case, shall be connected to a mineral-oil filled diaphragm housing to separate the gauge from liquid in discharge line, and shall have accuracy of $\pm 1\%$. Provide isolation valve and union at connection to pipe to allow the gauges to be removed while the line is under pressure.
- M. Seal Water System:
 - 1. Provide necessary components for complete seal water system as specified herein and as shown on the drawings. Seal water components shall include copper tubing, pressure regulating valves, solenoid valves, pressure gauges, needle valves, filter, control valves, and Y-strainer. Copper tubing, solenoid valves, pressure gauges, control valves, and Y-strainers shall be as specified. Pressure-regulating valves shall have bronze body, by Watts, or equal. Filter shall have clear bowl, 50 micron pleated cartridge, by Keystone Filter Division or equal. Provide three spare cartridges for each filter.
 - 2. CONTRACTOR shall verify seal water system requirements with manufacturer. See Pump Specifications in Division 11.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Interior or Exposed Piping:
 - 1. Provide pipe supports for all piping. Pipe support spacing and type shall, at a minimum, conform to manufacturer's recommendations unless more restrictive requirements are specified or shown on the drawings. All interior or exposed pipelines shall be securely supported by adjustable saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile. Strap hangers, tin clips, or U-hooks will not be acceptable. Piping shall be supported, even though not shown on the drawings, using base fittings and concrete pads to 6 inches above the floor, Anvil 264, B-line, or equal adjustable pipe saddle stand with floor flange to 6 feet above the floor, and supporting clamps or inserts more than 6 feet above the floor. In general, the maximum spacing of supports shall not exceed 10 feet on centers. Except as specified for plumbing system, all PVC piping shall be supported using galvanized supports for flexible piping except as indicated. Piping in chemical feed rooms shall be supported with a plastic support system, Aikinstrut, or equal. Stainless steel supports shall be used in submerged locations, tanks, wet wells, screening facilities, sludge digestion facilities, or as indicated. Piping shall be adequately supported and braced to resist thrust at bends, rubber expansion joints, and joints. Insulation saddles shall be used at supports of insulated piping. CONTRACTOR shall furnish and place hangers, supports, wall pipes, and sleeves in the forms before concrete is poured wherever needed or shown on the drawings.

2. All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete, or rod ties. The weight of the piping shall be supported independently of connected equipment.
3. All supports and parts shall conform to the latest requirements of the ASME code for Pressure Piping B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Where vertical movement up to 1/8-inch are anticipated, a precompressed variable spring support shall be used. Rigid hangers shall be provided with a means of vertical adjustment after erection. Where horizontal piping movements are greater than 1/2-inch, or where the hanger rod angularity from vertical is greater than 4 degrees from hot to cold position of the pipe, the hanger pipe and structural attachments shall be offset in a manner that the rod is vertical in the hot position. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so stress will not be transferred to them.
4. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
5. All carbon steel parts shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation of all carbon steel parts shall be performed at such time during the assembly process as to preclude damage to the equipment once installed and assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9.
6. The following maximum spacings shall be provided for supports:

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING				
	Copper Tubing			
Nominal Pipe or Tube Size	Water Service ft	Vapor or Air Service ft	Ductile Iron (See Note 1) ft	PVC Pipe (See Note 2) ft
1/4	5	5		
3/8	5	6		Continuous
1/2	5	6		Continuous
3/4	5	7		Continuous
1	6	8		4
1 1/4	7	9		4
1 1/2	8	10		4
2	8	10		4
2 1/2	9	10		4

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING				
Nominal Pipe or Tube Size	Copper Tubing		Ductile Iron (See Note 1) ft	PVC Pipe (See Note 2) ft
	Water Service ft	Vapor or Air Service ft		
3	10	10		4
4	10	10	10	4
5	10	10	10	4
6	10	10	10	9
8	10	10	10	9
10	10	10	10	10
12	10	10	10	10
14			10	10
16			10	10
18			10	10
20			10	
24			10	
30			10	
36			10	
42			10	

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

Note 2: Spacing is based on Schedule 80 at 100°F. For Schedule 40 or higher temperatures, provide shorter span. Consult manufacturer's recommendations.

7. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
8. Provide saddles or shields under piping hanger and supports for all insulated piping to prevent crushing of insulation.
9. Anchored supports shall include a stainless steel U-bolt and nuts bolted to the wall bracket.
10. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings, and floors to permit access for covering of pipe and painting work. Care shall be taken in laying out piping so that there is no interference with the proper location of piping for other purposes or other equipment and shall be run with regard to the requirements of each service.
11. Piping shall not interfere with headroom or clear floor space. Unless otherwise shown, piping shall run exposed in buildings, except in finished areas. Unless otherwise shown, small water piping in finished areas shall be concealed in interior walls, above suspended ceilings, or under floors where possible. Water piping shall not be installed in exterior walls, unless otherwise shown or noted on the drawings. Joints shall not be

used under floor slabs. Unless otherwise shown, piping under floor slabs shall clear floor slabs or footings by a minimum of 6 inches. Pipes under floors shall have a minimum of 6 inches of sand cover. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring-, and snap-type.

12. An ample number of standard weight ground joint unions shall be provided in all threaded pipelines and at all equipment. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.
13. The appropriate number, size, and lengths of spool pieces and flange fillers needed for plumbing and leveling any existing piping shall be included in the price bid.
14. All glass-lined and PVC piping shall be protected from dust and debris deposits on the inside of the pipe during storage and installation. Protection shall be by plastic film or coated paper banded over the pipe ends to be removed just prior to installation. Any foreign matter shall be removed from the pipe interior at the time of installation.
15. On clear liquids and on lines carrying solids where neither side of the pipeline drains, the valve shall be positioned so that the seat end of the valve is downstream of the shutoff pressure. On sludge or slurry lines where one side of the line normally drains, it is preferential to install the seat end of the valve upstream so that the valve cavity drains empty. Where possible in horizontal pipelines, the valve shall be installed with the axis of the plug horizontal and the plug is in the top of the valve when in the open position. In vertical pipelines carrying sludge or slurries, the seat end shall be at the top of the valve.
16. The locations and elevations of existing piping are approximate. Any changes in the pipe location or elevation shall be approved by ENGINEER.
17. CONTRACTOR shall submit shop drawings showing new pipe routing and existing pipe removal. CONTRACTOR shall be responsible for final pipe routing and shall route new piping as required to minimize conflicts. Piping shown on the drawings is approximate only. Not all existing piping, conduit, equipment, etc., are shown on the drawings. CONTRACTOR shall field verify locations. CONTRACTOR shall reroute existing piping, conduit, etc., as indicated or as required to install new piping or equipment. CONTRACTOR shall remove and relocate existing pipe supports as required to install new piping. CONTRACTOR shall provide all piping, fittings, flange fillers, and other appurtenances as required to provide functional system at no additional cost to OWNER.
18. All connections except those adjacent to storage or feeder areas shall have guards which will direct any leakage away from space occupied by workers.
19. Exposed pipes in all areas containing hazardous chemicals that are located above shoulder level shall be provided with continuous drip collection trays and coupling guards which will eliminate the spraying or dripping of these chemicals onto workers.
20. All piping containing or transporting corrosive or hazardous chemicals shall be identified with labels every 10 feet (3 m) and with at least two labels in each room, closet, or pipe chase. Color coding shall also be used.

B. Wall and Other Pipe Penetrations:

1. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the drawings.
2. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping. The sleeve diameter shall not exceed the pipe O.D. plus 2 inches (or the pipe flange O.D. plus 1 inch as applicable), unless otherwise shown on drawings. If the concrete members are to be watertight, the annular space around the pipe shall be sealed with a mechanical seal. Sleeves shall be steel unless noted otherwise and shall include minimum 1-inch waterstop. For copper pipe, provide an elastomeric sleeve on pipe where it passes through walls or slabs.
3. Where pipe passes through nonwatertight walls, the annular space shall be grouted full. Where pipes pass through nonwatertight floors, the sleeve shall extend 1 inch above the finished floor elevation. The annular space shall remain open, except the annular space between a rated space (example—Class 1, Division 1, Group D hazardous location) and a nonrated space shall be sealed with a mechanical seal.
4. Where new pipes go through existing watertight concrete members, CONTRACTOR shall core a hole through the member, unless otherwise shown on the drawings. The annular space between the concrete and pipe shall be sealed with a mechanical seal. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and annular space between the concrete and the pipe shall be grouted full (walls or floors at rated spaces), or remain open (floors at nonrated spaces). Prior to any coring, CONTRACTOR shall locate reinforcing steel in the member and shall consult with ENGINEER to determine optimal location for the core. Plug abandoned pipes and wall pipes, after pipe and fittings removal flush to the concrete surface, with nonshrink grout, or as otherwise approved to achieve a watertight seal.
5. Nonshrink grout shall be as specified in Division 3.
6. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the drawings or specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case where such cutting or core drilling is necessary shall reinforcing rods be cut or disturbed without requesting the opinion of ENGINEER. All openings for pipe work shall be neatly patched in a workmanlike manner.
7. Rough openings in wet well walls shall be provided to install force main discharge piping. Opening shall be minimum necessary to provide for nominal adjustments of pipe installation to eliminate the need for special flanges or sleeves in the wet well to allow for laying length adjustments. After piping is installed and properly supported, opening shall be filled with nonshrink grout formed to the wall surfaces.

- C. Cleaning and Disinfection: All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the potable water system before it is put online. Water main shall be disinfected according to AWWA C651.

3.02 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price Bid.

- B. All work shall be inspected, tested, and approved in accordance with federal, state, and local rules and regulations. All work shall also be tested as specified in this section. Unless indicated by ENGINEER in writing before testing begins, all tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.
- C. All new piping shall be tested. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
- D. All piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Pressure Tests: The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids, such as SCM/WAS, shall be tested at the higher test pressure.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
Chlorine Gas (CG), SDG, Under Pressure	300	Dry N ₂ Gas	Zero
Chlorine Gas (CG), SDG, Under Vacuum	15 inches Hg	Vacuum	Zero
CLS	150	Water	"A" ⁽¹⁾
ML, PI, SCM, SE, RAS (Gravity Flow), PE	10	Water	"A"
DS, RAS (Pump Discharge), SPD, WAS, EF	50	Water	"A"
NPW, PW, SWS	150	Water	"A"

¹ Leakage allowance Designation "A" shall mean zero leakage.

- F. See Section 15400–Plumbing for testing of building drainage systems.
- G. Prior to making final connection between new and existing piping, new piping shall be tested as specified above.
- H. Polyethylene encasement of cast iron drainage piping and appurtenances shall be in accordance with AWWA C105. Use Method A for pipe and Method C at valves. Repair any rips or punctures prior to backfilling pipe.

3.03 DEMOLITION

- A. All interior piping removals, including appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Any change in pipe location or elevation shall be approved by ENGINEER.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.
- D. It is the responsibility of CONTRACTOR to remove the following, including piping and appurtenances, as specified and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner to the satisfaction of ENGINEER. All costs shall be included in the Lump Sum Bid.

END OF SECTION

SECTION 15250

MECHANICAL INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: All new potable water and nonpotable water; seal water supply piping; exposed to view or above suspended ceilings in buildings shall be insulated with pre-formed pipe insulation. Buried piping shall be insulated where specified or shown on the drawings. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. See Section 01300–Submittals for shop drawing submittal procedures.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Except as otherwise specified, insulation shall be manufactured by the following:
 - 1. Schuller International, Inc.
 - 2. Owens Corning.
 - 3. Knauf.
 - 4. Armstrong.
 - 5. Johns Manville.
 - 6. Or Equal.

2.02 PIPE INSULATION

- A. All pipe covering, jackets, duct insulation, vapor barriers, adhesive, and mastics shall have a flame spread rating of 25 or less and a smoke-developed rating of 50 or less in active return or supply air plenums. Insulation in all other areas within the building shall have a flame spread of 25 or less and a smoke-developed rating of 150 or less. Test method shall be ASTM E84.
- B. Water Piping: All new and existing potable water and nonpotable piping, fittings, valve bodies, and flanges shall be covered with 1-inch glass fiber (K-factor of 0.25 at 75°F mean). Provide All Service Jacket except in the following process and other areas: In the screening building and in basements with sludge pumps, provide 30 mil PVC jacketing, fitting covers, and end caps. Color shall be selected by OWNER.

- C. Piping in Slabs and Walls: All new cold and hot water piping, nonpotable water, injector water, and seal water supply inside concrete slabs or inside masonry walls shall be insulated with Armstrong Armaflex II, or equal, 1/2-inch-thick.
- D. Buried Pipe: Except for Natural Gas (G), and Perforated Drain Pipe (PDP), Storm Sewer (ST), rigid insulation shall be provided over all buried piping where the depth of cover over the pipe is less than 5 feet. Width of the insulation varies with depth of piping below the ground surface as follows, except minimum width of insulation shall be at least 3 times the pipe diameter.

Depth of Piping (ft)	Minimum Width of Insulation (ft)
2.5	6
3.0	5
3.5	4
4.0	3
4.5–5.5	2

- E. Rigid insulation over buried piping shall be minimum 2-inch thick extruded polystyrene closed cell rigid board with continuous skins on both sides. Aged thermal resistance (R-value) at 72°F shall be a minimum of 7.5. Rigid insulation shall be Styrofoam Square Edge by the Dow Chemical Company; Foamular 250 Polystyrene Insulation by UC Industries, or equal.
- F. Rigid insulation shall be installed as recommended by the manufacturer and according to details shown on the drawings.

2.03 HEAT TRACING

- A. Where shown on the drawings, furnish self-limiting 120-volt electrical heating strip of parallel circuit construction consisting of a continuous inner core of variable resistance conductive heating material between two parallel copper bus wires. The hazardous area circuits shall be covered with a tinned copper shield and an overall jacket suitable for exposure to aqueous inorganic chemicals. The strip shall be positioned or spiraled to maintain 50°F pipe temperature when the surrounding temperature is -20°F. During installation, the strip shall be cut to length at the jobsite to match as-built piping requirements. Strip shall be loop-wrapped and overlapped without burn-outs on valves and fittings according to manufacturer's recommendations. The system shall be complete with all tee kits, power on indicating light, power connectors, end seals, labels, fiberglass tape, splices, and thermostats with remote sensor bulb as required for a complete installation. All components shall be guaranteed in writing by the manufacturer for a period of 10 years. Heat tracing shall be Raychem BTV-CR or BTV-CT, with JBM-100-L-A power connection, AMC-1A thermostat, E-150 end seal, AT180 aluminum tape, and PS03 pipe strap for power function, or equal. CONTRACTOR shall have manufacturer perform and submit calculations considering pipe material, ambient temperature, insulation thickness and material, and desired process temperature. CONTRACTOR shall select heat tracing based on manufacturer's recommendations subject to approval by ENGINEER. Provide mounting brackets as required.

PART 3–EXECUTION

3.01 INSTALLATION

- A. All insulation shall be applied in strict accordance with the manufacturer's written recommendations.
- B. All pipe insulation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation, or with "Zeston"-type, pre-molded PVC fittings installed in accordance with the manufacturer's instructions. Fittings are to be finished with 8-ounce glass mesh and mastic (use breather mastic on systems operating above 50°F; a vapor barrier mastic on systems operating from 50°F down). Jackets on pipe insulation may be stapled using outward clinch staples spaced 3 inches apart at least 1/4-inch in from the lap edge on systems operating at 50°F and above; below 50°F and on roof drain lines, the laps are to be vapor sealed using self-sealing lap, lap-seal tape gun, or adhesive. All insulation ends are to be tapered and sealed regardless of service.
- C. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers are to be sized large enough to be installed over the outer surface of the insulation. Load distributing corrosion-resistant metal shields shall be installed around the lower 1/3 circumference of the insulation. For each pipe hanger, provide a half-round, 12-inch-long hanger block at the bottom half of the pipe in place of the fiberglass insulation. The blocks shall be molded foam glass insulation. Shields shall be 16 gauge. Shields shall be 12 inches long.

END OF SECTION

SECTION 15290

HEATING, VENTILATION, AND AIR CONDITIONING INSULATION

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Ductwork insulation.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM E84—Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM C533—Specification for Calcium Silicate Block and Pipe Thermal Insulation.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300—Submittals.

PART 2—PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers are Owens-Corning, Knauf, or Johns Manville.

2.02 DUCT INSULATION

- A. Rigid-type duct insulation shall be 3-pound density, rigid insulating board with FSK facing attached with mastic bands and mechanical weld pins with washers compatible with duct material. Thermal conductivity shall be not more than 0.23 at 75°F mean.

PART 3—EXECUTION

3.01 INSTALLATION

- A. All insulation shall be applied in accordance with manufacturer's recommendations.
- B. Ductwork Insulation: Rigid-Type:
 - 1. Brush on heavy coat of MEI Eco-Mastic 55-50, or equal, over first layer of canvas, embed second layer canvas mesh and smoothen. While still wet, brush on finish layer of Sealfas, or equal.
 - 2. Provide finished edges at all access doors and ends of insulation.
 - 3. Provide additional insulation trim pieces over flanged ductwork joints to completely insulate and seal to the thickness specified.

4. For exterior ductwork, place an additional strip of fiberglass on the top-center of the duct prior to applying canvas to act as a water shed.

3.02 DUCT INSULATION THICKNESS SCHEDULE

Service	Insulation Type	Thickness (Inch)
Exhaust and Relief Ducts from Louver or Gravity Roof Ventilator to 12 Inches Beyond Damper	Rigid Fiberglass	2.0
Ductwork Exterior to Building	Rigid Fiberglass	3.0
Intake and Exhaust Damper Frames	Rigid Fiberglass	2.0

END OF SECTION

SECTION 15400

PLUMBING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All material and piping for plumbing.
 - 2. Concrete foundations and anchor bolts for all equipment furnished under this section.
 - 3. Piping connections to all plumbing equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials shall be National Sanitation Foundation (NSF)-approved.

2.02 PLUMBING PIPING AND APPURTENANCES

- A. Unless otherwise specified, piping shall be in accordance with Section 15050–Piping and Appurtenances.

2.03 PLUMBING SPECIALTIES

- A. Unless otherwise specified, valves shall be provided in accordance with Section 15050–Piping and Appurtenances.
- B. Floor Drains:
 - 1. (FD-1) Floor drains for piping 4 inches and under shall be Zurn Z-551, Wade W-1300, or equal, and for piping larger than 4 inches Zurn Z-505, Wade W-1240, or equal. Drains receiving pump drainage piping shall be provided with Zurn Z-329, Wade EG-8, funnel converter assembly, or equal.
 - 2. (FD-2) PVC floor drains: Floor drains in areas where noted on the drawings shall be Sioux Chief 860-4D (8.5-inch-diameter grate), or equal. PVC drains shall include PVC grating.
 - 3. Each drain shall be provided with a trap.

C. Cleanouts:

1. Manufacturers shall be Zurn, Wade, Smith, Josam, or equal.
2. Each cleanout shall be gas and watertight.
3. Cleanouts that are elevated shall include a membrane flashing flange to prevent leakage to the lower floor.
4. Interior Concrete Floor Areas: Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.
5. Interior Exposed Vertical Stacks: Line-type cleanout tee with tapered threaded ABS closure plug. Zurn Z-1445.
6. Interior Horizontal Lines: Cast iron hub with tapped ferrule and tapered threaded ABS or PVC closure plug or no-hub coupling and blind plug.

2.04 PLUMBING FIXTURES

- A. Service Sinks and Sample Sinks: (SS): K 6719 (24×20), A 7692.023, with Chicago Faucets 835-SFB for supplies from below exposed on wall as in well pump stations. Sink shall have supplies with vacuum breaker, Nidel 34H, or equal.

B. Emergency Fixtures:

1. Manufacturers: Bradley (B), Guardian (G), Haws (H), or equal.
2. Unit shall be hydrostatically tested to meet or exceed ANSI Z358.1–1998.
3. (EEWS): Corrosion-resistant safety station with ABS plastic shower head, ABS plastic bowl, cast aluminum powder-coated flag handle, PVC floor flange, 2-inch IPS Schedule 80 PVC pipe and fittings, 1-inch IPS and 1/2-inch IPS U.S.-made PVC-coated brass stay-open ball valve, and polished stainless steel pull rod. Unit shall have two polypropylene “GS” spray heads with integral “flip-top” dust covers, filter, and 1.8 gpm flow control orifice mounted on chrome stainless steel head assembly. Model No. (B) S19-310PVC, (G) G1992, or (H) 8336.

2.05 PLUMBING EQUIPMENT

A. Sump Pumps:

1. Furnish and install complete Hydromatic, or equal, sump pump system(s) as shown on the drawings and summarized below. The complete system shall include pumps, electric controls, level controls, and all accessories.

Pump No.	Pump Model No.	HP	Capacity (gpm)	TDH (ft)	Discharge Diameter	Building
SEP-70-01 and SEP-70-02	Hydromatic SKHS100	1	64	40	2 inch	RAS Pumping Building
SP-70-01 and SP-70-02	Hydromatic SPD50H	1	78	36	2 inch	RAS Pumping Building
SEP-30-01 and SEP-30-02	Hydromatic SK50		80	15	2	Control Building
SP-20-01*	Flyght Ready 4	0.6	55	10	2	Chemical Storage Containment

- * Provide Flyght Ready 4 with 50 feet of stainless steel lifting cable, 50 feet of power cable, and 100 feet of 2-inch NPSM flexible hose. No panel required for this pump.

2. The motor shall be submersible-type, ball bearing design, oil-filled and protected with manual reset thermal-type overload. Motor housing shall be filled with dielectric pure, clean, insulating oil. Motor shall have precision mechanical seal to prevent leakage into the housing. Seal faces shall be carbon and ceramic, super lapped for long leak-proof life. The motors shall be three phase, 60 cycle, 460 volts for operation at 3,450 rpm. Power cord and float switch cords shall be provided in lengths adequate to reach the control panel as provided by pump manufacturer and as shown on the drawings.
3. All pumps shall be heavy-duty-type with cast iron housing. Impeller shall be constructed of cast iron of the nonclog-type, passing minimum 2-inch solids. Except for SP-70-01 and SP-70-02, which must pass 3/4-inch solids, all fasteners shall be of stainless steel. Discharge piping from each pumps and shall include one flexible connector, two check valves, and one gate valve for each pump as shown on the drawings.
4. A NEMA 4X control panel with controls as indicated below shall be furnished. Panel shall include a non-fused, main disconnect with interlock to prevent opening the panel with switch in "On" position. A defeater shall be provided to bypass this interlock, with handle lockable in "Off" position. Control wiring inside the panel shall be insulation type MTW, minimum size 16 AWG. The control panel shall include combination starters for each pump, circuit breakers for each pump, H-O-A switches, green "Run," and red "Fail" push-to-test indicating lights for each pump, elapsed time meters, red "HWL" push-to-test indicating light, and a duplex alternator. The alternator shall have a three-position selector switch to select either pump as the lead pump or auto alternation of the two pumps. All devices shall be installed on the control panel door. Level sensing shall be by mercury-free float switches, one each for pump ON, one for pump OFF and one for HWL alarm at each station provided. There shall be an auxiliary contact from the HWL alarm signal for remote indication at the SCADA.
5. Cover shall ensure airtight seal between the sump and atmosphere. Pump discharges, 3-inch vent, level control, and power cables shall enter the sump through the side of the sump. The openings in the sump shall be sealed with a mechanical seal.
6. All electrical controls shall be installed under Division 16, including those items specified to be furnished with the equipment. All electrical equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Unless otherwise specified, installation of piping shall be in accordance with Section 15050—Piping and Appurtenances.
- B. Plumbing system shall be installed with hangers and supports in accordance with the Plumbing Code. Insulation saddles shall be used at supports of insulated piping.
- C. Plumbing system shall be installed in accordance with local plumbing requirements and applicable portions of the Illinois Plumbing Code. Where requirements conflict, the stricter standard shall apply.
- D. Install all piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General

Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster walls or ceilings, furnish the access doors to the General Contractor.

- E. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- F. Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to counters, floors, and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping.
- G. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- H. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy-duty-type with brass stems and screwed or sweat inlet connections. Compression-type inlets are not acceptable.
- I. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- J. Existing Fixtures: Where existing fixtures and fittings are indicated to be reused or relocated, this Contractor is responsible for documenting condition prior to construction and for damages incurred during construction.

3.02 FIELD QUALITY CONTROL

- A. Unless otherwise specified, testing shall be in accordance with Section 15050–Piping and Appurtenances.
- B. Building drainage systems shall be tested and inspected in accordance with local requirements and the Illinois Plumbing Code.

END OF SECTION

SECTION 15835

TERMINAL HEAT TRANSFER UNITS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Electric Heaters.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. NFPA 70–National Electric Code.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 ELECTRIC HEATERS

- A. CONTRACTOR shall provide electric heaters of the type, size, capacity, and accessories as listed on the equipment schedule. All units shall be UL listed.
- B. All electric unit heaters shall be factory-assembled and tested.
- C. Electric Unit Heaters (Standard):
 - 1. Acceptable manufacturers are Chromalox, QMark, or equal.
 - 2. The cabinet shall be constructed of heavy gauge, die-formed steel. Manufacturer shall provide mounting bracket.
 - 3. Provide a propeller fan with direct drive, totally enclosed motor.
 - 4. Provide control power transformer.
 - 5. Provide an aluminum-finned, copper-clad steel sheath heating element.
 - 6. Provide an automatic reset thermal cutout to protect the element.
 - 7. Line voltage thermostat shall be provided by Division 16 Contractor in accordance with Section 16940-Controls and Instrumentation.
 - 8. Manufacturer shall provide all starters and disconnects. Disconnect shall be mounted exterior to unit within sight and meet the requirements of Section 16440–Disconnect Switches and Section 16480–Motor Control.
 - 9. Mount units to provide 8-foot 0-inch clearance below.

- D. Electric Unit Heaters (Explosion-proof):
1. Acceptable manufacturers are Chromalox, QMark, or equal.
 2. The cabinet shall be constructed of heavy gauge epoxy-coated steel with a louvered grille and wall-mounting bracket.
 3. Unit shall include an epoxy-coated aluminum propeller fan with direct drive, totally enclosed motor for operation in a Class 1, Division 1, Groups C and D hazardous environment. Heat exchanger shall be sealed liquid-to-air-type with a field-replaceable immersion heating element.
 4. Provide control power transformer.
 5. Line voltage thermostat shall be provided by Division 16 Contractor in accordance with Section 16940—Controls and Instrumentation.
 6. Unit mounted equipment disconnect shall be provided by manufacturer, suitable for Class 1, Division 1, groups C and D locations.
 7. Mount units to provide 8-foot 0-inch clearance below.
- E. Electric Unit Heaters (Corrosion-Resistant):
1. Acceptable manufacturers are Chromalox, QMark, or equal.
 2. The cabinet shall be constructed of heavy gauge stainless steel with a corrosion-resistant grille and stainless steel wall-mounting bracket. Heating elements shall be 316 stainless steel sheathed with 316 stainless steel fins.
 3. Unit shall include a direct drive, totally enclosed motor, designed to resist moisture and corrosion, wired to a NEMA 4X enclosure.
 4. An automatic reset thermal cutout shall be included to protect the element. Line voltage thermostat shall be provided by Division 16 Contractor in accordance with Section 16940—Controls and Instrumentation.
 5. Provide all starters and control power transformers in a factory-installed NEMA 4X enclosure. Unit mounted equipment disconnect shall be provided by manufacturer suitable for corrosive locations.
 6. Mount units to provide 8-foot 0-inch clearance below.
- F. Electric Wall Heaters (EWH):
1. Acceptable manufacturer is QMark, or equal.
 2. Furnish and install a steel cabinet for recessed mounting in standard 2 by 4 stud wall. Provide a cabinet with 16 gauge steel grille bars and finished in a baked enamel.
 3. Provide a direct drive, propeller fan, and permanently lubricated totally enclosed motor.
 4. Provide steel finned metal sheath electric heating elements.
 5. Provide automatic reset thermal overheating protection to disconnect power in the event of overheating. Provide an integral, tamper-resistant thermostat. Provide integral contactors and disconnects.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's recommendations and local codes including minimum mounting heights above floor.
- B. CONTRACTOR shall provide all mounting hardware and accessories necessary to complete installation.

- C. Drawings are based on the scheduled make and model number. Any changes because of substitutions shall be provided and coordinated at no additional cost to OWNER.

END OF SECTION

SECTION 15855

AIR HANDLING UNITS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Electric make up air units (MAU).
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ARI 430—Central Station Air Handling Units.
- B. ASHRAE 15—Safety Code for Mechanical Refrigeration.
- C. NFPA 70—National Electric Code.
- D. NFPA 90A.
- E. UL900—Test Performance of Air Filter Units.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300—Submittals.

1.04 QUALITY ASSURANCE

- A. Unit performance shall be certified in accordance with ARI Standard 430 for Central Station Air Handling Units.
- B. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Unit shall be stored and handled in accordance with the unit manufacturer's instructions.

PART 2—PRODUCTS

2.01 ELECTRIC MAKEUP AIR UNITS (MAU)

- A. Acceptable manufacturers are Greenheck, Model MSX with Special Design Request No. M0600773, or equal.
- B. Unit casing shall be fabricated of galvanized steel with 1-inch fiberglass insulation and baked enamel finish. Provide hinged gasketed access panels for all internal controls and

components. The casing shall be designed for hanger mounting or roof curb mounting (see drawings for configuration).

- C. Blower section shall include forward curved centrifugal belt drive blower statically and dynamically balanced with heavy-duty, field regreasable bearings.
- D. Motor shall be premium efficiency, totally enclosed fan-cooled type with adjustable base.
- E. Provide V-Bank filter box with 2-inch-thick permanent filters. Box shall be complete with guides and access doors.
- F. Electric heaters shall be UL listed and feature open coil heating elements. Heater control cabinet shall be installed completely within the heating section, factory wired, and meet all requirements of the National Electric Code.
- G. All heater and blower controls including motor starters shall be furnished by unit manufacturer and shall be factory-prewired for single point power connection and housed in a weatherproof enclosure. All electrical components shall be UL listed, recognized or classified where applicable and wired in compliance with the National Electric Code. Starter shall be combination-type NEMA rated with solid state adjustable overload relay and single phase protection shall be standard. All wiring shall be numbered and routed in plastic wiring ducts. Plastic spiral wrapping may be substituted for plastic wiring ducts. All components within control panels shall be labeled on the enclosure back panel and all labels shall match the schematic drawings.
- H. Provide a factory-mounted two-position intake damper and electric actuator.
- I. Discharge air damper shall be provided separate from unit by Division 15 contractor.
- J. Unit controls shall be provided to allow control from the plant SCADA system as described below.
 - 1. Provide Thermolec D35 Pre-Calibrated SCR controller to accept 4-20mA discharge air temperature setpoint from the plant PLC. The control signal to the electric heater shall be controlled by SCR controller.
 - 2. With the signal at 4mA, the electric heater shall be at minimum output. With the signal at 20mA, the electric heater shall be at maximum output. Provide a built-in high limit circuit to prevent over heating of the electric heater.
 - 3. The unit shall accept a dry contact for start/stop control of the fan from EF-70-01 starter.
 - 4. The unit shall accept a dry contact for enable/disable control of the electric heater from the plant PLC.
 - 5. The unit shall provide a dry contact, rated at 120 volts, for fan run indicator and fan motor starter overload.
 - 6. The unit shall provide 120 volt power to externally-mounted discharge air damper. Damper shall be opened whenever the unit is running.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install in accordance with drawings and manufacturer's recommendations.
- B. Furnish and install neoprene vibration isolators sized by the manufacturer.
- C. Wiring and interconnection to be provided by Division 16.
- D. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.
- E. Provide flexible duct connections between all ductwork and unit in accordance with Section 15910-Ductwork Accessories.
- F. Installation of all equipment furnished under this contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- G. All duct work routed on the exterior of a building shall be insulated in accordance with Section 15290-Heating, Ventilation, and Air Conditioning Insulation.

3.02 CLEANING

- A. Unit shall be cleaned and new filters shall be furnished and installed prior to final acceptance by OWNER.

END OF SECTION

SECTION 15860
CENTRIFUGAL FANS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Centrifugal inline fans.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. AMCA 99–Standards Handbook.
- B. AMCA 210–Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300–Test Code for Sound Rating Air Moving Devices.
- D. AMCA 301–Method of Calculating Fan Sound Ratings from Laboratory Test Data.
- E. NFPA 70–National Electrical Code.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals.

1.04 QUALITY ASSURANCE

- A. Fans shall bear AMCA certified rating seals.

1.05 DELIVERY, STORAGE AND HANDLING

- A. All fans shall be stored and handled in accordance with manufacturer's instructions.
- B. Motors, shafts, and bearings shall be protected from weather and dust.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers are Greenheck, Cook, or equal.
- B. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

2.02 CENTRIFUGAL INLINE FANS

- A. Centrifugal inline fans shall be belt drive, centrifugal-type. Fan performance shall be as indicated on equipment schedules. Fans shall be UL listed.
- B. The fan wheel shall be centrifugal with backward-inclined blades. The fan wheel shall be statically and dynamically balanced.
- C. The fan shall be quiet operating and vibration free. Fan performance shall include AMCA-certified air and sound ratings and AMCA seal. Furnish and install spring-type vibration isolators provided by fan manufacturer.
- D. The fan shaft shall be mounted in prelubricated ball bearing pillow blocks. Bearings shall be sealed and rated for 200,000 hours.
- E. The fan housing shall be at all aluminum construction with square inlet and discharge collars. Provide access panels for servicing drives and motors.
- F. Belt drives shall have a sliding or pivoting motor plate for belt tensioning. The belt and motor shall be totally enclosed by a guard with tachometer holes. The motor shall be mounted out of the airstream. The fan motor shall be totally enclosed, fan-cooled, and shall be NEMA approved, ball bearing-type. Starters shall be provided as a part of Division 16. Equipment disconnects shall be provided with all fans and shall be factory-prewired to the motor and accessible without opening housing. Disconnect shall be mounted exterior to unit and within sight. Toggle switches are not allowed.
- G. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.
- H. Where drawings indicate fan to be suitable for corrosive environments, all surfaces of fans and motor/belt guards shall be coated with 2 to 3 mils of Hi-Pro Polyester powder coating. Wheel shall be rebalanced statically and dynamically by the fan manufacturer after application of the coatings. Manufacturer shall provide a NEMA 4X equipment disconnect.
- I. Provide a fan, motor, and disconnect suitable for Class 1, Division 1 environments where schedules indicate. Fans serving Class 1, Division 1 environments shall be equipped with nonsparking fan wheels with AMCA B rating, a NEMA 7 (explosion-proof) motor, and the fan shall be provided with Hi-Pro coating.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and drawings.
- B. CONTRACTOR to provide all mounting hardware and accessories necessary to complete installation.
- C. Provide flexible duct connections on inlet and outlet of all fans.

- D. Drawings are based on the scheduled fan make and model number. Any changes because of substitutions shall be provided and coordinated at no additional cost to OWNER.

END OF SECTION

SECTION 15890

DUCTWORK

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Metal ductwork.
 - 2. Nonmetal ductwork.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36—Structural Steel.
- B. ASTM A90—Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- C. ASTM A167—Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- D. ASTM A480—General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- E. ASTM A653—Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- F. ASTM A527—Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- G. ASTM B209—Aluminum and Aluminum-Alloy Sheet and Plate.
- H. AWS D9.1—Welding of Sheet Metal.
- I. NBS PS 15—Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.
- J. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
- K. NFPA 90B—Installation of Warm Air Heating and Air Conditioning Systems.
- L. SMACNA—HVAC Air Duct Leakage Test Manual.
- M. SMACNA—HVAC Duct Construction Standards—Metal and Flexible.
- N. UL 181—Factory-Made Air Ducts and Connectors.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700–Contract Closeout.
- B. Record actual locations and sizes of ducts and duct fittings. Record changes in fitting location sizes and types. Show additional fittings used.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA–HVAC Duct Construction Standards–Metal and Flexible.

1.06 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A standards.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain recommended minimum temperatures during and after installation of duct sealants.

PART 2–PRODUCTS

2.01 MATERIALS

- A. All sheet metal used for construction of duct shall be 24 gauge or heavier.
- B. Galvanized steel ducts shall be ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating in conformance with ASTM A90, A653.
- C. Aluminum ducts shall be ASTM B209; Type 3003-H14 aluminum.
- D. Stainless Steel Ducts: ASTM A240/A240M and A480/A480M, Type 304 or 316 as indicated on drawings.
- E. PVC Ducts:
 - 1. PVC material shall conform to ASTM D1784, Class 12454-B. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact pipe conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467, and for threaded, ASTM D2464.
 - 2. All duct delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be solvent weld, except where flanges are required or as shown on the drawings or where transition to another pipe material is required.

3. All exterior exposed duct shall be formulated with sufficient ultraviolet-light screeners to provide for long-term outdoor exposure with no deleterious effects.
- F. Glass Fiber Reinforced Plastic (FRP) Ducts:
1. Fiber reinforced plastic ducts shall be as manufactured by Spunstrand, Composite Systems, or equal. Ductwork shall be glass fiber reinforced plastic to NBS PS 15, with minimum 3/16-inch wall thickness.
 2. Where indicated on drawings to be of nonflammable construction, duct shall be built to NBS PS 15 standards with inner epoxy resin rich carbon surfacing veil and a 100 mil corrosion barrier. The balance of construction shall be filament wound with a 6-ounce cloth exterior.
- G. All fasteners shall be 316 stainless steel unless otherwise indicated.
- H. Duct sealant shall be United McGill United Duct Sealer, or equal, for indoor applications and United McGill Uni-Weather, or equal, for outdoor applications. Sealant shall be UL classified for flame and smoke development and shall be suitable for mating materials.
- I. Hanger rod shall be ASTM A36 galvanized steel or 316 stainless steel for ducts other than galvanized; threaded both ends, threaded one end, or continuously threaded.
- J. All ductwork in corrosive or Class 1, Division 1 areas shall be stainless steel, FRP or PVC.

2.02 DUCTWORK FABRICATION

- A. Field and Shop Fabricated Ductwork (Rectangular):
1. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards—Metal and Flexible. Provide duct material, gages, reinforcing, and sealing in accordance with SMACNA Standards for 2-inch static rating, 2,500 fpm velocity, and duct seal Class A.
 2. Construct Ts, bends, and elbows with radius of not less than 1 1/2 times width of duct on centerline. Where not possible, rectangular elbows may be used with turning vanes in accordance with Section 15910 -Ductwork Accessories.
 3. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
 4. Provide 45 degree expanded entry takeoffs unless otherwise indicated. Flange ductwork for attachment to grille registers and outlets unless otherwise detailed.
- B. Manufactured Ductwork and Fittings (Round):
1. Manufacture in accordance with SMACNA HVAC Duct Construction Standards—Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
 2. Ductwork shall be United McGill Uni-Seal, or equal, fabricated spiral seam round. Material and sizes shall be as indicated on the drawings.
 3. Ductwork shall be constructed with lock-tight spiral grooved seams, gored elbows with centerline radius of 1 1/2 times the duct diameter, and male/female fittings. Conical tees, conical 45° laterals, conical bellmouth taps, and fittings shall be used. Seal all joints air-tight with gaskets and sealants per SMACNA.
 4. Where grilles and registers are shown to be tapped into ductwork sides, the entire assembly including the round duct section and the rectangular tap shall be fully welded and provided by the manufacturer.

5. Ductwork construction, sheet metal gauges, sealant, reinforcing, joints, accessories, spiral seams, hangers, and bracing shall be in accordance with SMACNA Standards for 2-inch to 10-inch static pressure rating, 4,000 fpm velocity, and duct seal Class A.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards—Metal and Flexible.
- C. Duct sizes are inside clear dimensions.
- D. Provide openings in ductwork to accommodate testing equipment and controllers. Where openings are provided in insulated ductwork, install a metal insulation sleeve of same material as ductwork.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. Make all necessary incidental changes in cross section, offsets, etc., to avoid interference with other equipment and supports.
- F. Use double nuts and lock washers on threaded rod supports.
- G. Exposed ductwork shall be painted per Division 9—Finishes.
- H. Connect air diffusers, registers, and grilles to supply and return ducts directly, unless flexible ductwork is specifically indicated on the drawings. Where registers and grilles are to be mounted on exposed ductwork, provide flanged opening for finished appearance.
- I. For flexible ductwork, follow manufacturer's installation instructions with particular attention to fully extending duct. Ducts shall be supported to prevent sags in excess of 4 inches in 10 feet. No more than one long turn (radius = $1\frac{1}{2} \times \text{diameter}$) will be allowed in any single run. Use round sheet metal stub ducts with conical bell mouth inlet and damper attached to trunk or branch duct for starting flexible duct run and provide insulated guard. Furnish and install a rigid elbow at the inlet to each diffuser of same diameter as flexible duct. Steel strap clamp bands or plastic draw bands with self-lock may be used for connection of flexible ducts to other materials. Maximum duct lengths shall be 6 feet for any runout.
- J. FRP and PVC ductwork shall have joints sealed per manufacturer's recommendations. Duct shall be supported so that no hanging equipment fasteners or accessories penetrate ductwork.
- K. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- L. Provide an experienced installer to go through the air distribution system with the balancer.

- M. Any modifications to the ductwork shown on the drawings must be approved by ENGINEER prior to installation. Any changes in the ductwork layout not approved by ENGINEER affecting static pressure shall be the responsibility of CONTRACTOR to modify air handling equipment at no additional cost to OWNER.

END OF SECTION

SECTION 15910

DUCTWORK ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Air turning devices.
 - 2. Duct access doors.
 - 3. Duct test holes.
 - 4. Flexible duct connections.
 - 5. Duct screens.
 - 6. Volume control dampers.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.
- B. SMACNA–HVAC Duct Construction Standards–Metal and Flexible.
- C. UL 33–Heat Responsive Links for Fire-Protection Service.
- D. UL 555–Fire Dampers and Ceiling Dampers.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300–Submittals.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700–Contract Closeout.
- B. Record actual locations of access doors, fire dampers, flexible duct connections, dampers, and screens.

PART 2–PRODUCTS

2.01 AIR TURNING DEVICES

- A. Provide factory-fabricated metal air turning vanes in all square elbows and bends per SMACNA Standards. Turning vanes shall be constructed of the same material specified for the ductwork. Where ductwork is lined, provide perforated airfoil blades filled with glass fiber insulation.

2.02 DUCT ACCESS DOORS

- A. Provide Ductmate, or equal, duct access doors equal to Ductmate Model FD&H for galvanized ductwork. Access door hinge and cover shall be constructed of material similar to that specified for ductwork. Provide insulated access doors where ductwork is insulated.
- B. Provide Chicago Plastics Systems PVC gasketed duct access doors with hinges and plastic knobs in all PVC ductwork, or equal.

2.03 DUCT TEST HOLES

- A. Provide Ventfabrics, Inc. No. 699 Instrument Test Holes, or equal, complete with gaskets and screw caps.

2.04 FLEXIBLE DUCT CONNECTIONS

- A. All ductwork shall be isolated from fans, fan enclosures, etc., with flexible connections. Provide connections to air handling equipment (except as noted), with Ventfabrics, Inc., "Ventglass," or equal, neoprene coated glass fabric with a metal-to-metal gap of approximately 6 inches.

2.05 DUCT SCREENS

- A. Provide metal screens, equal to Ryerson Ryex Standard, 3/4-inch, 12 gauge sheet metal with border frame for protection on open duct inlets and outlets and as indicated on the drawings. Frame and screen shall be of similar material to ductwork.

2.06 VOLUME CONTROL DAMPERS

- A. Dampers shall be Greenheck Model VCD-23, or equal, low leakage damper with galvanized steel construction.
- B. Dampers for open/closed control shall be parallel blade and modulating damper shall be opposed blade.
- C. Damper frame shall be 16 gauge. Dampers shall have extruded vinyl blade edge seals, flexible metal compression-type jamb seals, nylon bearings, and solid stops. Dampers shall be rated at a leakage of less than 10 cfm per square foot at 4 inches of water column pressure differential.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards-Metal and Flexible. Refer to Section 15890-Ductwork for duct construction and pressure class.

- B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8-inch by 8-inch size for hand access, 18-inch by 18-inch size for shoulder access and as indicated.
- C. Provide duct test holes as necessary for testing and balancing purposes.
- D. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts for air balancing and where indicated on the drawings. Install minimum two duct widths from duct takeoff.
- F. Provide balancing dampers on duct take-off to diffusers, grilles, and registers regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 15940

AIR OUTLETS AND INLETS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Diffusers and grilles.
 - 2. Louvers.
 - 3. Gravity roof ventilators.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ADC 1062–Certification Rating and Test Manual.
- B. AMCA 500–Test Method for Louvers, Dampers, and Shutters.
- C. ARI 650–Air Outlets and Inlets.
- D. ASHRAE 70–Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- E. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

- A. Submit under provisions of 01300–Submittals.

1.04 QUALITY ASSURANCE

- A. Performance of air terminals shall be in accordance with ADC 1062.
- B. Louvers shall be tested and certified in accordance with AMCA 500 and shall bear the AMCA seal.

PART 2–PRODUCTS

2.01 DIFFUSERS AND GRILLES

- A. Acceptable manufacturers are Carnes, Price, or Metalaire. Submit standard color chart with shop drawings for selection by OWNER.
- B. Supply grilles for sidewall and surface mounting shall be Carnes model RSDB, or equal. Grilles shall be steel construction with double deflection blades.

2.02 LOUVERS (EXTRUDED ALUMINUM)

- A. Acceptable louvers are Greenheck ESD 635, or equal. See drawing for sizes and locations.
- B. Blades and frame shall be extruded aluminum 6063-T5 alloy and 0.08-inch thickness. Blades shall be 45° drainable-type spaced at 4 inches on center. Louver shall be capable of a velocity of 1,250 fpm with no water penetration. Performance shall include AMCA-certified air and moisture penetration data and louver shall bear the AMCA seal. Vertical and horizontal mullions and connections between panels shall not be exposed.
- C. Provide channel frame, unless noted otherwise on the drawings.
- D. Provide aluminum insect screen on backside of louver. All fastenings shall be stainless steel or aluminum.
- E. Louvers shall be furnished with 70% Kynar 500 finish, with custom color selected by OWNER. Submit standard color chart with shop drawings.

2.03 GRAVITY ROOF VENTILATORS

- A. Acceptable manufacturers are Greenheck Model GRSR, or equal.
- B. Gravity roof ventilator shall be heavy gauge aluminum construction and provided with roof curb, bird screen, and motorized damper.
- C. Furnish and install a pre-fabricated, insulated roof curb with wood blocking to match roof pitch to allow for a level curb on roof. Curb insulation shall be 1 1/2 inches thick, 3 pounds per cubic foot rigid fiberglass board. Curb height for low side of curb shall be 12 inches unless otherwise indicated. Curb shall have an aluminum liner.
- D. Provide baked enamel finish. Color to be selected by OWNER. Submit color chart with shop drawings.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install diffusers, grilles, and registers in locations shown on drawings and in accordance with manufacturer's recommendations.
- B. Clean surface of diffusers, grilles, and registers after installation.
- C. Install louvers in accordance with manufacturer's recommendations and drawing details.

END OF SECTION

SECTION 15980

TEMPERATURE CONTROLS AND INSTRUMENTATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Electrical components.
 - 2. Dampers and actuators.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit under provision of Section 01300–Submittals.
- B. Submittal shall include control schematics with wiring and logic diagrams in addition to equipment information. All wiring shall be color coded and labeled at each end with corresponding numbers in accordance with 15195–Equipment Identification. This numbering shall be shown on the shop and record drawings. Wiring diagrams shall be job specific and indicate all point-to-point wiring connections. Manufacturer's standard wiring diagrams are not acceptable.

1.03 QUALITY ASSURANCE

- A. Temperature control equipment including panels and other standard marketed apparatus shall bear the nameplate of the manufacturer. The entire system including temperature control wiring shall be installed by mechanics employed by or under contract to the temperature control provider, a factory-licensed distributor, or factory-licensed dealer. The provider shall be responsible for the quality and satisfactory operation of all materials.
- B. All control panels shall bear a serialized UL label.
- C. Comply with the National Electric Code (NFPA 70) and any and all local codes as applicable to construction of electrical wiring devices, material, and equipment herein specified.

PART 2–PRODUCTS

2.01 ELECTRICAL COMPONENTS

- A. Provide electrical work in accordance with Division 16. All line voltage wiring and conduit shall be provided by Division 16 Contractor. All low voltage wiring (100 volts and below) shall be provided by temperature controls contractor and be installed in raceways provided by Division 16 Contractor.

- B. Provide all components necessary to complete the work of this section including, but not limited to relays, transformers, motors, solenoid valves, starters, switches, override controls, operator linkages, and associated low voltage wiring. Outdoor wiring and equipment shall be NEMA 4X, or as indicated.
- C. All relays, time clocks, transformers, motors, operator linkages, wiring, etc., not specifically mentioned herein but necessary to make the control system complete and operative in accordance with the sequence of operation shall be provided as part of this section.
- D. All boxes for thermostats shall be provided by Division 16 Contractor.
- E. All control and auxiliary relays shall have indicating LEDs.
- F. Pushbuttons shall be heavy-duty, oil-tight, 30 mm, flush head-style.
- G. Indicating lights shall be heavy-duty, oil-tight, 30 mm, push-to-test-type.
- H. Selector switches shall be heavy-duty, oil-tight, 30 mm.

2.02 DAMPERS AND ACTUATORS

- A. Outside Air Intake and Exhaust Outlet:
 - 1. Dampers shall be TAMCO Series 9000 BF, or equal, thermally insulated control damper with aluminum construction. Dampers for corrosive and Class 1, Division 1 environments shall be TAMCO Series 9000SW provided with an anodized coating and stainless steel linkage.
 - 2. Dampers shall be parallel blade.
 - 3. Extruded aluminum (6063T5) damper frame shall be thermally broken, minimum 0.080-inch thickness. Damper frame to be 4 inches deep and shall be insulated with polystyrene on four sides. Damper shall be rated at a leakage of less than 4.0 cfm per square foot at 4.0-inch of water column pressure differential at 20°F.
 - 4. Blades to be extruded aluminum (6063T5), internally insulated with nonCFC, expanded polyurethane foam, and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
 - 5. Blade gaskets shall be extruded EPDM; blade seals shall be extruded TPE.
 - 6. Shaft to actuator shall be hex-type, material to match damper construction.
- B. Actuators:
 - 1. Actuators shall be Belimo AF 120-S, or equal, with auxiliary switch rated for 133-inch/lb of torque. Dampers shall be power-to-open, spring-closed unless otherwise specified.
 - 2. Where actuators are located in Class 1, Division 1 rated spaces, provide Belimo ZS260 or equal, explosion-proof housing for actuators.
 - 3. Where actuators are in areas requiring NEMA 4X equipment, provide Belimo ZS300, or equal, NEMA 4X housing for actuators.
 - 4. All actuators shall be direct-coupled to damper and mounted outside the air stream.
 - 5. Remove additional appliance cord if auxiliary switch is not used.
 - 6. All actuators shall be of the same manufacturer. Manufacturer shall be responsible for furnishing quantity of actuators required to meet minimum damper torque rating, plus an additional 10% torque.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install all equipment in accordance with manufacturer's recommendations and Division 16.
- B. Coordinate location of exposed devices prior to rough-in. Thermostats shall be mounted where shown on the drawings.
- C. Temperature controls to be installed in or on insulated ductwork shall be installed after the insulation has been applied.
- D. Thermostats, humidistats, and temperature control panels shall be mounted 4 feet 0 inches above floor to centerline, unless otherwise noted. Notify ENGINEER of conflicts.
- E. Install all dampers in accessible locations with ample space to install direct coupled actuator, housing and accessories.

3.02 SEQUENCE OF EVENTS

- A. Electrical wall heater EWH-20-01 shall be controlled by the integral thermostat.
- B. Supply fan SF-20-02 shall run continuously. No means of shutting off the fan shall be available other than at the circuit breaker. The motor operated damper at the fan and the associated dampers shall be open when the fan is running and spring closed when the fan is off.
- C. Controls for electric unit heaters (EUH) shall be provided by the Division 16 Contractor as specified in Section 16940-Controls and Instrumentation.
- D. Controls for make-up air units (MAU) shall be provided by the Division 16 Contractor as specified in Section 16940-Controls and Instrumentation.
- E. Controls for the following fans shall be provided by the Division 16 Contractor as specified in Section 16940-Controls and Instrumentation.
 - 1. EF-20-01.
 - 2. EF-20-02.
 - 3. EF-20-03.
 - 4. SF-20-01.
 - 5. EF-70-01.
 - 6. EF-70-02.
 - 7. EF-30-01.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1—GENERAL

1.01 GENERAL

- A. Work Included: Balancing air systems.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit under provisions of Section 01300—Submittals.
- B. Prior to final balancing, submit a final report which includes the following information.
 - 1. For each supply, return and exhaust register, and ceiling outlet:
 - a. Room number.
 - b. Type of register and outlet and catalog size.
 - c. Air flow factor.
 - d. Design CFM and velocity.
 - e. Actual CFM and velocity.
 - f. Percent of design CFM.
 - g. Room pressure relationship.
 - 2. For each fan:
 - a. Unit number.
 - b. Fan size and wheel type.
 - c. Motor horsepower.
 - d. Motor nameplate voltage and amps.
 - e. Design CFM and static pressure (total pressure).
 - f. Actual CFM and static pressure (total pressure).
 - g. Actual fan RPM.
 - h. Actual motor voltage and amps (each phase).
- C. Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting, and balancing. Provide recommendations for correcting unsatisfactory performances, and indicate whether modifications required are within the scope of the contract, are design-related, or installation-related. List instrumentation used during testing, adjusting, and balancing procedures.

1.03 QUALITY ASSURANCE

- A. Obtain services of an independent testing organization to perform testing and balancing work. The criteria for determining qualifications shall be membership in the Associated Air Balance Council (AABC), or certification by the National Environmental Balancing Bureau (NEBB).

- B. Balancing procedures shall be observed by Division 15 contractor, temperature controls contractor, OWNER, or ENGINEER. Balancing report must include verification of observation by any of the parties listed above.

PART 2-PRODUCTS

2.01 BALANCING EQUIPMENT

- A. CONTRACTOR shall have the following minimum equipment for balancing systems:
 - 1. Duct air velocities below 1,000 fpm: Pitot tube and Micro-Manometer or Alnor velometer and duct-jet using zero to 1,000 fpm range.
 - 2. Supply Register Velocities: Alnor velometer and applicable jet or Anemotherm.
 - 3. Fan Rotative Speed: Timec tachometer or RPM counter and stop watch (1-minute reading, minimum).
 - 4. Contact pyrometer 0-300°F range.
 - 5. Amprobe model RS-3, or equal.
 - 6. Inclined manometer 0-30 inches of water.
 - 7. Instruments used for measurements shall be accurate, and calibration shall be calibrated by the manufacturer or an AABC-approved method.
 - 8. Instruments shall be applied in accordance with manufacturer's instructions.
- B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards.

PART 3-EXECUTION

3.01 PRELIMINARY REPORT

- A. Provide an experienced installer to check the air distribution system for completion to be sure that the test openings and volume dampers indicated on the drawings or called for in the specifications are installed, that dampers are in the open position, that the fans operate properly, and that the system is ready for balancing. Add test openings, volume dampers, air scoops, deflectrols, turning vanes, etc., as required. Adjust and change fan drives and belts, remove and reinstall ceilings, air terminals, access doors, and air devices as required to balance the system. Maintain the air handling equipment in good operating condition during the testing and balancing procedures.

3.02 ROOM AIR PRESSURE RELATIONSHIPS

- A. The balancing contractor shall pay special attention to specific room pressure relationships specified. Rooms indicated to be positive or negative shall be balanced such. Rooms indicated to be positive shall have 10% more supply air than return/exhaust air quantities. Rooms indicated to be negative shall have 10% more exhaust than supply air quantities. The balancing contractor shall adjust and change fan drives to provide this feature regardless of plan air quantities noted on drawings.

3.03 METHOD OF AIR BALANCE (CONSTANT VOLUME SYSTEMS)

- A. Prepare balancing sheets tabulating air quantities, unit areas, correction factors, and calculated air velocities required for each terminal system. For procedures not specified, follow AABC. Balancing shall be completed with all doors closed.
- B. Adjust total air quantity to 110% of design, as measured by duct traverse, by adjusting fan speeds or branch duct volume dampers.
- C. Read and record on the balance sheets the air velocities and volumes obtained. (Do not change any volume dampers while reading and recording.)
- D. If air quantities are not within 10% of design values, readjust the duct terminal dampers to proportion the air.
- E. Adjust the fan speed or the branch duct damper to adjust the air volume and then reread and record.
- F. Immediately after completion of the final round, measure the total pressure in the duct and record on the balance sheet.
- G. Adjust register, dampers, etc., to equalize the air volume between outlets, and adjust air pattern on supply outlets to produce the correct air pattern.
- H. Repeat the above for each branch duct system.
- I. Proportion the air flow for each branch duct system by adjusting the branch duct volume dampers using a pitot tube traverse or the total pressure reading recorded above.
- J. Adjust the fan speed to deliver or exhaust the required air volume when the automatic dampers are placed in the 100% outside air position (and 100% exhaust air position when so equipped). Balance modulating dampers at extreme conditions, and record both sets of data. Balance variable air volume systems at maximum air flow rate, full cooling, minimum flow rate, and full heating; record all data.
- K. Measure static pressure ahead of filters and heating coil. Measure static pressure at fan inlets and fan outlets. Correct any problems. Measure fan speed and motor inputs and compare with manufacturer's fan data to determine the point of operation. Adjust fan speeds to produce the correct air volumes. (Do not overload the motors.) Reread and record the pressure (positive and negative), RPM, and motor input readings.
- L. Final air volumes shall be within 10% of design values except that specified room air pressure relationships must be provided. Provide reports on pressure relationships.

3.04 GENERAL REQUIREMENTS

- A. Contact the temperature control contractor for assistance in operation and adjustment of controls during testing, adjusting, and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.

- B. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- C. Division 15 Contractor to correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work. Test and balance agency will notify the project representative of these items and instructions will be issued to the Division 15 Contractor for correction of the deficient work.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes general requirements for all electrical work.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/NFPA 70—National Electric Code.
- B. ANSI/IEEE C2.

1.03 CONTRACT DOCUMENTS

- A. Any device or fixture roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to OWNER.
- B. The drawings are generally diagrammatic, and CONTRACTOR shall coordinate the work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.

1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to ANSI/IEEE C2.
- C. The rules and regulations of the federal, state, local, civil authorities, and utility companies in force at the time of execution of the Contract shall become a part of this specification.
- D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be by CONTRACTOR.

1.05 CODES AND ORDINANCES

- A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.
- B. In preparing Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities,

whether or not these are specifically covered by the drawings and specifications. All cases of serious conflict or omission between the drawings, specifications, and codes shall be brought to ENGINEER's attention as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.

- C. When requested by ENGINEER, CONTRACTOR shall provide written calculations to show compliance with applicable codes or the Contract Documents. This shall include, but not be limited to, conduit and wire sizing, junction and pull box fill and sizing, manhole sizing, conductor derating, and voltage drop. CONTRACTOR shall indicate calculation method used as well as compliance with applicable code, drawing, or specification.

1.06 EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

- A. Included in this Contract are electrical connections to equipment provided under other divisions. CONTRACTOR shall refer to final shop drawings for equipment being furnished under other divisions, for exact location of electrical equipment, and the various connections required.

1.07 ELECTRICAL DISTRIBUTION SYSTEM

- A. Provide a complete electrical distribution system consisting of components indicated on the drawings or specified herein, including but not limited to:
 - 1. All miscellaneous equipment coordination and related appurtenances required by power company.
 - 2. Feeders, branch wiring, and electrical distribution equipment.
 - 3. All control wiring.
 - 4. Access panels and access doors for access to equipment installed by Division 16.
 - 5. Wiring between system components if equipment is not prewired.
 - 6. Lighting fixtures, lighting controls, and associated wiring.
 - 7. Support system design and supports for electrical raceways.
 - 8. Code-required disconnects.
- B. CONTRACTOR shall connect the following equipment furnished by Divisions 11, 14, and 15 consisting of components indicated on the drawings or specified herein, including but not limited to:
 - 1. Unit heater fans.
 - 2. HVAC unit starters.
 - 3. Pumps, starters and control panels.
 - 4. Air intake and exhaust fans.
 - 5. Motorized actuated valves.
 - 6. Trolleys and hoists.
- C. Provide balancing and adjusting of electrical loads.
- D. CONTRACTOR shall instruct OWNER's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.
- E. Provide miscellaneous items for a complete and functioning system as indicated on the drawings and specified herein.

- F. A partial list of work not included in Division 16 is as follows: Painting (except as otherwise specified herein).

1.08 NOISE

- A. Eliminate any abnormal noises which are not considered by ENGINEER to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

1.09 DRAWINGS

- A. The drawings indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements in conformance with Contract Documents and cooperation with other trades.
- B. Prior to locating light fixtures, confer with ENGINEER as to desired location in the various areas. In no case should fixture locations be determined by scaling drawings. Relocate fixtures and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.
- C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on drawings, and when CONTRACTOR is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at CONTRACTOR's expense.
- D. The drawings are schematic in nature and are not intended to show exact locations of conduit but rather to indicate distribution, circuitry, and control.

1.10 EXISTING UNDERGROUND UTILITIES

- A. The drawings show approximate location of existing underground electrical based on OWNER-provided record drawings. CONTRACTOR shall excavate and verify the location of all underground electrical prior to installing new electrical equipment and prior to making modifications to existing electrical. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground electrical to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

1.11 SUBMITTALS

- A. CONTRACTOR shall submit to ENGINEER for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Section 01300–Submittals for requirements.
- B. CONTRACTOR shall, in addition, submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by ENGINEER for purposes of clarification of CONTRACTOR's intent. CONTRACTOR shall also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or

equipment. Drawings and details under this section shall include, but not be limited to, the following, where applicable to this project:

1. Electrical interconnection wiring diagrams; see Section 16480–Motor Control and Section 16940–Controls and Instrumentation.
 2. Major feeder routing in plan and elevation, including service entrance raceways and cable.
 3. Equipment room layouts showing exact locations and arrangements of equipment, feeders, wiring, etc., and clearances.
- C. These drawings and diagrams shall show all electrical switch and breaker sizes as well as the manufacturer's name and catalog number for each piece of equipment used.
- D. Equipment and material submittals must show sufficient data to indicate complete compliance with Contract Documents as follows:
1. Proper sizes and capacities.
 2. That the item will fit in the available space in the manner that will allow proper service. Provide 1/4-inch scale plan view and elevations of all electrical rooms showing equipment layouts and clearances.
 3. Construction materials and finishes.
- E. When the manufacturer's reference numbers are different from those specified, provide correct cross reference number for each item. The shop drawings shall be clearly marked and noted accordingly.
- F. When fixtures, equipment, and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.
- G. See additional requirements of shop drawings under Division 1–General Requirements.

PART 2–PRODUCTS

2.01 STANDARD PRODUCTS

- A. All equipment shall be UL and NEMA approved.
- B. Major distribution equipment such as panelboards, motor control centers, motor starters, TVSS units, transformers, etc., shall be by the same manufacturer.
- C. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, rain-tight, explosion-proof, dust-tight, or any other special type).

2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. While it is not the intention of OWNER to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. CONTRACTOR shall submit with each request for approval of substitute material or equipment, sufficient data to show conclusively that it is equivalent to that specified in the following respects:

1. Performance:
 - a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
 - b. Energy consumption at the point of rating shall not exceed that of the specified equipment.
 - c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
 2. Materials of construction.
 3. Gauges, weights, and sizes of all portions and component parts.
 4. Design arrangements, methods of construction, and workmanship.
 5. Coatings, finishes, and durability of wearing parts.
 6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
 7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.
- B. Requests for substitution shall include CONTRACTOR's reason for the request.
- C. If ENGINEER does not consider the items equivalent to those specified, CONTRACTOR shall provide those specified.
- D. See General Conditions for additional requirements.

PART 3-EXECUTION

3.01 CONTINUITY OF SERVICE

- A. CONTRACTOR shall provide and maintain continuous services (power, controls, alarms, etc.) during the entire construction period.
- B. No service shall be interrupted or changed without permission from OWNER. Written permission shall be obtained before any work is started.
- C. When interruption of service is required, all persons concerned shall be notified and a prearranged time agreed upon. Notice shall be a minimum of 72 hours prior to the interruption.

3.02 CLEANING UP AND REMOVAL OF RUBBISH

- A. All lighting and appliance panelboards, MCCs, motor starter and disconnect switch enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cutoff prior to installation of covers.
- B. Where louvers are provided in MCCs or transformer enclosures, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in equipment such as control panels, motor control centers and transformers, CONTRACTOR shall replace all filters with new at the time of final completion.
- C. All lighting fixture lenses and lamps (interior and exterior fixtures) shall be cleaned at time of installation, and all lens exteriors shall be cleaned just prior to final inspection.

- D. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

3.03 CONCRETE WORK

- A. All cast-in-place concrete for new electrical equipment bases shown on the drawings shall be provided by CONTRACTOR except where specifically noted to be provided by others. All new equipment shall be set on 3 1/2-inch minimum leveling slabs including MCCs, free-standing enclosures, etc. Pads shall be 3 inches larger than equipment being supported.
- B. Concrete shall comply with Section 03300–Cast-In-Place Concrete.
- C. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

3.04 PAINTING

- A. All painting of electrical equipment shall be done by CONTRACTOR unless equipment is specified to be furnished with factory-applied finish coats.
- B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.
- C. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR to the satisfaction of ENGINEER.
- D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

3.05 CAULKING

- A. Caulk with a caulking sealant where indicated on the electrical drawings or hereinafter specified.
- B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.
- C. Caulking sealant shall contain no acid or ingredients which will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.
- D. Caulking shall be performed by craftsman skilled at such work.

3.06 BUILDING ACCESS

- A. CONTRACTOR shall arrange for the necessary openings in the building to allow for admittance of all apparatus.

- B. When the installation requires openings and access through existing construction and the openings are not provided, CONTRACTOR shall provide the necessary openings.

3.07 COORDINATION

- A. Provide wiring for all motors and all electrically powered or electrically controlled equipment.
- B. All starters, disconnects, relays, wire, conduit, push-buttons, pilot lights, and other devices for the power and control of motors or electrical equipment shall be provided by CONTRACTOR except as specifically noted elsewhere in these specifications or on the drawings.
- C. Where starters or other devices are provided by others, they shall be connected and wired by CONTRACTOR.
- D. CONTRACTOR's drawings and specifications shall show number and horsepower rating of all motors furnished, together with their actuating devices. Should any change in size, horsepower rating, or means of control be made to any motor or other electrical equipment after the Contract is awarded, any additional costs because of these changes shall be the responsibility of CONTRACTOR.
- E. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters as specified here or under the various trades' sections of these specifications.
- F. CONTRACTOR shall provide all line voltage power and control wiring (100 volts and above) including temperature control wiring for operation, control, and supervision of all motorized equipment including wiring between motor starters and control devices all herein specified and as shown on the drawings. Low voltage control wiring (below 100 volts) shall be provided by CONTRACTOR supplying the equipment which has low voltage wiring unless otherwise noted. CONTRACTOR shall provide raceways for ALL low voltage wiring.
- G. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.
- H. Motors 1/2 hp and larger shall be NEMA rated 460 volts, three phase, 60 Hz, unless otherwise shown. Motors 1/3 hp and below shall be 115 volt, single phase, 60 Hz, unless otherwise shown.

3.08 EXCAVATION AND BACKFILL

- A. Backfilling of all trenches beneath concrete floor and stair slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Section 02222–Excavation, Fill, Backfill, and Grading.
- B. Lines passing under foundation walls shall have a minimum of 1 1/2-inch clearance.
- C. Care shall be taken to insure no disturbance of bearing soil under foundations.

- D. CONTRACTOR shall follow underground pipe runs where possible to avoid additional rock excavation. See Division 2 for rock excavation requirements.

3.09 EQUIPMENT ACCESS AND LOCATION

- A. CONTRACTOR shall coordinate work of this division with that of other divisions so that all systems, equipment, and other components of the building will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this division. Any components for the electrical systems which are installed without regard to the above shall be removed and relocated as required to provide adequate access at CONTRACTOR's expense.
- B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials which will fit properly the types of finishes actually installed.
- C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by CONTRACTOR at no additional cost.
- D. Equipment shall be installed with ample space allowed for removal, repair, or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment which is to be installed or which is already in place.
- E. Locate electrical outlets and equipment to fit the details, panels, decorating, or finish of the space. ENGINEER shall reserve the right to make minor position changes of the outlets before the work has been installed. Verify door swings before installing room lighting switch boxes, and install boxes on the latch side of door unless noted otherwise.

3.10 WORKMANSHIP

- A. Install work using procedures defined in NECA Standard of Installation.
- B. Location of process equipment as shown on the drawings is approximate.
- C. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.
- D. Locations of utilization equipment and control devices as shown on drawings are within 10 feet of actual positions. Any mounting of this equipment within this 10-foot distance will be performed at no additional cost to OWNER.
- E. Unless otherwise noted, equipment shall be fastened to building structure or equipment framework and not placed on the floor.
- F. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the bid.

- G. Materials and equipment of the types for which there are National Board of Fire Underwriters' Laboratories (UL) listing and label service shall be so labeled and shall be used by CONTRACTOR.

3.11 AREA CLASSIFICATION

- A. As noted on the drawings.

3.12 MODIFICATIONS TO EXISTING CONSTRUCTION

- A. Alterations:
 - 1. Alter, extend, and reconnect conduits as necessary.
 - 2. Reconnect existing conduits which were reused, cut, or exposed because of construction as quickly as possible.
 - 3. Where wiring is involved, new wires shall be "pulled-in" between the nearest available accessible reused outlets to the extent allowed by the governing code.
 - 4. Furnish and install new conduits for wires if they cannot be "pulled-in" to existing conduits.
 - 5. All new conduits, wiring, and electrical items shall be connected to the existing systems so as to function as a complete unit.
 - 6. Where existing electrical equipment, devices, fixtures, electrically operated items, etc., interfere with any remodeling work, they shall be removed and reinstalled in another location to avoid such interferences. All existing and relocated equipment shall be left in good operating condition.
- B. Include in Bid removal from service of existing electrical material and equipment as specified hereinafter, as noted on the drawings, or as needed by field conditions.

END OF SECTION

SECTION 16110

CONDUIT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Rigid metal conduit and fittings.
 - 2. PVC externally and internally coated galvanized rigid metal conduit.
 - 3. Rigid aluminum conduit.
 - 4. Polyvinyl chloride conduit and fittings.
 - 5. Liquid-tight flexible metal conduit and fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ANSI C80.1—Rigid Steel Conduit, Zinc-Coated.
- B. ANSI C80.5—Rigid Aluminum Conduit.
- C. ANSI/NEMA FB 1—Fittings and Supports for Conduit and Cable Assemblies.
- D. NEMA RN 1—PVC Externally and Internally Coated Galvanized Rigid Steel Conduit.

1.03 QUALITY ASSURANCE

- A. Manufacturers of Raceways: Firms regularly engaged in the manufacture of electrical raceways of the types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300—Submittals.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Provide color-coded thread protectors on the exposed threads of threaded rigid metal conduit.
- B. Handle conduit carefully to prevent end damage and to avoid scoring the finish.
- C. Store conduit inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, waterproof wrapping.

PART 2-PRODUCTS

2.01 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: ANSI C80.1. Heavy wall seamless tubing with hot-dipped galvanized coating.
- B. Rigid Aluminum Conduit: ANSI C80.5. Heavy wall.
- C. PVC coated conduit and fittings shall be internally and externally hot dipped galvanized rigid metal conduit with hot galvanized threads and PVC coating. PVC coating shall be UL listed with rigid metal conduit as the primary means of corrosion protection for the conduit, and PVC coating shall have an external 40 mil thickness with an internal 2 mil red urethane coating. Acceptable manufacturers shall be Plasti-bond RedH₂OT by Robroy Industries, Permacote Industries Supreme Conduit System, or equal. PVC coated conduit and fittings shall meet the following listings and manufacturing standards, and shall bear the ETL Verified PVC-001 label to signify conformance to the adhesion performance standard.
 - 1. Federal Specification WW-C-581 E
 - 2. ANSI C80.1
 - 3. UL6 and UL 514B
 - 4. ETL verified to Intertek ETL SEMKO high temperature water PVC coating adhesion test procedure.
- D. Conduit bodies for PVC coated rigid conduit shall be as manufactured by Plasti-bond RedH₂OT by Robroy Industries, Perma-Cote Industries Supreme Conduit System, or equal, and have a 40 mil PVC exterior coating and 2 mil red urethane interior coating. Conduit bodies shall be Form 7 style or pulling elbow and include domed, gasketed covers and stainless steel screws. CONTRACTOR shall select body style and size per application.
- E. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded-type, material to match conduit.

2.02 POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

- A. Conduit: Heavy wall rigid, Schedule 40, Schedule 80 where noted, UL listed for underground, encased, and above ground applications. PVC conduit installed in exterior locations shall be sunlight resistant.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1.

2.03 LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: Electro-galvanized single strip steel with PVC coating and integral grounding conductor. Liquid-tight conduit installed in exterior locations shall be sunlight resistant.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1.

2.04 CONDUIT COUPLINGS (HAZARDOUS LOCATIONS)

- A. Flexible conduit in hazardous locations shall be liquid-tight, stainless steel, and be rated for use in Class I, Division 1 rated spaces. Outer braid and end fittings shall be stainless steel with flexible brass inner core. An insulated ground conductor shall be installed in all couplings.
- B. Couplings shall be as manufactured by Crouse Hinds EC Series, or Appleton EX Series.

2.05 CONDUIT SUPPORTS AND SPECIAL FITTINGS

- A. Conduit seals for Class I, Division 1 Location: Robroy Industries Plasti-Bond Red H₂OT Series EYS seal fittings and Crouse Hinds "Chico A" sealing compound, Arrow-Hart, or equal. All other areas shall be sealed with duct sealing compound, OZ Gedney Type DUX, or equal.
- B. Expansion Fittings: Crouse Hinds type XJG, or equal.
- C. Expansion-deflection Fittings: O-Z type "DX", Appleton, or equal.
- D. Mechanical Seals: 316 stainless steel, LinkSeal, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners.
- E. Supports in NEMA 4X areas and when using PVC coated conduit shall be fiberglass, PVC or 316 stainless steel.
- F. Conduit Clamps, Straps, and Supports: Steel with no crevices. See Section 16190—Supporting Devices for additional requirements.
- G. Watertight Hubs: Die cast, insulated, and gasketed, rated for wet or dry locations, indoors or outdoors. Water tight hubs shall be Appleton HUB, Crouse-Hinds Myers Hubs, or equal.

PART 3-EXECUTION

3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Size conduits for branch circuit conductors, control wires, and instrumentation cables so as to have not less than 25% spare capacity after installation; 3/4-inch minimum size. Minimum size for liquid-tight flexible metal conduit is 1/2-inch.
- B. Maintain at least 1 inch of separation between conduit sizes to 1 1/2 inches and 2 inches between conduits 1 1/2 inches or larger. Maintain 1 foot of separation between signal conduits (below 100 volts) and power conduits (100 volts and above).

3.02 CONDUIT INSTALLATION

- A. Provide for the proper application, installation, and location of inserts, supports, and anchor bolts for a satisfactory raceway system. Where any component of the raceway system is damaged, replace or provide new raceway system.
- B. Run conduits concealed to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid all materials and equipment of other trades. Maintain a minimum clearance of 6 inches from all hot water pipes, flues, or any high-temperature piping or duct work.
- C. Avoid exposed conduit runs. Conduit may be run exposed only where it is impossible to conceal. Conduit may be run exposed on the underside of precast or poured concrete floor slabs or in basements. Run exposed conduit grouped and parallel or perpendicular to construction. Do not route exposed conduits over boilers or other high-temperature machinery nor in contact with such equipment. All conduit shall be run exposed in structures below grade.
- D. Conduits shall be attached to building surfaces and not suspended unless installed in a unistrut type conduit rack as specified herein. Individual conduits shall not be suspended. Clevis hangers are not allowed.
- E. Center conduit in structural slabs (other than topping), clear of reinforcing steel and spaced on centers equal or exceeding three times the conduit diameter. Outside diameter of conduit shall not exceed 1/3 the slab thickness for each run of conduit 1 1/4-inch or larger. Provide shop drawings when it will be installed in structural slabs.
- F. All conduits that protrude from poured concrete shall be PVC coated rigid conduit. Conduit shall extend a minimum of four feet beyond the poured concrete (both sides).
- G. Conduits passing through masonry, concrete, or similar construction shall be cast-in-place using PVC coated rigid conduit extending completely through the construction.
- H. Where conduits pass through cores in existing structures or through masonry walls, grout openings between conduit and walls or floors with sand-cement mortar consisting of one part Portland cement and three parts sand, by volume. Add sufficient water to make a stiff, placeable mortar.
- I. Where wall penetrations through existing walls are below grade, cored openings shall be sealed with waterproof mechanical seals. Cores shall be pitched slightly, such that conduit

slopes away from building. Sleeve diameter shall be provided and mechanical seals installed as recommended by the manufacturer.

- J. Conduit shall not be run in slabs-on-grade or structural topping slabs.
- K. Ream conduit smooth at ends, cap upon installation, rigidly attach to structural parts of the building, and securely fasten to all outlet boxes, panel cabinets, junction boxes, pull boxes, splicing chambers, safety switches, and all other components of the raceway system.
- L. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice. Conduits through roofs shall be equipped with pitch pockets.
- M. Conduits installed for future equipment or electrical work shall be cut-off and capped flush with finished floor. Conduit ends shall have threaded fittings to accommodate future conduit installation.
- N. Provide all empty raceways 2 1/2-inch and over with #10 galvanized fishwire, and nylon cord for conduits smaller than 2 1/2-inch. Empty raceways and fishwire/nylon cord shall be identified with permanent label, and label shall include conduit termination point. All empty conduits shall be threaded, capped and flush with finished floor. Exposed conduits shall be threaded and capped.
- O. Conduit attached to building surfaces which may be damp shall be spaced out to avoid rust and/or corrosion using fittings approved for the use. Use back-straps on all conduit in damp or wet locations or mount conduit with Unistrut straps, or equal. Watertight hubs shall be used in all damp locations. Damp locations shall include, but not be limited to, all basement areas, exterior locations, garage areas, all wet wells and dry wells, all areas below grade, and any wash-down areas.
- P. Conduit seals shall be provided where conduits pass from the interior to exterior of the building where conduits enter a room which at any time is a low or high temperature room, and any conduit entering a NEMA 4X area.
- Q. All conduits entering or passing through areas that are "hazardous areas" as defined by the NEC and/or NFPA shall be sealed as specified herein following manufacturer's recommended installation methods.
- R. All conduits located in hazardous areas shall be installed in accordance with NEC.
- S. Conduits for intrinsically safe circuits shall be dedicated to intrinsically safe wiring. Conduits shall be installed and identified by labeling or color coding in accordance with Article 504 of the NEC.
- T. Conduits shall be securely fastened to building structure at intervals not exceeding 8 feet or closer, if necessary, with one-hole malleable straps. Where hangers are necessary, 3/8-inch rod/eyelets/rings/or trapeze-type in Unistrut channel and pipe clamps shall be used. Wire or perforated strap iron is not acceptable. PVC conduit shall be securely fastened to building structure at intervals not exceeding 3 feet, or closer.
- U. Vertical conduit runs 1 1/4-inch and larger passing through floors shall be supported at each floor with conduit riser grips.

- V. Liquid-tight flexible conduit shall be installed in such a manner that liquids tend to run off the surfaces and not drain toward the fittings.
- W. All runs of flexible conduit to equipment and devices shall be as short as practicable, of the same size as the conduit it extends, and with enough slack to reduce the effects of vibration to a minimum. A minimum of 18 inches of flexible conduit shall be installed for each motor.
- X. Where fittings are brought into an enclosure with a knock-out, a gasket assembly consisting of an "O" ring and retainer shall be installed on the outside. Fittings shall be insulated throat-type.
- Y. Provide conduit expansion fittings as specified herein, in all conduit runs that cross a structural expansion joint.
- Z. Provide conduit expansion-deflection fittings as specified herein, in all conduit runs where movement perpendicular to axis of conduit may be encountered.
- AA. All conduit installed below grade shall be buried a minimum of 2 feet 0 inches.
- BB. PVC conduit installed in earth shall be bedded in compacted sand with a minimum of 6-inch cover on all sides.

3.03 CONDUIT INSTALLATION SCHEDULE

- A. The following schedule lists specific conduit types allowed in designated areas. Those areas not listed under a specific conduit type shall not have that type of conduit installed.
 - 1. Rigid steel:
 - a. Structural slabs.
 - b. All concealed interior locations.
 - c. Interior locations requiring mechanical protection.
 - d. All interior exposed locations.
 - 2. Rigid Aluminum:
 - a. All locations where attached to aluminum railings.
 - b. Exterior locations (except in earth and at Chlorine Contact Tank) and locations exposed to weather.
 - 3. PVC coated rigid steel:
 - a. Class I, Division 1 locations.
 - b. Conduits protruding from concrete.
 - c. Earth.
 - d. Exterior locations and locations exposed to weather.
 - e. Within 6 feet of building or structure footing, wall, or manhole.
 - f. Interior and exterior locations requiring mechanical protection.
 - 4. PVC:
 - a. Earth, except within 6 feet of a building or structure footing, wall, or manhole, and under pavement or roadways.
 - b. NEMA 4X listed rooms.
 - 5. Liquid-tight flexible metal conduit not over 4 feet in length for final connections to:
 - a. Equipment in wet locations.
 - b. Equipment with sliding bases or flexible positioning.
 - c. Equipment with vibration isolation mounting.

- d. Equipment housing ferromagnetic cores or with integral moving components capable of generating noise or vibrations, including transformers and motors.
- e. All pumps and associated equipment.

END OF SECTION

SECTION 16112

MANHOLES

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes electrical construction features related to electric manholes.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.
- B. Calculations for manhole sizing shall be submitted to ENGINEER for review.

PART 2–PRODUCTS

2.01 PREFABRICATED MANHOLES

- A. Electrical manholes shall be manufactured by Quazite Utility Products, PG Style, sized by CONTRACTOR per the NEC, minimum size, 30 inches wide by 48 inches long by 30 inches deep, or equal. Manholes which are not in roadways shall have an application tier 8 rating. Manhole covers shall be gasketed and have the logo “ELECTRIC” stamped on them. Manholes shall have an open bottom. Manhole covers shall be bolt-on type.

PART 3–EXECUTION

3.01 INSTALLATION

- A. CONTRACTOR shall be responsible for reviewing the site grading plan and coordinating elevations of manholes prior to installation. CONTRACTOR shall provide extension rings for all manholes when required and to ensure all conduits entering manholes will be pitched to drain into the manholes.
- B. Provide 3/4-inch stone fill to a depth of 1-foot 0-inch under all manholes and within a 2-foot 0-inch radius of exterior of manhole.
- C. Install plastic bushings in the ends of duct runs before pulling cable.
- D. All conduits must enter sides of manholes. Conduits entering the bottom of manholes will not be permitted. Seal all side wall openings with grout.
- E. Manholes shall be considered wet locations for purposes of equipment selection.

- F. All conduits shall be pitched so that drainage is towards manhole and away from all structures.

END OF SECTION

SECTION 16113

SURFACE RACEWAYS

PART 1–GENERAL

1.01 SUMMARY

- A. Work included: Furnish and install surface raceways, include surface metal and nonmetal raceways, multi-outlet assemblies, auxiliary gutters (wireways) and wall duct.
- B. Related Sections and Divisions:
 - 1. Section 16141-Wiring Devices.
 - 2. Section 16450–Secondary Grounding.
 - 3. Applicable provisions of Division 1 shall govern Work in this section.

1.02 QUALITY ASSURANCE

- A. Cable tray sections and fittings shall be UL labeled.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 SURFACE METAL RACEWAY

- A. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway; 4000 Series, manufactured by Wiremold.
- B. Size: 4 3/4-inch by 1 3/4-inch.
- C. Faceplate and Activation Fittings: Wiremold 4050 faceplates, corresponding components and “Open Connectivity Solutions Modules” shall be installed for all 4000 Series locations. Adapter CM-ARA with Insert CM2-U2ATT shall be used for all voice and data jack locations.
- D. Finish: Ivory or to match existing as approved by OWNER.
- E. Fittings: Couplings, elbows, ceiling trim rings and connectors designed for use with raceway system.
- F. Boxes and Extension Rings: Designed for use with raceway systems.
- G. Description: Sheet Metal channel with fitted cover, suitable for use as surface raceway, manufactured by Wiremold Series V700 is acceptable at locations with two or less data or power drops. Provide deep box and Lucent M14L faceplates for voice and data locations.

- H. Description: Sheet metal channel with fitted cover, suitable for use as surface raceway, manufactured by Wiremold Series V2400D fittings is acceptable at locations with 3 or less combined power and data drops. Provide Series V2400D fittings as necessary to accommodate voice, data, and power drops.

PART 3-EXECUTION

3.01 INSTALLATION-SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY

- A. Use flat-head screws to fasten channel to surfaces every 24 inches. In addition, mount plumb and level and as per the manufacturer's recommendations.
- B. Unless otherwise stated, all devices shall be approximately 24 inches AFF.
- C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- D. Install trim rings at the ceiling when the raceway passes through the ceiling.
- E. Maintain grounding continuity between raceway components to provide a continuous grounding path as per the manufacturer's installation requirements.
- F. Fastener Option: Use clips and straps suitable for the purpose. Use two hole straps for 700 size wiremold.
- G. Surface-mounted raceway shall only be installed in Lab and Superintendant's Office in the Control Building where conduit cannot be concealed within walls.

END OF SECTION

SECTION 16120

WIRE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Wire.
 - 2. Terminal blocks and accessories.
 - 3. Wiring connections and terminations.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.03 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01300–Submittals.
- B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
- C. Submit manufacturer's instructions.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-wrapped, waterproof, flexible barrier material for covering wire on wood reels, where applicable; and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

- B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

PART 2-PRODUCTS

2.01 WIRE

- A. All wire for permanent installation shall be new stranded copper, delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted. The use of multi-conductor cable is NOT ALLOWED.
- B. Motor circuit branch wiring and associated control wiring:
1. Insulation type shall be THHN.
 2. Minimum size for motor control wiring shall be 14 AWG.
 3. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on drawings.
- C. All power wiring to motors utilizing Variable Frequency Drives (VFDs) shall be type XHHW-2.
- D. All wiring within control panels and supervisory control centers shall be insulation type MTW, minimum size 16 AWG.
- E. Wiring in dry locations shall be THHN. Wiring in damp and wet locations shall be type XHHW-2. Damp and wet locations shall include but not be limited to exterior locations, buried conduits, wet wells, and any washdown areas.
- F. All available colors shall be used; however, green shall be used only for equipment grounds. Where color-coded wire in larger sizes is not available, one wrap of 1-inch-wide, colored, self-adhesive tape at each terminal end shall be used for identification. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.
- G. All wiring for intrinsically safe circuits shall be light blue. Refer to Section 16940-Controls and Instrumentation for additional wire color requirements.
- H. Color Coding:

	120/208V	277/480V
A Phase	Black	Brown
B Phase	Red	Orange
C Phase	Blue	Yellow
Neutral	White	Gray
Travelers	Yellow	Orange
Equipment Ground	Green	Green

- I. Branch circuit wiring in excess of 75 feet, for ALL exterior lights shall be minimum 10 AWG. Circuits 150 feet or over shall be sized for a maximum 2% voltage drop.

2.02 WIRING CONNECTIONS AND TERMINATIONS

- A. Stranded conductors may only be terminated with UL or ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back-wired method.
- B. Provide insulated, **silicone-filled** spring wire connectors with plastic caps for 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Safety Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, and switch boxes.
- C. Provide in-line splices for all conductor connections, 6 AWG and larger. Splice crimp component shall be Burndy compression splice long barrel-bell entry, type YS, or equal. Splice shall be made with crimp tool by manufacturer that allows expanded conductor ranges. Splice insulation component shall be Raychem heavy-wall, low voltage tubing, type WCSM, or equal. No splices will be allowed unless approved by ENGINEER.

2.03 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed.
- B. Power Terminals: Unit construction-type, closed-back-type, with tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction-type, channel mounted; tubular pressure screw connectors, rated 300 volts.
- D. Manufacturer and Model Number: Phoenix Contact UK 5 N, or equal.

PART 3-EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which the work is to be installed and notify CONTRACTOR of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 GENERAL WIRING METHODS

- A. Install electrical wire and connectors in accordance with the manufacturer's written instructions; applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation"; and in accordance with recognized industry practices to ensure that products serve the intended functions.
- B. Place an equal number of conductors for each phase of a circuit in same raceway.
- C. Splice only in junction or outlet boxes. Avoid splices between terminals of interconnecting power and control wiring.

- D. Spring wire connectors shall only be used in junction, outlet, or switch boxes. Equipment wireways (e.g. motor control centers, switchgear, etc.) and control panels shall not have any spring wire connectors installed; all terminations shall be on terminal strips.
- E. Neatly train, lace, and tie wrap all wiring inside boxes, equipment, MCCs, and panelboards.
- F. Make conductor lengths for parallel circuits equal.
- G. The same color shall be used for each numbered wire throughout its entire length.
- H. Terminate all wiring on terminal blocks in control panels, starter cubicles, and similar equipment.
- I. Provide preprinted adhesive or heat shrink-type wire numbering labels at all terminations and splices. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (e.g. Brady labels) are not acceptable.
- J. Use appropriate wiring methods and materials for the equipment or environment.
- K. Do not use a pulling means which can damage the raceway.
- L. Signal wiring (below 100 volts) and intrinsically safe wiring must be in a conduit separate from power and/or control wiring (over 100 volts). Signal wire shall include, but not be limited to, loop powered devices, voice and data communications, and communication wiring (i.e. DeviceNet, RS-232, etc.). Intrinsically safe wiring shall be separated and identified in accordance with Article 504 of the NEC.
- M. Control wiring (e.g., internal thermal overloads, lockout stops, etc.) to motors utilizing VFDs shall be in a conduit separate from motor power wiring.
- N. Provide junction or pull boxes to facilitate the “pulling in” of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.
- O. Thoroughly clean wires before installing lugs and connectors.
- P. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.
- Q. Terminate spare conductors with electrical tape, label as “SPARE,” and indicate where the conductors terminate. Refer to Section 16195-Electrical Identification for additional requirements.

3.03 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL-listed wire-pulling lubricant for pulling 4 AWG and larger wires. Yellow 77 pulling lubricant is not allowed.
- B. Install wire in raceway after interior of building is enclosed, watertight, dry, and all mechanical work likely to injure conductors has been completed.

- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes or outlet boxes.
- E. CONTRACTOR shall observe code limitation on the number and size of wires in an outlet box. CONTRACTOR shall either lay out work so that the wires do not exceed the particular box limitation, or provide larger boxes approved for additional capacity.
- F. Panel riser feeder conductors shall be identified with colored tape at panel lugs. The same phase relation shall be maintained throughout.
- G. Circuiting is indicated diagrammatically on the drawings.

3.04 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.
- B. Torque test conductor connections and terminations to manufacturer's recommended values.
- C. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.
- D. Subsequent to wire hook-ups, energize circuitry and demonstrate functioning in accordance with these specifications.
- E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- F. Perform field inspection and testing according to provisions of this section.

3.05 ACCEPTANCE TESTS

- A. CONTRACTOR shall furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of OWNER or OWNER's representative and must be passed before final acceptance of the work.
- B. CONTRACTOR shall be responsible for powered tests of each field installed device unless specifically noted otherwise. CONTRACTOR shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.
- C. Operation Test—By operational testing, OWNER will give final acceptance of the wiring system when all of the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the drawings. All motors shall be properly connected to protective devices, and motor rotation shall be in the correct direction.
- D. At the request of OWNER's representative, demonstrate by test the compliance of the installation with these specifications and drawings, the National Electrical Code, and the

accepted standards of good workmanship. These tests shall include operation of equipment, continuity of the conduit system, grounding resistance and insulation resistance.

- E. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to OWNER. Such tests shall show compliance with governing codes.
- F. The transformer, feeder, and subfeeds to the lighting panels shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C as follows:
 - 1. Front-to-rear, top-to-bottom, or left-to-right when facing equipment.
 - 2. Phasing shall be accomplished by using distinctive colors for the various phases. The same color or variation of it shall be used for a particular phase throughout the building and project.

3.06 WIRE INSTALLATION SCHEDULE

- A. Install all wiring in raceways except as otherwise noted. This includes all low voltage wiring such as temperature control, phone, network, fiber optic, etc.

END OF SECTION

SECTION 16130

BOXES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Wall and ceiling outlet boxes.
 - 2. Pull and junction boxes.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/NEMA OS 1—Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. ANSI/NEMA OS 2—Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. NEMA 250—Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, boxes, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300—Submittals.

PART 2–PRODUCTS

2.01 OUTLET BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel, 4-inch square or octagon, minimum 2 1/8 inches deep. Raco, Appleton, or equal.
- B. Masonry and Partition Boxes: Galvanized steel, non-gangable. Thomas & Betts, GW Series, or equal. Provide number of gangs for devices shown on the drawings.
- C. Cast Boxes: Aluminum or cast faralloy, deep-type, gasketed cover, threaded hubs, Crouse-Hinds FD Series, or equal.
- D. NEMA 4X Boxes: PVC or FRP, Carlon FS Series, or equal with proper cover and gasket.

2.02 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1: Code gauge steel with galvanized or sheradized finish, secured by galvanized machine screws. Hoffman ASG Series without knockouts, or equal.
- B. Cast Boxes: NEMA 250; Type 4, flat-flanged, surface-mounted junction box, UL-listed as watertight. Cast aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws, Crouse-Hinds WCB Series, or equal.
- C. NEMA 4X Boxes: PVC or FRP, Carlon NS Series, or equal with proper cover and gasket.
- D. Boxes Larger Than 12 Inches in Any Dimension: Hinged enclosure in accordance with Section 16160–Cabinets and Enclosures.
- E. Boxes specified in this section are not allowed to have knockouts and are not allowed to be used as enclosures for control panels.

PART 3–EXECUTION

3.01 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.
- B. Electrical box locations shown on drawings are approximate. Verify location and size of floor boxes and outlets in all work areas prior to rough-in.
- C. Where dedicated raceways are provided for different voltage systems or wiring (e.g. motor powered wiring and motor space heaters), separate boxes shall also be provided unless approved by ENGINEER. Where approved by ENGINEER, combined boxes shall be physically divided to separate the wiring.
- D. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of access doors.

- E. Locate and install to maintain headroom and to present a neat appearance.
- F. All boxes attached to building surfaces which may be damp shall be spaced out to avoid rust and/or corrosion. All boxes in damp locations shall be on 1-inch standoffs. Damp locations shall include, but not be limited to, all basement areas, exterior locations, garage areas, all wet wells and drywells, all areas below grade, and any washdown areas.

3.02 SWITCH AND OUTLET BOX INSTALLATION

- A. Locate boxes in masonry walls for cutting of masonry unit corners only. Coordinate masonry cutting to achieve neat openings for boxes.
- B. Provide knockout closures for unused openings.
- C. Support boxes independently of conduit.
- D. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- E. Install boxes in walls without damaging wall insulation.
- F. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- G. Switch and outlet boxes provided for branch circuits and feeders shall not contain control wiring. Control wiring and intrinsically safe wiring shall each have dedicated pull and junction boxes provided. Wiring for different voltage systems (e.g. 24V, 120V, 480V) shall have dedicated pull and junction boxes for each voltage.
- H. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- I. In plaster or concrete walls, single receptacle, single- or double-switch outlets, use 4-inch square masonry boxes fitted with raised plaster covers. In poured concrete walls below grade, use cast boxes.
- J. In unplastered brick or block walls use masonry boxes.
- K. In metal door frames use partition boxes.
- L. For weatherproof switches, devices, and exterior fixtures use cast boxes with proper cover and gasket.
- M. All exterior outlet boxes shall be NEMA 4X.
- N. All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted.
- O. Knock-out punches or saws shall be used for holes; boxes with pre-punched holes are not acceptable.

- P. Boxes shall be of a depth to accommodate wires and splices and shall be equipped with both fixture hanging studs and tapped fixture ears. Boxes shall be installed so they will support the weight of the fixture. Conduit will not be considered as adequate supports.
- Q. Cast boxes with 3/4-inch hubs and aluminum fittings and enclosures may be used with all conduit types.

3.03 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.
- D. All junction boxes shall be labeled with permanent labels (not adhesive type). Permanent labels shall include painted stencil-type labels or engraved laminated nameplates. Labels shall indicate circuit or load served, as well as power source.
- E. All interior exposed junction and pull boxes shall be cast-type with cover, unless noted otherwise.
- F. All exterior junction and pull boxes shall be NEMA 4X. Boxes in areas subject to damage shall be stainless steel.

END OF SECTION

SECTION 16141

WIRING DEVICES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Wall switches.
 - 2. Receptacles.
 - 3. Cover plates.
 - 4. Control switches.
 - 5. Thermostats.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. NEMA WD 1—General-Purpose Wiring Devices.
- B. NEMA WD 5—Specific-Purpose Wiring Devices.
- C. Drawings—Bill of Materials.

1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters' Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300—Submittals.

- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2-PRODUCTS

2.01 WALL SWITCHES

- A. A-C general use Industrial specification grade, snap switch, 20 amperes, 277 volts, one of the following: Cooper 222*, Leviton 122*, Pass and Seymour PS20AC*, or equal.
- B. Provide ivory colored handles.
- C. Manual motor switches or manual motor controllers for 120V or 240V motors on circuits 20 amps or less shall be specification grade snap switch as specified above. Manual motor switches or manual motor controllers for 120V or 240V motors on circuits 30 amps or less shall be Cooper 303*, Leviton 303*, or Pass and Seymour PS30AC*. Manual motor switches for three phase motors 30 amps or less shall be as specified in Section 16440-Disconnect switches.

*Complete catalog number for pole arrangement necessary.

2.02 RECEPTACLES

- A. 20 ampere, 125 volt, NEMA 5-20R, Industrial specification grade, straight blade, 3-wire duplex grounded outlets, one of the following: Cooper 5362, Leviton 5362, Pass and Seymour 5362-A. 208 volt receptacles shall be grounded-type, rated same as circuit indicated on the drawings. Provide ivory coloring.
- B. Outdoor Receptacle: Pass and Seymour 2094, brown receptacle with Leviton Catalog No. 5977 cover and mounted vertically on nonferrous box.
- C. Class I, Division 1 Receptacles: Crouse Hinds CPS-152 or Appleton CPS. Provide two plugs (total) to match receptacle.
- D. GFCI Receptacles: Pass and Seymour 2094, Cooper XGF20, duplex convenience receptacle with integral ground fault current interrupter. GFCI receptacles shall not be series wired.
- E. Provide spare receptacles as described in Section 16951-Spare Parts.

2.03 COVER PLATES

- A. Each and every flush box shall be provided with standard 302 series stainless steel plates, blank, receptacle, switch or cord as designated by outlet symbol. Surface boxes shall have plates to match Crouse-Hinds, Appleton, or equal cast boxes.
- B. Thermoplastic ivory cover plates shall be used in all "finished" areas.
- C. NEMA 4X and weatherproof switch covers shall be Carlon, Industrial Gray, toggle switch cover, Model E98TSCN-CAR, or equal. Interior NEMA 4X receptacle covers shall be Leviton, Catalog No. 5976, or equal.

- D. Cover plates for manual motor switches or manual motor controllers shall have provisions for locking the switch in the On or Off position.

2.04 CONTROL SWITCHES

- A. Heavy-duty, oil-tight operators in NEMA 4X enclosures unless otherwise noted. Control stations shall be Square D, Class 9001, Type SKY, Allen Bradley Bulletin 800T, or equal, with operators as shown on the drawings. Lockouts where called for on the drawings shall be Square D Type K5, or equal.
- B. All control devices shall have permanent labels as specified herein.

2.05 THERMOSTATS

- A. Line voltage thermostats for single stage heating or single stage cooling shall be Honeywell T6051A. Line voltage thermostats for single stage heating or single stage cooling in NEMA 4X areas shall be Honeywell T631F.
- B. Line voltage thermostats for single stage heating or single stage cooling in Class I, Division 1 locations shall be Honeywell T6051B.
- C. Line voltage thermostats for two stage heating, two stage cooling, or one heating and one cooling stage shall be Honeywell T6052.
- D. Analog (low voltage) thermostats shall be provided to generate a 4-20 mA signal for interface with the SCADA system. Thermostats shall include temperature transmitter and temperature sensor. Transmitters shall be installed in single-gang box and be TCS/Basys model TX1507. Provide intrinsic safety barrier for thermostats located in Class I, Division 1 locations. Sensors shall be as follows:
 - 1. Sensors for outdoor air temperature, NEMA 4X, and Class I, Division 1 locations shall be TCS/Basys model TS1003.
 - 2. Sensors for indoor NEMA 1 locations shall be TCS/Basys model TS1000.
 - 3. Sensors for duct discharge air temperature shall be TCS/Basys Model TS1002.
- E. Thermostats shown on the drawings shall be single stage unless otherwise noted.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install wall switches 48 inches above floor (top of junction box), "Off" position down, except as otherwise noted.
- B. Install convenience receptacles 15 inches above floor (bottom of junction box), grounding pole on bottom except as otherwise noted.
- C. Install specific-use receptacles at heights shown on Contract drawings.
- D. Convenience Receptacles: Specification grade self-grounding.

- E. Install devices and wall plates flush and level.
- F. Backwiring shall not be used in wet locations or outside. Backwiring of switches and receptacles in conjunction with spring loaded wire connections is not allowed. Wires shall be terminated with the device screw terminal.

END OF SECTION

SECTION 16160
CABINETS AND ENCLOSURES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Hinged cover enclosures.
 - 2. Cabinets.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. NEMA 250–Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. ANSI/NEMA ICS 1–Industrial Control and Systems.
- C. ANSI/NEMA ICS 6–Enclosures for Industrial Control Equipment and Systems.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.
- B. Show Drawings for Equipment Panels: Include wiring schematic diagram, connection diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1.

PART 2–PRODUCTS

2.01 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, larger than 12 inches in any dimension. Acceptable manufacturers: Hoffman, B-Line, or equal.
- B. Covers: Continuous hinge, applicable NEMA rating with hasp and staple for padlock.
- C. Back Panel for Mounting Terminal Blocks or Electrical Components: 14 gauge steel, white enamel finish.
- D. All cabinets with double doors or that are free-standing shall have 3-point latch.

2.02 CABINETS

- A. Construction: NEMA 250. Acceptable manufacturers: Hoffman, Saginaw, Lehman, or equal.

- B. Cabinet Fronts: Steel, surface-type with screw cover front, concealed hinge and flush lock. Finish in white baked enamel.

2.03 FABRICATION

- A. Shop assembled enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.
- B. Provide conduit hubs on all enclosures.
- C. Provide protective pockets inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.
- D. Provide gasketed surfaces for all enclosure and cabinet doors and covers.

2.04 ENCLOSURE RATING

- A. Cabinets and enclosures shall be rated as listed below, unless noted otherwise on the drawings:
 - 1. Indoor: NEMA 12, steel.
 - 2. Outdoor, corrosive or wet location: NEMA 4X, stainless steel.
 - 3. Hazardous locations: NEMA 7, cast iron.

2.05 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

- A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards. Labels shall include, but not be limited to, the following items.
 - 1. Arc-flash boundary.
 - 2. Flash hazard category (0-4).
 - 3. Minimum arc rating (cal/cm^2).
 - 4. Required personal protective equipment.
- B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install cabinets and enclosures plumb. Anchor securely to wall and structural supports at each corner, minimum.
- B. All cabinets and enclosures shall be labeled with permanent labels (not adhesive type). Permanent labels shall include painted, stencil-type labels or engraved laminated nameplates (4-inch by 4-inch minimum size).
- C. Provide accessory feet for free-standing equipment enclosures.

- D. Install trim plumb.
- E. All cabinets and enclosures attached to building surfaces which may be damp shall be spaced out to avoid rust and/or corrosion. All boxes in damp locations shall be on 1-inch standoffs. Damp locations shall include, but not be limited to, all basement areas, exterior locations, garage areas, all wet wells and drywells, all areas below grade, and any washdown areas.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Conduit and equipment supports.
 - 2. Fastening hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2–PRODUCTS

2.01 MATERIAL

- A. Support Members:
 - 1. 316 stainless steel, fiberglass, or PVC in exterior locations, NEMA 4X areas, and Class I, Division 1 areas.
 - 2. Galvanized steel in all other areas.
- B. Hardware:
 - 1. Stainless steel in exterior locations, NEMA 4X areas, and Class I, Division 1 areas.
 - 2. Galvanized steel in all other areas.
- C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors. Do not use spring steel clips and clamps.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces.
- C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- D. Do not use powder-actuated anchors.

- E. Do not drill structural steel members.
- F. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring lock washers under all nuts.
- G. In wet locations install free-standing electrical equipment on concrete pads. Anchor all equipment to adjacent walls and caulk.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- I. Do not use chain hangers.
- J. All welds shall be continuous and ground smooth.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Nameplates.
 - 2. Labeling tags.
 - 3. Wire markers.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.
- B. Provide schedule for nameplates and labeling tags with shop drawings. Reference drawings for type used.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Type “A” Nameplates:
 - 1. Use:
 - a. Motor starters.
 - b. Each separately mounted circuit breaker or disconnect switch.
 - c. Each device in main distribution panels.
 - d. Each device in Motor Control Centers.
 - e. SCADA System computers.
 - f. TVSS units.
 - g. Cabinets, enclosures, pull, and junction boxes.
 - 2. Size: 2-inch by 3-inch.
 - 3. Material: 3-layer laminated Micarta.
 - 4. Background Color: Black.
 - 5. Character Color: White.
 - 6. Character Size: 1/4-inch.
 - 7. Engraving: See MCC schedule and one-line for labels or as requested by ENGINEER. Labels shall include equipment numbers and description (i.e. SCAL-60-01 Fluoride Scale).
 - 8. Mounting Location: Front exterior.
- B. Type “B” Nameplates:
 - 1. Use: Standby power systems as in “A” above.
 - 2. Size: 2-inch by 3 5/8-inch.
 - 3. Material: 3-layer laminated Micarta.

4. Background Color: Red.
 5. Character Color: White.
 6. Character Size: 1/4-inch.
 7. Engraving: See MCC schedule and one-line for labels or as requested by ENGINEER.
 8. Mounting Location: As requested by ENGINEER.
- C. Type "C" Nameplates:
1. Use:
 - a. Motor Control Centers.
 - b. Supervisory Control Centers.
 - c. Panelboards.
 - d. Transformers.
 2. Size: 4-inch by 4-inch.
 3. Material: 3-layer laminated Micarta.
 4. Background Color: Black.
 5. Character Color: White.
 6. Character Size: 2 1/4-inch.
 7. Engraving: Equipment label, Emergency to be white with red letters. Label shall include equipment number with a description (i.e. LP-10-01 First Floor Power).
 8. Mounting Location: Equipment: Top wireway.
- D. Type "D" Nameplates:
1. Use: Identify control stations, thermostats, etc.
 2. Size: 3/8-inch by 2-inch.
 3. Material: 3 Layer Laminated Micarta.
 4. Background Color: Black.
 5. Character Color: White.
 6. Character Size: 1/8-inch.
 7. Engraving: Control station number and equipment description (e.g. T-15-01 Chlorine Room).
 8. Mounting Location: Device front at top.
- E. Type "F" Nameplates:
1. Use: Identify Supervisory Control Center communication and I/O modules.
 2. Size: As necessary.
 3. Material: 3-layer laminated Micarta.
 4. Background Color: Black.
 5. Character Color: White.
 6. Character Size: 1/8-inch.
 7. Engraving: Operating function.
 8. Mounting Location: As requested by ENGINEER.
- F. Type "H" Nameplates:
1. Use:
 - a. Electrical Distribution System.
 2. Size: As necessary.
 3. Material: 3-layer laminated Micarta.
 4. Background Color: Yellow.
 5. Character Color: Black.
 6. Character Size: 3/16-inch.
 7. Engraving and Mounting Location: As requested by ENGINEER.
- G. Type "I" Nameplates:

1. Use: Operator instructions.
2. Size: As necessary.
3. Material: 3-layer laminated Micarta.
4. Background Color: Yellow.
5. Character Color: Black.
6. Character Size: 3/16-inch.
7. Engraving and Mounting Location: As requested by ENGINEER.

H. Labeling Tags:

1. Use: Field-mounted devices (valves, limit switches, etc.).
2. Size: 1-inch by 3-inch.
3. Material: 1/32-inch-thick stainless steel.
4. Character Size: 1/4-inch.
5. Engraving: As requested by ENGINEER.

2.02 WIRE MARKERS

- A. Wire markers shall be permanently attached sleeve or heat shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wrap around numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.
- B. Wire markers shall be specifically printed for this project using permanently attached computerized adhesive tags, such as Brady IDXPRT labeling printer with self laminating vinyl, permasee sleeve heat-shrink polyolefin, or equal. Hand-written markers are not acceptable.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Affix nameplates with stainless steel screws in outdoor locations and stickyback adhesive in indoor locations.
- D. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8-inch hole to accommodate wire tie.
- E. Prepare and install neatly typed directions in all panels including existing panels where work is done under this Contract.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor, including neutral and spare conductors, in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Spare conductors shall have control wire number or shall indicate termination point of wire.

- B. Conductors in pull boxes, motor control centers, supervisory control panels, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system.

END OF SECTION

SECTION 16412

TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Service entrance devices.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/IEEE C62.41 and C62.45.
- B. NFPA 70, and 75.
- C. UL 1449, most recent issue.

1.03 QUALITY ASSURANCE

- A. Manufacturers of transient voltage surge suppressors. Firms regularly engaged in the manufacture of these products of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide TVSS devices which have been listed and labeled by Underwriters' Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300—Submittals.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1. Test reports certified by the manufacturer shall be provided to ENGINEER upon request for each model submitted.

1.05 WARRANTIES

- A. Manufacturer shall provide a 10-year warranty from the date of substantial completion to cover repair or replacement of the device. This warranty shall exclude plug-in modules and coordinated fuses, both of which shall carry a lifetime warranty.

PART 2–PRODUCTS

2.01 GENERAL

- A. These specifications describe the electrical and mechanical requirements for high energy transient voltage (service entrance and branch panels) surge suppressors. The specified surge protective device shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-1991 location Category C3 (service entrance). Testing shall be per ANSI/IEEE C62.45–1992 using ANSI/IEEE C62.41 Category C3 waveforms and amplitudes.
- B. The system individual units shall be UL listed under UL1449 Standard for Transient Voltage Surge Suppression (TVSS) and the surge ratings shall be permanently affixed to the TVSS.
- C. Operating Temperature: Operating temperature range shall be -40 to +55°C (-40 to 131°F).
- D. Storage Temperature: Storage temperature range shall be -40 to +85°C.
- E. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% noncondensing relative humidity.
- F. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.
- G. Design Life: >15 years.
- H. Operating Voltage: Maximum continuous operating voltage shall be no less than 115% of the nominal rated line voltage.
- I. Power Frequency: The power frequency range shall be at 47 to 440 Hertz.
- J. All TVSS devices shall be MOV type. Noise filtering capabilities shall be provided as an option for the devices specified herein.

2.02 SERVICE ENTRANCE DEVICES

- A. The maximum surge current capacity per phase of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least: 1 Event at 160 kA. The surge life (8/20) shall be at least 6kA for 10,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses.

- B. The suppressor shall be capable of interrupting a 65 kA, short circuit current delivered from the AC power line. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
- C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the manufacturer's installation notes for best performance.
- D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple 40 mm metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector shall provide redundant protection within each phase module with two replaceable fuses per module.
- E. Red and green solidstate LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.
- F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Normally open and normally closed contacts shall be provided with voltage and current limiting protection.
- G. The system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.
- H. A front panel built-in surge counter shall be included to record the number of suppression events. A switch shall be provided for resetting the counter.
- I. A 14 gauge, NEMA Type 4, steel enclosure, with corrosion-resistant hardware shall be provided for the unit.
- J. Service entrance devices shall be as manufactured by MCG, SF160M Series, or equal.

2.03 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

- A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards.
- B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3-EXECUTION

3.01 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation and maintenance instructions and all national and local codes.
- B. Each device shall be installed in parallel with the protected equipment. No series connected protective elements shall be used. Each installed device shall be fed by a 3-pole, 30-amp circuit breaker in the protected panel.
- C. Units shall be installed as close as practical to the electrical panel. Low impedance cabling furnished by the manufacturer shall be utilized for service entrance devices.
- D. Manufacturer shall provide protection modules and coordinated fuses under a no-cost lifetime replacement warranty.

END OF SECTION

SECTION 16420

ELECTRICAL SERVICE SYSTEM

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Utility company.
 - 2. Secondary service characteristics.
 - 3. Definitions.
 - 4. Sequencing, scheduling.
 - 5. Underground electrical service.
 - 6. Telephone service.
- B. Allowances: CONTRACTOR shall INCLUDE in the Bid the cost of the following items specified in this Section. Refer to the individual sections listed below for a complete description of the Work required:
 - 1. Electric Utility Service Entrance-Section 1.06—Underground Overhead Electrical Service.
 - 2. Telephone Utility Service Entrance-Section 1.07-Telephoen Service.
- C. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 UTILITY COMPANY

- A. The Utility Company is AmerenCILCO.

1.03 SECONDARY SERVICE CHARACTERISTICS

- A. The secondary service will be 277/480 volt, 4 wire, 3 phase for power and 120/208 volt, 4 wire, 3 phase for lighting.

1.04 DEFINITIONS

- A. Service—As defined in the NEC, Article 100.
- B. Primary Voltage—Above 600 volts.
- C. Secondary Voltage—600 volts and below.

1.05 SEQUENCING, SCHEDULING

- A. Provide electrical service system, except the Utility Company will furnish the utility transformer pad ground rods and ground conductor as well as the metering to be installed by CONTRACTOR.

1.06 UNDERGROUND ELECTRICAL SERVICE

- A. Provide complete underground electrical service except for items furnished and installed by the Utility Company.
- B. Duct Lines: Rigid steel conduit, heavy wall seamless tubing with hot-dipped galvanized coating.
- C. Duct Lines: PVC conduit, heavywall rigid, type 40 listed for underground encased applications.
- D. Coordinate the electrical service with the Utility, and all Utility costs shall be included in the lump sum bid. An allowance of \$7,500 for Utility costs shall be included in the lump sum bid to be adjusted at final payment in accordance with actual utility charges.

1.07 TELEPHONE SERVICE

- A. Coordinate the telephone service with Verizon. A total of one independent telephone line for use with the SCADA system will be required in addition to the existing phone lines. An allowance of \$2,000 shall be included in the Lump Sum Bid to be adjusted at final payment in accordance with actual utility charges.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 INSTALLATION

- A. Trench and backfill for duct lines and manholes in accordance with Division 2–Site Work.
- B. Install top of duct lines a minimum of 2 feet below finish grade and pitched for drainage.

END OF SECTION

SECTION 16429

LOW-VOLTAGE DISTRIBUTION SWITCHBOARDS (GROUP MOUNTED)

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: CONTRACTOR shall provide where shown on the drawings a free-standing, dead-front-type low-voltage distribution switchboard utilizing group mounted circuit protective devices as specified herein and as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. The low-voltage distribution switchboard and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards of the following:
 - 1. NEMA PB-2.
 - 2. UL Standard 891.

1.03 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of electrical equipment, cable, and wire products of the types and ratings necessary, whose products have been in satisfactory use in similar service for not less than five years. The manufacturer shall be ISO 9000, 9001, or 9002 certified.
- B. Installer: A firm with at least five years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.
- E. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material, construction, and testing, where applicable.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300—Submittals.

B. The following information shall be submitted:

1. Master drawing index.
2. Front view elevation.
3. Floor plan.
4. Top view.
5. Single line.
6. Schematic diagram.
7. Nameplate schedule.
8. Component list.
9. Conduit entry/exit locations.
10. Assembly ratings including:
 - a. Short-circuit rating.
 - b. Voltage.
 - c. Continuous current.
11. Major component ratings including:
 - a. Voltage.
 - b. Continuous current.
 - c. Interrupting ratings.
12. Cable terminal sizes.
13. Product data sheets.

1.05 REGULATORY REQUIREMENTS

- A. The low voltage switchboard shall be UL labeled.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products under provisions of Section 01600—Materials and Equipment.
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions.

PART 2—PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Low-voltage distribution switchboards shall be manufactured by Cutler-Hammer Pow-R-Line C, Square D, or equal, as approved by ENGINEER and in accordance with the substitutions under provisions of the General Conditions. All equipment specified in this section and provided by CONTRACTOR shall be by the same manufacturer.
- B. The drawings and specifications were prepared based on Cutler-Hammer. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 RATINGS

- A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 42,000 amperes symmetrical at rated voltage.

- B. Voltage rating shall be as indicated on the drawings.

2.03 CONSTRUCTION

- A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
- B. All sections of the switchboard shall be front aligned with depth as required. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall.
- C. The assembly shall be provided with adequate lifting means.
- D. The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.
- E. Provide Seismic-tested Equipment as follows: The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) for Zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, IBC: a peak of 2.45 g's (3.2-11 Hz), and a ZPA of 0.98 g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

2.04 BUS

- A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65°C over a 40°C ambient (outside the enclosure).
- B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings. If neutral bus is not required, provide neutral landing lugs.
- C. A copper ground bus (minimum 1/4-inch by 2-inch) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.
- D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.05 WIRING/TERMINATIONS

- A. Small wiring, necessary fuse blocks, and terminal blocks within the switchboard shall be provided as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75°C of the size as indicated on the drawings.

- C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.
- D. All control wire shall be Type SIS, bundled, and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections except where saddle-type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminals blocks with suitable numbering strips. Wire markers shall be permanently attached wrap-around adhesive, sleeve or heat shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wrap-around numbers (such as Brady preprinted markers) are not acceptable.

2.06 MOLDED CASE CIRCUIT BREAKERS

- A. Main and feeder protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics and shall be Cutler-Hammer, or equal.
- B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy, and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- C. Circuit breakers shall have a minimum symmetrical interrupting capacity of 42,000 amperes RMS at rated voltage.
- D. Feeder circuit breakers 400-ampere frame and below shall be Cutler-Hammer with thermal-magnetic trip units and inverse time-current characteristics.
- E. Main circuit breaker and feeder circuit breakers larger than 400-ampere frame shall be Cutler-Hammer with microprocessor-based rms sensing trip units.
 - 1. Molded case circuit breaker microprocessor-based tripping system shall consist of three current sensors, a trip unit, and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.
 - 2. An adjustable trip setting dial mounted on the front of the trip unit, or interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be adjustable. Rating plugs shall be interlocked so they are not interchangeable between frames and interlocked so that a breaker cannot be closed and latched with the rating plug removed.
 - 3. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.
 - 4. When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override.

5. Where internal ground fault protection is specified, adjustable settings shall not exceed 1,200 amperes.
 6. Breakers shall have built-in test points for testing the long time delay, instantaneous, and ground fault functions of the breaker by means of a test set. Provide one test set capable of testing all breakers 400 ampere frame and above.
 7. System coordination shall be provided by the following microprocessor-based, time-current, curve-shaping adjustments:
 - a. Adjustable long time setting.
 - b. Adjustable short time setting and delay with selective curve shaping.
 - c. Fixed high instantaneous override function.
 - d. Adjustable ground fault setting and delay.
 8. Trip units shall be microprocessor-based RMS sensing type Digitrip RMS 510.
- F. Main circuit breakers shall be UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
- G. Ground fault protection shall be provided where indicated and for all breakers 1000 amps and larger.
- H. Breakers used in service entrance applications shall be service entrance rated.
- I. Feeder breakers shall be 100% rated as shown on the drawings.

2.07 MISCELLANEOUS DEVICES

- A. Control power transformers with primary and secondary protection shall be provided as required for proper operation of the equipment.
- B. All control power within the switchboard assembly shall be 120 volt and shall be provided from control power transformers integral to the switchboard.
- C. Provide a transient voltage surge suppression device (TVSS) as specified in Section 16412–Transient Voltage Surge Suppression (TVSS) on the load side of the main circuit breaker in this switchboard. Provide 30 amp, 3-pole circuit breaker for the TVSS as specified.
- D. Provide metering in service entrance section. Metering shall have ability to display phase current, Voltage L-L and L-N, Power (real, reactive, apparent), Energy (watt-hours, VAR-hours, VA-hours), frequency, power factor, minimum/maximum values, and system demand. Metering shall be UL listed. Meter shall provide power failure output for remote indication at the SCADA system. Meter shall be Cutler-Hammer IQ 200 Series, or equal.

2.08 ENCLOSURES

- A. NEMA 1 gasketed enclosure.

2.09 NAMEPLATES

- A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, white characters on black background, and secured with screws. Characters shall be 3/16-inch-high, minimum. Nameplates shall give item designation and equipment served

as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage and ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

- B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.10 FINISH

- A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

2.11 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

- A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards.
- B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3-EXECUTION

3.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard shall be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2,200 volts for one minute between live parts and ground and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1,500 volts for one minute between live parts and ground.
- B. The manufacturer shall provide three certified copies of factory test reports.
- C. Prior to shipment, the switchboard shall be factory inspected by ENGINEER. A manufacturer's representative shall coordinate and be available for the factory inspection. Any changes required as a result of the factory inspection which are necessary to meet the intent of the drawings and specifications shall be made prior to shipment of the switchboard.

3.02 INSTALLATION

- A. CONTRACTOR shall install all equipment per the manufacturer's recommendations and the contract drawings.

- B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to CONTRACTOR-supplied floor sills to be set level in concrete per manufacturer's recommendations. All necessary hardware to secure the assembly in place shall be provided by CONTRACTOR.

3.03 STARTUP AND TRAINING

- A. CONTRACTOR shall include eight hours of startup by a certified, factory-trained engineer. Startup services shall include, but not be limited to, inspection of CONTRACTOR installation and functional testing of the switchgear. On-site time shall be over and above the cost of travel and travel time to the site.
- B. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal workday (not including startup) at a jobsite location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly, circuit breakers, and major components within the assembly.

3.04 MANUFACTURER'S CERTIFICATION

- A. A certified test report of all standard production tests shall be available to ENGINEER upon request.

3.05 FIELD ADJUSTMENTS

- A. CONTRACTOR shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.
- B. Necessary field settings of devices, adjustments, and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by CONTRACTOR at no additional cost to OWNER.

END OF SECTION

SECTION 16440

DISCONNECT SWITCHES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Disconnect switches.
 - 2. Fractional HP motor switches.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. NEMA KS 1–Enclosed Switches.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.
- B. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short-circuit.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS–DISCONNECT SWITCHES

- A. Disconnect Switches: Square D, Class 3110 or Cutler-Hammer, Type DH.
- B. Manual Motor Switches: Square D, Class 2510 Type K or Cutler-Hammer B330.
- C. Substitutions: Under provisions of the General Conditions.

2.02 DISCONNECT SWITCHES

- A. Nonfusible Switch Assemblies: NEMA KS 1; heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle lockable in “Off” position.
- B. Manual Motor Switches: Where noted on the drawings, manual motor switches shall be provided for three phase motors with circuit rating of 30 amps or less. Manual motor switches shall have toggle operator without overload protection or indicator light. Provide cover plate for all switches to meet the finish or classification of the space. Cover plate shall have provisions for locking the switch in the On or Off position.

2.03 SINGLE PHASE MOTOR SWITCHES (2 HP OR LESS)

- A. Where noted on the drawings, motors rated 2 HP or less for operation on 120V or 240V, single phase, shall be provided with a specification grade wall switch as disconnecting means. See Section 16141-Wiring Devices for additional information.

2.04 ENCLOSURES

- A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the drawings:
 - 1. Indoor: NEMA 1, steel.
 - 2. Outdoor, corrosive or wet location: NEMA 4X, stainless steel.
 - 3. Hazardous locations: NEMA 7, cast iron.

2.05 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

- A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards.
- B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Provide disconnect switches where indicated on the drawings.
- B. Provide toggle switch for each single phase fractional horsepower motor where indicated on the drawings.
- C. Disconnects indicated to have auxiliary contacts shall have contacts by the disconnect manufacturer. Power to auxiliary contacts at field devices shall be removed when the disconnect is in the "Off" position.
- D. Disconnect enclosures that house wiring powered from a source separate from the motor power wiring (e.g. Mini-cas wiring) shall have a nameplate installed on the front of the disconnect indicating that power may be present at the motor when the disconnect is in the Off position.

END OF SECTION

SECTION 16450

SECONDARY GROUNDING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Power system grounding.
 - 2. Electrical equipment and raceway grounding and bonding.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.
- B. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Ground Rods: Copper bonded, 5/8-inch-diameter, minimum length 10 feet.
- B. Ground Connections Below Grade: Exothermic type-Cadweld, or equal.
- C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, KG, GBL, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Provide a separate, insulated equipment grounding conductor and neutral conductor (where applicable) for each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.
- B. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and cold water plumbing systems.
- C. Connect grounding electrode conductors to metal water piping, metal frame of building or structure, and structural reinforcing bars using suitable ground clamps. Make connections to flanged piping at a point ahead of meter or service shutoff valve.

- D. Ground system, transformer neutrals and equipment as required by code and local ordinances.
- E. All feeder neutrals shall be connected to neutral at only one point in the MCC or switchgear.
- F. All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.
- G. Water system grounds and a minimum of three ground rods at 15-foot separations near service entrance of each building shall be provided and ground wires must attach to point ahead of meter or service shutoff valve. These shall be connected to ground bus by conductors sized to code requirements. The above are minimum requirements.
- H. All service entrance ground conductors shall be installed in PVC conduit. All conduit bends shall be made using sweeping elbows. Conduit bodies and 90° bends are not allowed.
- I. Include ground for grounded receptacles, light fixtures, motors, and equipment items shown on drawings.
- J. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base, lighting fixture, or equipment frame to conduit system.
- K. Provide a separate grounding conductor system for the grounding of all lighting fixtures and devices installed in the same conduit as the branch circuit conductors. Ground conductors shall be individually connected at each fixture or device.
- L. All equipment in NEMA 4X areas that are fed from circuits in PVC conduit shall be provided with a separate green ground wire that is terminated at the metallic conduit system and the equipment.
- M. Separately derived systems as defined by the National Electric Code shall be grounded as such. This shall include, but not be limited to, 4-wire transformers.

3.02 INSTRUMENT GROUND SYSTEM

- A. Provide instrument ground system as required in Section 16930-Instrument Wire and Cable of these Specifications.

3.03 TESTING

- A. Inspect grounding and banding system conductors and connections for tightness and proper installation.
- B. Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three point "fall of potential" test. The test results shall include a graph of the results, plus a diagram of the testing layout. A single point of measurement is not acceptable, and the two point method of ground system testing shall only be used where there is no or insufficient "open earth" area to use the three point Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms. All ground system tests shall be witnessed by ENGINEER.

- C. The test meter shall be Associated Research Vibroground test set with null balance, James A. Biddle Megger Earth-Tester-Null Balance, or approved equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test report.
- D. Individual ground rods when tested separately shall be isolated from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.
- E. Multiple ground rod grids shall be isolated from all metallic connections, such as from grid under test to other grounded structures and electrical system neutrals.
- F. Provide test report using the attached form, 16450-1. Each ground grid, including service entrance transformers, motor control centers, etc., shall have a form submitted.

END OF SECTION

FORM 16450-1

GROUND ROD RESISTANCE TO EARTH TEST RECORD

1. DATE _____
2. PROJECT NAME _____
3. LOCATION OF TEST _____
4. DRAWING NO. _____
5. GROUND ROD TYPE _____
DIAMETER _____
LENGTH _____
6. TEST METHOD _____
INSTRUMENT TYPE _____
SERIAL NO. _____
7. REQUIRED MAXIMUM RESISTANCE TO EARTH _____
8. MEASURED RESISTANCE TO EARTH
ROD 1 _____
ROD 2 _____
ROD 3 _____

TEST PERFORMED BY: _____
Signature

TEST WITNESSED BY: _____
Signature

SECTION 16470

PANELBOARDS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Lighting and appliance panelboards.
 - 2. Power distribution panelboards.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of electrical equipment, cable, and wire products of the types and ratings necessary, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical equipment installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.
- E. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material, construction, and testing, where applicable.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300—Submittals.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All electrical equipment and material shall be received and stored with the factory tamper-proof wrapping intact. Provide factory-wrapped waterproof flexible barrier material for factory-packaging of equipment and material to protect against physical damage in transit. Do not install damaged equipment or material; remove from project site. Store equipment in factory coverings in a clean, dry indoor space which provides protection against weather.

PART 2-PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Square D.
- B. Cutler-Hammer.
- C. Substitutions: Under provisions of the General Conditions.
- D. The drawings and specifications were prepared based on Cutler-Hammer. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 PANELBOARDS

- A. Lighting and appliance and power distribution panelboards shall be provided as indicated on the drawings and as scheduled. Panelboards shall be factory assembled and constructed in accordance with latest NEMA, UL, and NEC requirements and shall bear the UL label. Panelboard cabinets, including boxes and fronts, shall be code gauge galvanized steel. Front covers shall be hinged to allow access to wiring gutters without removal of panel trim (door-in-door type). All fronts shall be complete with cylinder-type lock and catch, and all cylinders shall be keyed alike. Provide two keys per panelboard to OWNER.
- B. Gutter and wiring space shall be provided according to NEMA and UL standards.
- C. Panelboards shall have full ampacity bussing throughout and shall be full-size in regard to number of possible pole spaces. All lighting and appliance panels shall have 42 poles per section, except where shown to be less. Power distribution panels shall have number of poles as scheduled. Panelboards shall be identified with phases reading left to right and circuits alternately numbered left to right, odd numbers on the left, even numbers on the right.
- D. Panelboards shall have copper bussing. Provide copper ground buss in all panelboards.
- E. Lugs for incoming feeders shall be UL listed for use with copper conductors. Lugs shall be sized by CONTRACTOR in accordance with feeder sizes shown. Main lugs or main breakers shall be top or bottom mounted to coordinate with incoming feeder entrance location. Location shall be selected by CONTRACTOR.
- F. Circuit breakers shall be quick-make, quick-break, with thermal magnetic trip bolt-on-type. Multipole breakers shall have common internal trip, UL listed as multipole units; handle ties are not permitted. All breakers shall be of the same manufacturer as the panelboard and provided at ampere capacity as scheduled.
- G. Lighting and Appliance Panelboards shall be provided as follows (types listed are Cutler-Hammer):

Type	Maximum Voltage	Maximum Bus Amps	Maximum Brk. Amps	Minimum I.C.
Pow R-Line 1a	240	400	100	10,000
Pow R-Line 2a	277/480	400	100	14,000

- H. All panelboards scheduled with main circuit breakers shall be individually mounted main circuit breaker panels. Main circuit breakers installed in the location of branch circuit devices (branch mounted mains) are not acceptable.
- I. Provide spare parts as described in Section 16951–Spare Parts.

2.03 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

- A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards.
- B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3–EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which work is to be installed and notify CONTRACTOR of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Panelboards shall be provided as indicated. Final locations, sizes, and mounting of panelboards shall be reviewed with ENGINEER prior to installation.
- B. Each panelboard shall have a typewritten circuit schedule provided on the inside cover. This schedule shall be covered with clear plastic in a metal frame and shall include room numbers, room name, and area or item served by each branch circuit. Room numbers used shall be those used by OWNER, except as otherwise requested by ENGINEER.
- C. Prior to final inspection, clean all panelboard interiors, adjust trims, covers, hinges and locks, and refinish covers to original condition.
- D. Panel trim to have enamel finish, as selected by OWNER.

- E. Balance load on all panelboards so phases are balanced to 15% of each other. Reconnect or redistribute circuits and/or circuit breakers to achieve balanced condition. Submit ammeter readings for all panelboard feeders indicating normal operating load and phase balance.

END OF SECTION

SECTION 16480
MOTOR CONTROL

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Motor control devices, accessories, and general requirements.
 - 2. Manual motor starters.
 - 3. Magnetic motor starters.
 - 4. Variable frequency drives.
 - 5. Motor control centers.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/NEMA ICS 6–Enclosures for industrial controls and systems.
- B. NEMA AB 1–Molded case circuit breakers.
- C. NEMA ICS 2–Industrial control devices, controllers, and assemblies.
- D. NEMA ICS 18-Motor Control Centers.
- E. NEMA KS 1–Enclosed switches.
- F. NEMA PB 1–Panelboards.
- G. NEMA PB 1.1–Instruction for safe installation, operation, and maintenance of panelboards rated 600 volts or less.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.
- B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

1.04 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01300–Submittals.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 DELIVERY, STORAGE, AND HOLDING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.06 SPARE PARTS

- A. Furnish spare parts for equipment specified herein as listed in Section 16951–Spare Parts.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Motor control devices, motor starters and motor control centers shall be as manufactured by Allen Bradley, or equal, as approved by ENGINEER and in accordance with substitutions under provisions of the General Conditions. Variable frequency drives shall be as manufactured by Toshiba. All equipment specified in this section and provided by CONTRACTOR shall be by the same manufacturer other than the variable frequency drives.
- B. The drawings and specifications were prepared based on Toshiba for variable frequency drives and on Allen Bradley for all other equipment in this section. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS

- A. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts minimum, in addition to seal-in contact, or as necessary.
- B. Pushbuttons: NEMA ICS 2; heavy-duty, oil-tight, (30 mm) as shown on the drawings.
- C. Indicating Lights: NEMA ICS 2; heavy-duty, oil-tight, (30 mm), push-to-test type as shown on the drawings.
- D. Selector Switches: NEMA ICS 2; heavy-duty, oil-tight, (30 mm) as shown on the drawings.
- E. Timing Relays: UL Listed with On and Timing Out LEDs.
- F. Contactors: NEMA ICS 2. All contactors for starters specified herein shall be NEMA rated. IEC contactors are not allowed.
- G. Control Power Transformers: 240/120 volt secondary.

- H. Elapsed Time Meters: Redington/Engler 710 series, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.
- I. Relays for motor control circuits, hard-wired control logic, and for loads less than 10 amps shall be general purpose, industrial, square base relays. Relays for lighting circuits and small motor loads shall be industrial, electrically held power relays. Relays shall meet the following requirements.
 - 1. General purpose relays.
 - a. Configuration: DPDT or 3PDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120VAC.
 - d. Contact rating: 15A, minimum; $\frac{3}{4}$ HP.
 - e. Operating life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen Bradley, 700-HB, or equal.
 - 2. Power relays.
 - a. Configuration: Electrically held, 2-12 poles.
 - b. Mounting: DIN rail, square base.
 - c. Voltage: 120VAC.
 - d. Contact rating: 20A continuous; 1 HP.
 - e. Operating life: 10 million cycles.
 - f. UL listed.
 - g. NEMA rated.
 - h. Manufacturer: Allen Bradley, 700-PK, or equal.
- J. All starters shall be equipped with the auxiliary devices to meet the requirements of the plans and specifications. Each starter operating at other than 120 volt single phase shall be equipped with a control transformer providing 120 volt secondary for control power. Transformer shall have fused primary connections and shall be sized per manufacturer's recommendations. Coils and pilot lights in all starters shall be 120 volts.
- K. Wall-Mounted and MCC Enclosures: NEMA ICS 6:
 - 1. Enclosures in indoor, dry locations shall be NEMA 1 gasketed.
 - 2. Enclosures in indoor damp or wet locations, outdoor locations, or locations below grade shall be NEMA 4X, stainless steel.
 - 3. Enclosures in hazardous locations shall be NEMA 7, cast iron.
 - 4. Starters and disconnect devices for motors shall be installed in common enclosures, combination type, with all accessories such as terminal blocks, push-to-test pilot lights, and H-O-A switches, mounted in the enclosure fronts.
 - 5. All wiring within starter enclosures shall be landed on terminal blocks. This shall include internal control wiring, field wiring, and any spare or unused wiring.

2.03 MANUAL MOTOR CONTROLLERS

- A. Where noted on the drawings, controllers for motors rated 2 HP or less, for operation at 120V or 240V single phase, shall be specification grade wall switches as specified in Section 16141-Wiring Devices.

2.04 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Each magnetic starter shall be equipped with a solidstate overload relay, Allen Bradley E1 Plus, Bulletin 592-EE, or equal. Starters for submersible pumps, mixers, and motors installed outdoors shall include ground fault protection.
- B. Full-Voltage Starting: Reversing or Nonreversing type as shown on the drawings.
- C. Coil Operating Voltage: 120 volts, 60 Hz.
- D. Size: NEMA ICS 2; size as shown on drawings.
- E. Overload relays shall have the following features:
 - 1. Self-powered, solid-state.
 - 2. Up to 5:1 adjustments.
 - 3. DIP switch settings for trip class and reset mode.
 - 4. Current transformers (no heaters).
 - 5. Thermal memory.
 - 6. Visible trip indicators.
 - 7. Phase loss protection.
 - 8. Low energy consumption.
 - 9. Ground fault protection as specified herein.
- F. Combination Motor Starters: Combine motor starters with molded case circuit breakers.
- G. Through-the-door overload reset pushbuttons shall be provided for all magnetic starters installed in motor control centers and combination motor starters.

2.05 VARIABLE FREQUENCY DRIVES—TOSHIBA H9

- A. A variable frequency drive (VFD) system consists of enclosed inverter, motor, and any additional system control as specified.
- B. System Operating Conditions:
 - 1. 480 VAC $\pm 10\%$ for drives 20 horsepower and above.
 - 2. 480 VAC $+5/-10\%$ for drives below 20 horsepower.
 - 3. 3 phase, 3 wire, any phase sequence.
 - 4. 60 Hz $\pm 5\%$.
 - 5. Storage temperature -10°C to $+65^{\circ}\text{C}$.
 - 6. Operating temperature -10 to $+40^{\circ}\text{C}$.
 - 7. Altitude: 2,200 feet above sea level maximum.
 - 8. Humidity: 95% noncondensing maximum.
- C. Variable Frequency Unit:
 - 1. Conform to NEMA and NEC standards.
 - 2. UL approved.
 - 3. Input:
 - a. Withstand without component failure, line voltage transients up to 3,000 volts per ANSIC 37.904–1974.

- b. Design to include DC bus chokes (2) to be used in conjunction with one or more capacitors. The DC bus chokes are to be incorporated in the design to minimize line side harmonics. Magnetic only designs need to include line filters to limit harmonics to a value no greater than in a system using dual DC bus chokes.
 - c. Include MOV line side protection.
 - d. Inverter input to have a .95 PF or better throughout the speed range.
 - e. Units shall be capable of operating attached to the same power bus without affecting each others operations. If operational problems occur, an isolation transformer shall be added to each drive at no additional Contract cost.
 - f. Three percent line reactors (drives smaller than 200 HP).
 - g. Drives larger than 40 HP shall include fuses on the drive input.
 - h. Employ diode bridge rectification and IGBT power switching transistors.
4. Inverter Output:
- a. Match motor specified.
 - b. 3 phase, 3 wire.
 - c. Pulse width modulated wave form.
 - d. Maximum output 460 volts.
 - e. Frequency 2 to 66 Hz.
 - f. Frequency accuracy $\pm 1\%$ of setting at any point in the specified speed range, in a 24-hour period.
 - g. Full load output current shall be rated in excess of the AC motor selected.
 - h. Motor performance:
 - (1) 3% regulation in the manual speed control mode.
 - (2) Normal duty overload rating: 100% continuous current; 120% for 60 seconds.
 - (3) 110% starting torque minimum.
5. AC drive features:
- a. 4-20 mA circuitry mounted on separate printed circuit board to include offset, slope, minimum clamp, separate acceleration and deceleration adjustments from 0 to 3600 seconds. A light emitting diode is to be provided to show signal presence and an internal manual speed potentiometer is to be supplied for simulating the 4-20 mA input for start-up and maintenance. The circuit is to be designed to accept either a positive or negative signal, grounded or ungrounded.
 - b. Current limit circuitry: 0.1 amps to 150% of drive-rated amps.
 - c. Efficiency of the inverter shall be 100% rated speed and load 97% or better.
 - d. Displacement power factor shall be greater than 0.95 lagging over the entire speed range.
 - e. Additional features for constant torque units shall include:
 - (1) IR compensation to provide automatic voltage boost or reduction to optimize both starting torque and system input KW.
 - (2) Slip compensation to provide 0.5% regulation with a 100% load change.
 - (3) Inner current loop regulator.
6. Enclosures:
- a. The VFD shall be furnished with NEMA 1 rated enclosure for wall mounting or for mounting in an MCC structure as indicated on the drawings. MCC structures shall be 91 1/2 inches high by 20 inches deep with a width to accept the unit specified. MCC structure to incorporate bus where field wiring can be reduced.
 - b. Items to be mounted in the VFD structure or structures.
 - (1) Inverter.
 - (2) Incoming door interlocked circuit breaker.

- c. NEMA 4/13 items to be door mounted on the MCC structure/enclosure (for wall mounted drives):
 - (1) Power On light.
 - (2) Control devices, pilot lights, selector switches, etc., as shown on the drawings and specified herein.
 - (3) Interface to the drive shall be via a removable Human Interface Module (HIM) with integral display. This unit is a 6 line by 21-character backlit LCD display with graphics capability. HIM shall be used to display drive operating conditions, fault/alarm indications, and programming information with full text support in multiple languages. The LCD HIM shall be rated IP20/Type 1 and may also be used as a handheld terminal by connecting via a separate cable. The HIM keypads shall include monitor/programming keys, drive operating keys (Run, Stop, Direction, Jog, and Speed Control), a local/remote key with indicating LED, and a rotary encoder.
- d. Provide a minimum of three ground termination points.
- 7. Interlocks:
 - a. Fault contact to terminals.
 - b. VFD run contact to terminals.
- 8. VFD protection:
 - a. Adjustable current limit of 50 to 150% minimum.
 - b. Instantaneous overcurrent trip.
 - c. Electronic ground fault and short-circuit protection to shut down the drive without fuse or component failure. Electronic ground and short-circuit protection to be functional with an input line of 480 VAC plus and minus 10%. The drive manufacturer is to be prepared to demonstrate ground fault and short-circuit protection without the use of an isolation transformer at drive start-up.
 - d. Input thermal-magnetic ambient compensated circuit breaker with a through-the-door interlocked operator.
 - e. Shutdown on loss of any input phase for longer than 3 cycles.
 - f. Output phase sequence to be independent of input phase sequence.
 - g. High or low sustained voltage.
 - h. 120 VAC grounded control circuits.
 - i. Electrically and/or optically isolated low voltage logic.
 - j. Corrosion protection:
 - (1) Gold-plated plugs (male and female section) on all printed circuit boards.
 - (2) Protective board coating for adverse wastewater treatment plant environments.
 - k. MOV converter protection.
 - l. DC bus chokes to minimize line side current harmonics.
 - m. Additional features for constant torque units:
 - (1) I^2T protection to provide 150% current for one minute.
 - (2) Regenerative override protection.
 - n. Power semiconductor heat sink shall contain one or more thermal sensors monitored by the microprocessor to prevent semiconductor damage.
 - o. Interrupt rating shall be at least the same as the MCC interrupt rating.
 - p. Power semiconductor heat sinks shall contain one or more thermal sensors which shall be monitored by the drive controls. Overtemperature condition shall be indicated on the device interface.
- 9. VFD adjustments:
 - a. Maximum speed: 50 to 100%.
 - b. Minimum speed: 0 to 70%.
 - c. Current limit: 50 to 110%, 150% on constant torque units.

- d. Linear acceleration 5 to 600 seconds.
- e. Linear deceleration 5 to 600 seconds.
- f. Output volts/Hz trim.
- g. Voltage boosts.
- h. Additional features for constant torque units:
 - (1) Slip compensation.
 - (2) IR compensation.
- i. All drives shall attempt to restart three times prior to indicating failure.
- j. PWM switching frequency shall be adjustable.
- 10. Inverter digital or LED diagnostic features:
 - a. Current limit signal.
 - b. Regenerative override signal.
 - c. External fault (ex. motor overload).
 - d. Low line voltage.
 - e. High line voltage.
 - f. Current overload.
 - g. High DC bus voltage.
 - h. Current trip.
 - i. Short-circuit.
- 11. Inverter construction:
 - a. Modular construction-ease of maintenance.
- 12. Mount modules on enclosure subpanel.
 - a. Easily accessible from front.
 - b. Interconnect with plugs.
 - c. Construct boards of fire retardant materials in accordance with NEMA grade FR4 specifications.

D. Inverter Quality Control:

- 1. Test all power devices at rated temperature and current for dv/dt, tq, TRR, and leakage.
- 2. Test integrated circuits for programmed parameters at rated temperature.
- 3. Treat printed circuit boards for corrosion resistance.
- 4. Provide gold-plated connections at all points where plugs are used.
- 5. Thermal cycle all printed circuit boards for ten cycles between 0° to 65°C prior to installation in inverter.
- 6. All units to be tested at a rated load and temperature after assembly.

E. The variable speed drives shall be Toshiba H9, or equal, as listed below and on the drawings. All drives shall be by the same manufacturer.

Equipment Number	Description	HP	Normal/Heavy Duty	Constant/Variable Torque
RASP-70-01	RAS Pump No. 1	7.5	Normal	Variable
RASP-70-02	RAS Pump No. 2	7.5	Normal	Variable
RASP-70-03	RAS Pump No. 3	7.5	Normal	Variable
AER-40-01	Oxidation Ditch Aerator No. 1	50	Normal	Constant
AER-40-02	Oxidation Ditch Aerator No. 2	50	Normal	Constant
RSP-30-01	Raw Sewage Pump No. 1	25*	Normal	Variable
RSP-30-02	Raw Sewage Pump No. 2	25*	Normal	Variable

RSP-30-03	Raw Sewage Pump No. 3	30*	Normal	Variable

* See Drawings for motor FLA.

- F. Minimum, maximum, and harmonic skip speed setpoints shall be programmed into each VFD. CONTRACTOR shall coordinate these setpoints with the manufacturer of the equipment served.
- G. Provide manufacturer Protection Plus drive start-up and warranty service for each VFD. Service shall be for three years and include all travel and expenses.

2.06 COMBINATION MOTOR STARTERS

- A. Magnetic motor starters not installed in motor control centers shall be individually mounted as specified herein or noted on the drawings. Starters shall be combined with molded case circuit breakers, and enclosure type shall be as specified herein or noted on the drawings. Control devices and starter components shall be provided as specified herein, or noted on the drawings.
- B. All combination starters shall be factory assembled, wired, and tested. All internal wiring shall be color coded, numbered, and each wire shall be terminated on terminal strips. Schematic and wiring layout drawings, as specified in Section 16941-Controls and Instrumentation Drawings, which show all connections to external devices, a complete bill of materials, and a detailed description of operation, shall be submitted for each piece of equipment.
- C. Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.
- D. Nonfusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in "On" position. A defeater shall be provided to bypass this interlock. Handle lockable in "Off" position.

2.07 MOTOR CONTROL CENTERS

- A. Starters and disconnect devices for motors shall be installed in motor control centers, except where shown to be remote mounted at the motor location. Starters and disconnect devices shall be NEMA rated, sized according to application as specified. All starters and motor control centers shall be manufactured by Allen Bradley, or equal. To assure proper coordination between Section 16940-Controls and Instrumentation, supplied equipment, and the motor control centers, the MCC and NEMA Class IIB drawings shall be supplied as part of the Controls and Instrumentation package described in Section 16940-Controls and Instrumentation. MCC drawings provided by the MCC manufacturer will not be accepted as shop drawing submittals or O&M documents. System Supplier described in Section 16940-Controls and Instrumentation shall wire and test all MCCs for the functions described herein in their shop prior to shipment to the site. Provide one copy of the test report to ENGINEER.
- B. It shall be assumed that colors will be selected by OWNER and shall be nonstandard. Color shall match that specified for control enclosures specified in Section 16940-Controls and Instrumentation.

- C. Auxiliary contacts shall be of quantity necessary for equipment functions.
- D. Motor Control Center design shall be in accordance with latest applicable NEMA standards, shall have been tested to prove adequate mechanical and electrical capabilities, and all major components shall have been individually tested.
- E. Structures shall be totally enclosed dead front, free standing vertical sections, 90 inches high and not less than 20 inches deep for front mounted units and not more than 40 inches deep for units mounted back-to-back. Each vertical section shall have side panels extending the full height of the section to minimize fault propagation to adjacent sections.
- F. Each structure shall contain a main horizontal bus continuously braced within each section, with rating as specified, and vertical buss feeding unit compartments with a minimum rating of 300 amperes, or as necessary for load and feeder breakers. All horizontal and vertical buss of all MCC sections shall be powered regardless of location of transfer switch, unless otherwise noted. All motor control centers shall include a 1/4-inch by 2-inch ground buss. All buss shall be tin-plated copper and braced to withstand short-circuit currents as indicated.
- G. Structures shall contain a horizontal wire-way at the top, isolated from the horizontal bus, and shall be readily accessible by removal of its cover plate. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference and safely accessible without disrupting service.
- H. A vertical wireway with a minimum of 28 square inches of cross sectional area shall be adjacent to each vertical unit compartment and shall be covered by its own door. These vertical wire-ways shall be free of all live parts and shall contain cable supports. Exceptions to this are as shown on the drawings.
- I. All units shall be provided with a mechanical interlock with the unit door to prevent access unless the disconnect is in the off position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect.
- J. Padlocking facilities shall be provided to positively lock the disconnect in either the on or off position with from one to three padlocks whether the door is open or closed.
- K. All unit heights shall be of modular dimensions to allow for unit layout, in any combination, without structural interference. Drawout units shall have a tin-plated stab assembly for connection to the vertical buss; no wiring to these stabs shall extend into the bus compartments. All bus access openings shall be provided with automatic shutters that close when the unit (e.g. starter, breaker) is withdrawn.
- L. Terminal blocks for NEMA Type B assemblies shall be mounted within the unit and shall be factory wired.
- M. Control centers shall be NEMA Class II.
- N. Wiring in Control Centers shall be Type B. All conductors supplying power from the MCC buss to frame-mounted equipment shall have the phases identified as specified in Section 16120-Wire.

- O. Control Centers shall include NEMA 1 gasketed enclosures, unless otherwise noted.
- P. Remote mounted controls shall be heavy-duty, oil-tight (30 mm) of same quality and type furnished in starters and as shown on the drawings. Equipment controls that require a manual reset shall be accomplished through a reset pushbutton on the enclosure or motor control center bucket for the associated piece of equipment.
- Q. Motor control center enclosures must be in accordance with area designations shown on drawings.
- R. All lighting and small power transformers shall be dry-type, Class H insulation, 80°C rise (KVA as indicated on drawings). Coil windings shall be glass taped, dipped in silicone varnish, with two taps 2 1/2% above and below, 480 volt primary, Delta with 120/208 volt, three phase, 4 wire secondary, unless indicated otherwise.
- S. All lighting panelboards shall be Cutler Hammer Pow R-Line 1a, or equal, with 10,000 amp interrupting capacity, at 120/208 volt, three phase, 4 wire with branch breakers as shown on drawings, unless indicated otherwise. Branch mounted main circuit breakers will not be allowed. Minimum size shall be 20 inches wide by 5 3/4 inches deep. All bus shall be copper. Provide laminated, type-written panel schedule for all panelboards at project final completion.
- T. All motor control centers shall be factory assembled, wired, and tested. All internal wiring shall be color coded, numbered, and each wire shall be terminated on terminal strips. Schematic and wiring layout drawings, following the requirements of Section 16941, which show all connections to external devices, a complete bill of materials, and a detailed description of operation shall be submitted for each piece of equipment.
- U. Arrangement and physical locations of all equipment within each motor control center shall be subject to shop drawing approval.
- V. All components shall be properly identified with laminated engraved nameplates with 3/8-inch-high letters (white or black). Nameplates located outdoors shall be mechanically fastened. Nameplates located indoors shall be adhesive type.
- W. Unless otherwise indicated, all conduit entrances shall be through the bottom only.
- X. Motor Control Center interrupting rating shall be as shown on the drawings, minimum 22,000A.
- Y. The main service breaker or main lugs of each MCC shall be provided with a surge protection device and a 3 phase monitor. This surge protection device shall be on the load side of the main and be as specified in Section 16412-Transient Voltage Surge Suppression (TVSS). The 3 phase monitor shall be on the load side of the main and be Timemark *269, or equal. CONTRACTOR to select voltage to match electrical service.
- Z. Main Breaker: Molded case circuit breaker, 3 pole, amperes as shown on the drawings with lugs for 480 volt, 3 phase, 3 wire, 60 cycle entrance. Breakers noted on the drawings to be 100% rated shall be as such. When main breaker is the disconnecting means for a structure, breaker shall be service entrance rated.

2.08 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

- A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers of shock, arc flash and electrocution hazards.
- B. Warning labels shall be self-adhesive vinyl, 4 inches by 6 inches, and be as manufactured by Conney Safety products, or equal.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Provide motor control equipment in accordance with manufacturer's instructions and drawings.
- B. Motor Starter Panelboard Installation: In conformance with NEMA PB 1.1.
- C. Overloads shall be selected on the basis of nameplate horsepower and service factor. Selection of overloads based on horsepower shown on the drawings is not acceptable. If power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current due to improved power factor.
- D. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.
- E. Wireways in motor control centers shall be used only for routing of conductors. Splices are not allowed within wireways.
- F. Motor Data: Provide neatly typed label inside each motor starter enclosure identifying motor served, nameplate horsepower, full-load amperes, code letter, service factor, and voltage/phase rating.
- G. Provide disconnect device for all motors in accordance with applicable codes and as specified. Final location shall be determined in the field.
- H. All motors will be provided by other divisions, ready for connections. This contractor shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.
- I. Provide motor circuit wiring for each motor from the source of supply to the terminal box on the motor including all intermediate connections at devices such as motor starters, disconnect switches, etc.
- J. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits.
 - 1. Motor connection kits shall consist of heat-shrinkable, polymeric insulating material, flame-retarded per IPCEA S-19-81 and IEEE-383-1974 to cover the connection area, and a high dielectric strength mastic to seal the ends against ingress of moisture and

contamination. Bolt connection area shall be kept free of mastics and fillers to facilitate rapid stripping and reentry.

2. Motor connections shall be suitable for continuous operation at conductor temperatures of 90°C.
 3. Motor connection kits shall be as manufactured by Raychem Corporation, or equal.
- K. Provide motor starters as specified for all motors, unless shown or specified that starters or control equipment will be furnished by others.
- L. Provide motor circuit disconnect devices for all motors, unless shown or specified that disconnect devices or starters are furnished with other equipment.

END OF SECTION

SECTION 16500

LIGHTING

PART 1-GENERAL

1.01 SUMMARY

- A. Work includes a complete functional lighting system.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

- A. Underwriters Laboratories: Lighting fixtures shall be manufactured in accordance with the standards of the Underwriters Testing Laboratories and shall bear the "UL" label where practicable. In all cases the lighting fixtures shall be constructed with "UL" listed components.
- B. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electrical Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, and other applicable regulations.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.

1.03 SYSTEM DESCRIPTION

- A. Intent: It is the intent of these specifications to obtain a completed lighting fixture installation by CONTRACTOR. Completed means lamped, cleaned, adjusted, tested, and ready for occupancy and operation in accordance with the above indexed paragraphs and in accordance with the other sections of these Contract Documents. It is the responsibility of CONTRACTOR to point out discrepancies, errors, and other problems.
- B. All lighting fixtures are to be provided complete with all necessary accessories for a proper installation. Catalog numbers shown are basic fixture types, and additional features, accessories, and options specified, scheduled or required, are to be included for all fixtures provided.
- C. Provide lamps for all fixtures of size and type as recommended by the fixture manufacturer and as scheduled.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals. Shop drawings shall include, but not be limited to, the following:
 - 1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall and detail dimensions, finishes, pre-finishes, metal thickness, fabrication methods, support method, ballasts, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents. Manufacturers' catalog cut sheets will not be acceptable.
 - 2. Installation instructions.
 - 3. Certified test data and reports.
 - 4. Maintenance and operating instructions.
 - 5. Shop drawings shall not only clearly indicate the assigned fixture type but also the equipment location.
 - 6. Provide a submittal on all lamp types used. Submittal should include but not be limited to, lumen output, lamp color temperature, and CRI value.
- B. Submit for review samples requested by ENGINEER. The fixtures or components are to be tagged with the project name and the fixture type. Samples will be held by CONTRACTOR available for reference throughout the construction period. Fixtures or components under the contract shall be identical with the accepted samples. No sample (fixture or component) is to be installed on the Project.
 - 1. In the event the submissions are disapproved, the materials will be returned to CONTRACTOR to immediately make a new submission responding to the notations (corrections/revisions) of ENGINEER regarding compliance with the Contract Documents.
 - 2. All charges for these shipments shall be prepaid by CONTRACTOR.
 - 3. The fixture schedule shows the style of the fixture only. CONTRACTOR shall verify the types of ceiling construction prior to releasing fixtures for fabrication and delivery and provide fixtures adapted to the ceiling construction used.

1.05 QUALITY ASSURANCE

- A. Standards: Materials, equipment, and parts, as well as workmanship provided under this section, shall conform to the highest commercial standard as specified and as indicated on drawings. Fixture parts and components not specifically identified or indicated shall use materials most appropriate to their intended use or function and as such be resistant to corrosion and thermal mechanical stresses encountered in the normal application and function of the fixtures.
- B. Warranties: CONTRACTOR shall warrant all work under this section to be free from defects in materials and workmanship for a period of one year from the acceptance of the lighting system. CONTRACTOR shall secure and provide to OWNER manufacturer's warranties for ballasts and other such component items.
- C. Measuring and Testing Equipment: CONTRACTOR shall have available at all times, instruments for the measurement of voltage, luminaire temperature, lighting level, and fixture brightness level.

- D. Photometric Testing: Samples may be necessary to be subjected to photometric testing at the request of ENGINEER. Luminaire efficiency shall be determined in an integrating sphere not less than 100 inches in diameter. Testing will be at CONTRACTOR's expense.
- E. Manufacturers: Firms regularly engaged in the manufacture of lighting fixtures of the types and ratings for the project, whose products have been in satisfactory use in similar service for not less than 5 years.
- F. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices, lamps, and components necessary for the proper operation of the equipment.
- B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.
- C. Timely Purchasing: Luminaires and associated lamps and other allied equipment shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

PART 2-PRODUCTS

2.01 FABRICATION

- A. Materials: Provide dimensional thickness of metal, plastic, and composite materials so that all fixtures are rigid, stable, and will resist deflection, twisting, and warping under normal installation and relamping procedures.
 - 1. All luminaire housings minimum 22 gauge cold rolled steel, unless a heavier gauge is specified.
 - 2. All aluminum extrusion housings minimum 3/16-inch-thick.
 - 3. All spun, hydroformed, or sheet aluminum reflectors fabricated from #12 aluminum sheets minimum, 15 gauge (0.57-inch) or heavier.
 - 4. All acrylic and polycarbonate lenses and/or diffusers minimum 1/8-inch nominal thickness.
- B. Joints: Provide positive, durable, means of connection at all joints. NO HOLLOW RIVETS shall be used.
- C. Gaskets: Provide neoprene, silicone, rubber, or other appropriate gasketing, stops, and barriers where required to prevent light leak, control sound and vibration, prevent water leaks, and if pertinent, water vapor penetration.
- D. Edges: Provide finished product with the following minimum qualities:
 - 1. Ground and/or burr-free metal edges.
 - 2. Tight fitting connections, hinges, and closures.
 - 3. Clean neat corners, edges, trims, and frames.

- E. Castings: All cast parts, including die-cast members, shall be of uniform quality; free from blow holes, pores, hard spots, shrinkage defects, cracks, or other imperfections that affect strength and appearance or are indicative of inferior metals or alloys.

2.02 FINISHES

- A. Application: Fixture finishes shall be applied in a manner that will assure a durable wear-resistant surface:
 - 1. Prior to finishing, all surfaces must be free from foreign materials such as dirt, rust, oil, polishing compounds, and mold release agents.
 - 2. All castings and extrusions shall be machined, sanded, or similarly treated and given minimum one coat of baked-on clear methacrylate lacquer, unless a painted finish is specified.
 - 3. Aluminum surfaces exposed to weather (other than anodized reflectors covered elsewhere) receive a duromodic or polyester powder paint finish as specified for corrosion resistance.
 - 4. Sheet steel fixture housings, iron and steel parts, which have not received phosphating treatment ("Bonderizing" or similar process) or are to be utilized in exterior applications, are to be made corrosion resistant by zinc or cadmium plating or hot-dip galvanizing.
 - 5. Unless specified to the contrary, all fluorescent fixture housings shall have a complete coverage of white alkyd reflecting enamel, 85% minimum reflectivity, applied by either a spray or dip process, then baked in a temperature controlled oven until paint is thoroughly cured. Prior to applying the enamel, each metallic surface shall be prepared for painting by using a five-stage hot zinc phosphatizing process.
 - 6. Plastic refractors diffusers material shall be light-stable 100% virgin acrylic, translucent (98% minimum transmission), unless specified otherwise, conforming to minimum standards of IES-NEMA-SPI. Material shall perform as applied in a normal interior environment for a period of 20 years without noticeable deformation and with a transmission loss not exceeding 5%. Nominal thickness of material shall be 0.125-inch for either extrusions or injections.

2.03 LAMPS

- A. Lamps: Provide new lamps as specified for all lighting fixtures (luminaires) as shown on the Contract drawings.
- B. Incandescent Lamps:
 - 1. All incandescent lamps shall be of the same manufacturer.
 - 2. Incandescent lamps exposed or installed in open-type fixture without lenses or refractors shall be 125 volt inside frosted-type, A-shape.
 - 3. Incandescent lamps installed in fixtures having lenses or refractors shall be 125 volt, clear type, A-shape.
 - 4. Where fixtures are scheduled for PAR or R reflector-type lamps, provide medium flood type, 125 volt lamps.
- C. Fluorescent Lamps:
 - 1. All fluorescent lamps shall be of the same manufacturer.
 - 2. All fluorescent lamps shall be 3500 K color temperature.

3. Color Rendering Index (CRI).
 - a. Compact fluorescent lamps shall have a minimum CRI rating of 82.
 - b. Linear fluorescent lamps shall have a minimum CRI rating of 86.
 4. Lamps shall be of the wattage specified on the drawings.
- D. High Intensity Discharge (HID) Lamps:
1. All HID lamps shall be of the same manufacturer.
 2. HID lamps shall have a minimum CRI rating of 65.
 3. Lamps shall be clear, base up or down burning to suit application.
- E. Lamps shall be manufactured by Phillips, Sylvania Osram, or equal, wattage as indicated on the drawings.

2.04 LAMP HOLDERS

- A. Screw Base: Screw base sockets for incandescent lamps shall be of heavy-duty heat-resistant porcelain with spring center contacts and plated screw shells.
- B. Fluorescent Sockets: Fluorescent lamp sockets operating with an open circuit voltage in excess of 300 volts shall be of the safety-type that open the supply circuit when the lamp is removed from the sockets.
- C. All fluorescent fixtures installed that have no glass or metal enclosure shall be equipped with safety-type lamp holders so that lamps shall not become dislodged from the holders.

2.05 WIRING

- A. Minimum Standards: All wiring shall comply with the following standards.
1. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified in Section 16120–Wire.
 2. Wiring between fluorescent lamp holders and associated operating and starting equipment shall be of similar or heavier gauge than the leads furnished with the ballasts.
 3. Wire leads to the receptacle or connector of any side prong incandescent lamp, or any “cool-beam” lamp, or any lamp 200 watts or over shall be SF-2 (silicone rubber insulated) stranded wire.
 4. Wiring within fixture construction is to be concealed, except where the fixture design or mounting dictates otherwise.
 5. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear.
 6. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

2.06 LAMP BALLASTS

- A. Fluorescent Electronic Ballast:
1. Fluorescent Ballast: Shall meet UL Standard 935. Ballasts shall be PROGRAM RAPID START (PRS) type.
 2. Ballasts shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The input current 3rd harmonic content shall not exceed 13% of the input current. The total harmonic distortion shall not exceed 10%.
 3. Fluorescent ballasts shall conform to the performance criteria listed below:

Ballast	Nominal Lamp Watts	Max. Input Watts (ANSI)	Minimum Ballast Factor
1-F32T8	32	29	0.85
2-F32T8	32	58	0.85
All others			0.85

4. Luminaires designed as multi-level switching shall have a combination of 1 or 2 lamp ballasts configured to allow switching of all inboard lamps as a group separate from outboard lamps in the room. Master/slave luminaire arrangement is acceptable. CONTRACTOR shall verify ballast configuration to achieve switching shown prior to submittal.
 5. Ballasts shall be universal voltage. The ballast must maintain constant high output through the entire input voltage ranges of 120 volt to 277 volt.
 6. Ballast Requirements:
 - a. Current crest factor shall be no greater than 1.7 for all lamps.
 - b. The operating ambient temperature range shall be 50°F to 105°F.
 - c. Fluorescent ballasts shall operate at 20kHz or higher, with no detectable lamp flicker.
 - d. Four lamp ballasts shall operate parallel circuit lamps that allow remaining lamps to maintain full output if companion lamps fail.
 - e. Ballasts shall not be affected by lamp failure and shall yield normal lamp life.
 - f. Ballast power factor shall be greater than 95%.
 - g. Ballast shall be rated Class P, thermally protected and have a Class A sound rating, or better.
 - h. Ballast shall comply with EMI and RFI limits set by FCC (CFR 47 Part 18).
 - i. Ballasts shall carry a three-year warranty including labor allowance.
 - j. Program rapid start ballasts shall heat the filament prior to applying the starting voltage to the lamp, then remove lamp cathode heat.
- B. Compact Fluorescent Electronic Ballasts:
1. Fluorescent Ballast: ANSI C82.1; high power factor type, Class P with voltage rating matching branch circuit voltage. Ballast factor shall be .85 or greater.
 2. Current crest factor shall be no greater than 1.7. Ballast shall have a Class A sound rating.
 3. Ballast shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The total harmonic distortion for lamp wattage <26 watts shall not exceed 33%; all others shall not exceed 10%.
 4. Ballast shall have lamp fault shut off circuitry to prevent starting of a faulty lamp.
 5. Ballasts shall operate at a frequency of 20 kHz or higher with no detectable lamp flicker.
- C. High Intensity Discharge Ballasts:
1. HID Ballasts:
 - a. Comply with ANSI C82.4, C82.6 and C92.1.
 - b. Metal Halide Pulse Start: Super constant wattage auto-transformer with igniter and a maximum crest factor of 1.5.
 - c. The ballast design center shall not vary more than $\pm 5\%$ from rated lamp watts for nominal line voltage and nominal lamp voltage.
 - d. With a nominal voltage "reference" lamp, the wattage regulation spread shall not exceed 20% for $\pm 5\%$ line voltage variation for high reactance auto-transformer;

high power factor ballasts and 30% for $\pm 10\%$ line voltage variation for high power factor auto-regulator ballast.

- e. Ballasts must reliably start and operate the lamp in ambient temperatures down to -20°F for the rated life of the lamp. The ballast primary current during starting for high reactance auto-transformer type ballasts may exceed the normal operating current by a factor of 1.5 for 250-1000 watt lamps. Auto-regulating type ballasts shall not exceed normal operating current.
- f. High reactance autotransformer-high power factor ballasts shall be capable of sustaining lamp operation with a line voltage dip or sag of 20% for up to 4 seconds when operating a nominal voltage lamp with nominal line voltage applied to the ballast primary.
- g. Auto-regulating high power factor ballasts shall be capable of sustaining lamp operation with a line voltage dip or sag of 40% for up to 4 seconds when operating a nominal voltage lamp with nominal line voltage applied to the ballast primary.
- h. For high reactance auto-transformer-High power factor ballasts, the current crest factor shall not exceed 1.6 for $\pm 5\%$ line voltage variation, including lamp starting or from nominal lamp voltage through rated end of life lamp voltage.
- i. For auto-regulating high power factor ballasts, the current crest factor shall not exceed 1.8 for $\pm 10\%$ line voltage variation, including lamp starting or from nominal lamp voltage through rate end of life lamp voltage.
- j. For high reactance auto-transformer: High power factor ballasts, the line power factor of the lamp/ballast system shall not be below 90% for $\pm 5\%$ line voltage variation.
- k. For auto-regulating high power factor ballasts, the line power factor of the lamp/ballast system shall not be below 90% for $\pm 10\%$ line voltage variation.
- l. LS-NC Rating: NEMA LE-2, equal to or less than ratings listed in Table C-1.
- m. Two-year warranty.

- D. Acceptable Manufacturers: Ballasts made by the following manufacturers will be accepted:
 - 1. General Electric.
 - 2. Universal.
 - 3. Advance.
 - 4. Motorola.

2.07 MARKING OF FIXTURES

- A. Voltage Identification: Fixtures designed for voltages other than 110 to 125 volts circuits shall be clearly marked.
- B. Lamp Types: Fixtures equipped with ballasts, etc., for operation of rapid start lamps shall be plainly marked "Use Rapid Start Lamps Only." Similarly, fixtures equipped with ballasts, etc., for operation of instant start or other type lamps shall be plainly marked. Markings must be clear and shall be located to be readily visible to service personnel but invisible from normal viewing angles when lamps are in place.

2.08 FIXTURE TRIMS

- A. Trim Details: Provide trim details as shown on the drawings or as specified. The trim finish and dimensions are subject to the shop drawing approval of ENGINEER.
 - 1. Mitered corners shall be smoothed before shop finish is applied. No lapping of trim metal for all flush mounted ceiling trims for rectangular or square recessed fixtures.
 - 2. All exposed ceiling trim and inside reveals on all fixtures shall be painted in a color to match the Architect's sample.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install fixtures, lamps, lenses, etc., after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the complete spaces. All lamps, glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.
- B. Lamps installed for use as temporary lighting shall be replaced with new lamps.
- C. All wall mounted fixtures and all ceiling mounted surface fixtures shall be fed through a fixture Stud/Hickey/Nipple assembly and with provisions to prevent fixture turning.
- D. All fixtures shall be securely and adequately supported and installed.
- E. Surface or pendant mounted fixtures shall be attached to and supported from structural part of the building in a manner acceptable to ENGINEER. Fluorescent fixtures shall be supported by not less than two supports for each fixture. Where fluorescent fixtures are to be suspended, they shall be mounted on steel channel with the channel supported directly to the structure by a minimum of 3/8-inch rod inside rigid conduit stems. Any fixture which has an individual fixture weight of greater than 25 pounds shall have safety cable installed in addition to other support means. Cable to be 3/16-inch airplane cable. All fittings and connectors shall be compression-type. Cables must be secured to the superstructure and to a point or points on the fixture to ensure against falling parts.
- F. Industrial-type fixtures in unfinished areas which are near obstructions such as ducts and pipes shall be suspended so that the bottom of the fixture is no higher than the bottom of the obstruction. All fixtures in each room should be located at the height of the lowest fixture but not lower than 8 feet 0 inches A.F.F. Fixtures shall not be located until the locations of these obstructions are determined, and fixtures shall be accessible after installation of other equipment.
- G. Metal decking shall not be pierced for fixture support.
- H. All fixture whips shall be constructed of minimum No. 12 AWG conductors.

3.02 SUPPORTS

- A. Mounting Frames: Provide mounting frames (plaster frames for example) as necessary for installation and as called for under other sections of these Contract Documents. Frames are to be finished matte white baked enamel unless otherwise noted.

- B. Mounting Accessories: Provide bars, angles, or other attachment devices for all recessed fixtures. Fixtures shall be securely attached so there is minimum possible movement up, down, or sideways. Fixtures shall be mounted to permit access wiring. Fastening devices shall be of a positive, locking-type and will not require the use of special tools to apply or remove. Tie wires cannot be used in place of fastening devices.
- C. Fire Codes: Where necessary to meet Code requirements, enclosure housings shall be constructed to provide a 1-hour fire rating.
- D. CONTRACTOR Responsibility: CONTRACTOR shall verify all ceiling conditions from the drawings and furnish appropriate mounting details for each lighting fixture.
- E. Pendant Mounting: Provide pendant or surface mounted fixtures with required mounting devices and accessories, including hickey, stud extensions, ball aligners, canopies, and stems. Coordinate locations of fixtures in mechanical areas. Provide mounting stems on pendant fixtures of the correct length to uniformly maintain the fixture heights shown on the drawings or established in the field.
- F. Adequate, rigid, sturdy support shall be provided as necessary to prevent possibility of fixture falling. Surface and pendant fluorescent fixtures must be supported with two supports per 4-foot section, except that continuous 8-foot chassis shall have three supports. All pendants must have swivel aligners located at the top ends; pendants shall be 3/4-inch rigid steel conduit, unless specifically indicated otherwise on the drawings, painted on job site. Support surface mounted fluorescent fixtures from structural members other than ceiling tees by providing Unistrut members laid across main ceiling tees or by attachment directly to structure.

3.03 ADJUSTMENT

- A. Focusing/Adjustment: After the installation of lighting fixtures is completed, fixtures so requiring (both interior and exterior units) shall be adjusted after dark under supervision of OWNER.

3.04 CLEANING

- A. Installation Sequence: Lighting fixture mounting frames, plaster rings, etc., are required to be installed prior to the finishing assembly which shall not be installed until the Project is "broom clean." When the fixture location or construction cannot permit sequential installation, CONTRACTOR shall carefully protect all reflectors, lenses, flanges, and other visible surfaces.
- B. Cleaning: Before final acceptance by OWNER, all protective (strippable) coatings, dust, finger marks, paint spots, and any other materials deleterious to the appearance or functioning of the lighting fixtures must be removed. Abrasive cleaners are not permitted.

3.05 FINAL INSPECTION

- A. Upon completion of the installation, lighting equipment must be in first class operating order and free from defects in condition and finish:

1. At time of final inspection, all fixtures and equipment must be installed and lamped with new lamps and be complete with all lenses, diffusers, reflectors, side panels, louvers, or other necessary components.
2. Fixtures shall be completely clean and free from finger marks, dust, plaster, or paint spots.
3. Any reflectors, lenses, diffusers, side panels, or other parts damaged prior to the final inspection shall be replaced at no expense to OWNER.
4. Housing shall be rigidly installed and adjusted to a neat flush fit with the ceiling.

END OF SECTION

SECTION 16930

INSTRUMENT WIRE AND CABLE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This specification contains the requirements for instrument wire and cable as opposed to electrical power wire and cable.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this Section as listed in Division 1.
- B. Qualifications of Installers: Use skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

1.03 PRODUCT HANDLING

- A. Instrument cable shall be furnished in lengths as necessary.
- B. Reels, coils, or package rolls of instrument cable shall be identified with the project name and other tagging identification as called for.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 GENERAL

- A. All materials of construction for cable and wire shall be compatible and noncontaminating.
- B. Unless otherwise noted in these specifications, the requirements herein listed shall be strictly adhered to.

2.02 ELECTRONIC INSTRUMENT WIRING, PAIRS 4-20 MA–D.C. PROCESS INSTRUMENTATION

- A. Pairs (2/C) shall have stranded, tinned copper conductors, No. 16 AWG, twisted with 2-inch lay.
- B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties.

- C. Color coding shall be manufacturer's standard or as stated.
- D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 35 mils-thick, and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power limited circuit cable.
- E. If the electronic instrument wire is not installed in steel conduits, a 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A No. 18 AWG, 7 strand, tinned copper drain wire shall be furnished in continuous electrical contact with the shield.
- F. Single pair, shielded cables shall be Belden 9316, or equal.

2.03 FIBER OPTIC CABLE SYSTEM

- A. Fiber optic communications cable shall be riser rated, breakout-style cable, BX-Series as manufactured by Optical Cable Corporation, or equal. The cable shall be UL listed , riser rated type OFNR meeting requirements of NEC Sections 770-51(b) and 770-53(b) for use in building riser shafts and floor-to-floor runs. Cable shall be suitable for indoor and outdoor applications including installation in underground ducts.
- B. Individual fibers shall meet ISO 9314 (FDDI) specifications for local area network applications at 100 Mbps with a 62.5 μm diameter glass core, a 125 μm diameter glass cladding and a 250 μm diameter UV cured acrylate primary buffer. The fibers shall be proof tested at 100 kpsi.
- C. Each fiber optic cable shall contain 2 individual fibers. Each fiber shall be individually tight-buffered to 900 μm with PVC. The individually buffered cables and tensioned Kevlar strength members shall be tightly jacketed with a color-coded, water- and chemical-resistant, elastomeric subcable jacket. The jacketing shall bind the cable and strength members so that there is no free movement within the jacket. The individually jacketed cable shall meet the requirements of EIA-455-82A.
- D. The individual subcables shall be tightly bound and jacketed with PVC. The jacketing shall not allow slipping or axial movement of the individual subcables. The jacketing shall be fungus-resistant, UV-inhibited, and moisture-resistant.
- E. For connection to network switches, provide end connectors supplied by cable manufacturer. Provide heat-shrink tubing section where cable is broken out to protect jacketing end and minimize overflexing of the subcables. End connectors shall have integral strain relief and shall be designed to minimize losses. Connectors shall be provided on all fibers of each fiber optic cable. End connector styles shall be coordinated with the network switches provided as a part of Section 16940—Controls and Instrumentation.

2.04 SPECIAL CONSIDERATIONS

- A. Although twisted conductors effectively reduce magnetic noise, where additional magnetic shield is necessary to minimize interference from stray magnetic fields, armored electronic instrumentation and thermocouple lead extension wire shall be provided.

- B. Since magnetic interference is produced by currents flowing through conductors and electrical equipment, any instrument wire run near electric motors, generators, transformers, induction heaters, circuit breakers, motor starters, power lines, or AC power and control cables may need additional magnetic shielding.
- C. Armor may be necessary on instrument cables installed in nonmagnetic electrical ducts.
 - 1. Electronic instrument wiring, pairs. There shall be a steel wire armor of 24 gauge AISI 1006 soft annealed steel wire covering the inner jacket.
 - 2. The armor shall be covered by a flame-retardant and weather- and ultraviolet-resistant PVC, outer jacket 35 mil minimum thickness and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the physical characteristics of UL 1277. Cable shall be UL labeled as power limited cables.

PART 3-EXECUTION

3.01 GROUNDING

- A. All shields must be grounded.
- B. Shields shall be grounded at one point only. Single-pair electronic instrument cable shields shall be isolated and left open at the instrument. The single-pair electronic instrument cable shields shall be grounded to the control room instrument.
- C. Cable shield grounds shall be isolated from control system signal grounds, except at instrument system grounding electrodes.
- D. The control room instrument ground shall be separate and isolated from the electrical power grounding system.

3.02 TESTING

- A. Fiber Optic Cable: The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by OWNER, CONTRACTOR shall provide cable manufacturer's test report for each reel of cable provided. These test reports shall include (1) manufacturers on reel attenuation test results at the specified wavelengths for each optical fiber of each reel prior to shipment from the manufacture and (2) on-the-reel Bandwidth performance as tested at the factory.
- B. Tests Prior to Installation: CONTRACTOR, at their discretion and at no additional cost to OWNER, may perform tests deemed necessary by CONTRACTOR to ensure integrity of any OWNER-furnished optical fiber. Tests may range from a simple "flashlight test" to an OTDR of each optical fiber of each cable reel prior to installation. Upon request, CONTRACTOR shall supply this test data to ENGINEER prior to installation.
- C. Tests After Installation: Upon completion of cable installation and termination, the fiber optic cabling shall be tested to include:
 - 1. Optical Attenuation ("Insertion Loss" Method).
 - 2. Verification of Link Integrity (OTDR).

- D. Optical Attenuation Testing: Optical Attenuation shall be measured on all terminated optical fibers in both directions of transmission using the "Insertion Loss" method. Measurement shall be inclusive of the optical connectors and couplings installed at the system endpoints. Access jumpers shall be used at both the transmit and receive ends to ensure that an accurate measurement of connector losses is made.
- E. Multimode fibers shall be tested in accordance with the EIA/TIA 526-14A, Method B at 850 ± 30 nm. Single mode fibers (if applicable) shall be tested in accordance with the EIA/TIA 526-7-1998, Method A.1. Testing shall be at 1300 ± 20 nm.
- F. Attenuation of optical fibers shall not exceed the values calculated at follows:
1. Attenuation (max.) = $2 * C + L * F + S$ dB.
 2. where C is the maximum allowable Connector Loss (in dB), L is the length of the run (in kilometers) and F is the maximum allowable fiber loss (in dB/km). S is the total splice loss (number of splices* max. attenuation per splice).
- G. OTDR Testing: All fibers, even those that are left unterminated (if applicable), shall be documented in one direction of transmission using an Optical Time Domain Reflectometer (OTDR). Multimode fibers shall be tested at 850-nm (nominal). Single mode fibers (if applicable) shall be tested at 1300 (nominal). The OTDR(s) shall incorporate high-resolution optics optimized for viewing of short cable sections. Access Jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive end, shall be used.
- H. OTDR traces revealing a point discontinuity greater than 0.2-dB in a multimode fiber, or 0.1-dB in a single mode fiber (if applicable) at any of the tested wavelengths or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that fiber by OWNER. The installation of that cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that cable and the associated terminations shall be replaced at the expense of CONTRACTOR.
- I. Documentation: Upon completion of the installation, CONTRACTOR shall provide three full Documentation Sets to ENGINEER for approval. Documentation shall include the items detailed in the subsections below.
- J. Documentation of Test Results shall be submitted in hard copy or in electronic form (preferred). Electronic documents may be submitted on CD-ROM (preferred) or 3 1/2-inch diskettes for review and distribution. Where documentation provided in electronic form requires unique software (other than an MS-Word™ compatible Word Processor or MS-Excel™ spreadsheet) for viewing test results, CONTRACTOR shall provide along with the above documentation, one licensed copy of such software. The software shall run on a MICROSOFT Windows-based personal computer supplied by OWNER.
- K. Test Data—Fiber Optic Media: Test results shall include a record of test wavelengths, cable type, fiber and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
- L. OTDR traces of individual optical fiber "signatures" obtained as specified above shall be provided to ENGINEER for review. Trace files shall be so named as to identify each individual fiber by location in the cable system and fiber number or color.

IMPORTANT: Where paper copy documentation of OTDR traces are provided, the vertical and horizontal scales shall be set so as to maximize the detail in each backscatter trace. The portion of the trace which depicts the fiber under test shall extend a minimum of 50% of the display area.

END OF SECTION

SECTION 16931

OFFICE NETWORK CABLING

PART 1–GENERAL

1.01 SUMMARY

- A. This section includes computer network cabling system.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. CONTRACTOR shall furnish, install, and test all cabling and equipment necessary for a complete and functioning Local Area Network (LAN) cabling system as specified and indicated on drawings. Conduit, raceway, and outlet boxes for the "Information Outlets" shall be provided by this CONTRACTOR.
- B. The Horizontal (Station) Cabling System shall be Unshielded Twisted Pair (UTP), shall meet Category 5e performance standards, and shall be certified to comply with TIA standards.
- C. CONTRACTOR shall ensure cable runs from the Communications room to the Information Outlets do not exceed 90 meters.
- D. Provide all faceplates, patch panels, equipment racks, equipment trays, and all other items necessary to provide for telephone and computer connections at all specified data outlets and patch panel(s).
- E. The cabling system shall comply with the following standards:
 - 1. ANSI/IEEE C2–National Electrical Safety Code.
 - 2. NFPA 70-2005–National Electrical Code.
 - 3. TIA/EIA Standards 526-14A (OFSPT-14A), 526-7 (OFSPT-7), 568B.1 (Category 5e), 568B.2 (Category 6), 568B.3, 569A, 606A, and 607 (with exception).
 - 4. IEEE/ANSI 142-1982–Recommended Practice for Grounding of Industrial and Commercial Power Systems.

1.03 PROJECT/SITE CONDITIONS

- A. Examine areas and conditions under which all items are to be installed, and notify ENGINEER in writing of conditions detrimental to proper completion of the work. Do not proceed with that portion of the work affected until unsatisfactory conditions have been corrected in a manner acceptable to installer.

1.04 SUBMITTALS

- A. Initial Project Documentation: CONTRACTOR shall submit the following project documentation for approval prior to ordering equipment. See Section 01300–Submittals for requirements. Provide documentation in a binder tabbed for easy identification. Catalog sheets with complete technical data for all materials being furnished. Exact part/model numbers being provided shall be highlighted.
- B. Record Drawings:
 - 1. Three complete sets of drawings shall be provided by CONTRACTOR prior to final acceptance.
 - 2. These drawings shall contain the following:
 - a. Any changes made to the system during installation.
 - b. Location of all information outlets including jack number identification.
- C. Technical Manual: CONTRACTOR shall furnish three complete technical service manuals containing the following:
 - 1. Descriptions of maintenance/programming procedures for all equipment and systems.
 - 2. All warranty information required by manufacturers for submission of warranty claims for all equipment installed.
 - 3. All testing reports according to Section 3.03.

1.05 QUALIFICATIONS

- A. CONTRACTOR shall have at least 4 years experience in the installation of similar systems. CONTRACTOR shall provide documentation upon request to certify that all assigned staff have attended training courses corresponding to the type of cabling and equipment specified herein.
- B. CONTRACTOR shall currently be licensed to install low voltage electronic cabling systems in the state of the project.
- C. CONTRACTOR shall currently meet all manufacturer's requirements for the provision and installation of all equipment specified herein.
- D. CONTRACTOR shall utilize and have technicians trained in the utilization of the following test equipment: Copper Cable certification equipment. Microtest Penta Scanner.

NOTE: Printout showing "Pass/Fail" and cable footage shall be the first page(s) of the test reports.

PART 2–PRODUCTS

2.01 GENERAL

- A. All products bid shall be the most current and up-to-date versions available, unless otherwise specified.
- B. CONTRACTOR shall provide written notification to ENGINEER, prior to bidding, of any discrepancies in model or part numbers specified.

- C. CONTRACTOR shall provide written notification to ENGINEER, prior to bidding, of the announced discontinuation or replacement of any items specified herein.
- D. CONTRACTOR shall provide all necessary supplies, mounting hardware, and accessories required to install the materials specified herein.

2.02 MATERIALS

- A. Horizontal Copper Cabling: Provide 4-pair 24 AWG twisted-pair cabling meeting EIA/TIA Category 5e requirements. Lucent Technologies 1061 PVC Level 6 350 MHZ, or equal.
- B. Faceplates: Systimax Solutions:
 - 1. "ML" Series: Ivory, or equal.
 - 2. MPS100E-246 (Ivory) for voice, MPS100E-112 (orange) for data, or equal.
- C. Jacks: Systimax Solutions, or equal.

PART 3—EXECUTION

3.01 GENERAL

- A. Install all equipment and components in accordance with manufacturer's written instructions, in compliance with NEC, ANSI/TIA/EIA-569-A and with recognized industry practices, to ensure that all items comply with specifications and serve intended purposes.
- B. All cabling shall be installed in accordance with good engineering practices as established by the EIA and the NEC. Cabling shall meet all applicable local, state, and federal building codes. Voice and Data Cables shall be terminated according to TIA-568A:
 - 1. Pair 1—Pins 5 and 4
 - 2. Pair 2—Pins 3 and 6
 - 3. Pair 3—Pins 1 and 2
 - 4. Pair 4—Pins 7 and 8
- C. Record serial numbers of all items provided that are serialized prior to final acceptance.
- D. All items must be complete as specified prior to final acceptance. It will be the responsibility of CONTRACTOR to ensure cabling meets all specifications and standards defined herein.
- E. It will be the responsibility of CONTRACTOR to ensure that any data run from the communications room to the "Information Outlet" jacks do NOT exceed 90 meters.

3.02 INSTALLATION

- A. Cabling—General:
 - 1. All wiring shall be installed in conduit.
 - 2. Provide cabling runs from the nearest SCC to each information outlet shown on the drawings. A dedicated cabling run shall be utilized for each faceplate jack.
 - 3. Conduit, raceways, and outlet boxes shall be provided as required.
 - 4. Provide faceplates and faceplate jacks in outlet boxes for all information outlets shown on drawings.

5. Excess cable behind face plate connections shall be pulled back into junction boxes in ceiling space and secured in such a manner as to prevent damage to cabling or connections.
6. Provide grommets and/or bushings in conduit ends to prevent damage to insulation or conductors.
7. Use cable tie tool to install cable ties with appropriate pressure to the cable bundles so not to damage cable and provide a smooth cut of excess cable tie. Cable ties MUST be able to be turned freely around the bundle of cable. Cable bundles shall be limited to 3-inch-diameter.
8. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.
9. Allow sufficient slack in cable to prevent premature deterioration of cable system components and to assist in the maintenance and servicing of cable and/or other building systems and components. Avoid excessive and sharp bends. Ensure manufacturer's recommended pulling tensions are not exceeded.
10. Fittings or connections are allowed only at the input and output of devices. Splicing shall not be accepted in any cable run. The entire cable run shall be replaced in all such instances.

B. Grounding:

1. Ground all equipment according to manufacturers' instructions, NEC requirements, EIA/TIA 568, and EIA/TIA 607.
2. In general, ground wiring consists of a #6 AWG green stranded ground wire in PVC conduit from each equipment rack to the building electrical distribution ground.

C. Labeling:

1. Pan Net machine fed labels, or equal, self-adhesive typed labels shall be utilized as follows:
 - a. Place labels on faceplates adjacent to each jack.
 - b. Label all patch panel terminations at each jack location.
 - c. Label each end of all cabling runs with a label at 3 inches to 5 inches from the termination.
2. ALL labels MUST be by the same manufacturer, same size and same font, and comply with ANSI/TIA/EIA-606.

3.03 ADJUSTING/TESTING

- A. Test all cabling and connections with specified equipment and certify as meeting all TIA/EIA Category 5e requirements. Provide hard copy test results for each cabling run in Technical Manual.

END OF SECTION

SECTION 16940

CONTROLS AND INSTRUMENTATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
- B. Allowances: SYSTEM SUPPLIER shall INCLUDE in the Bid the cost of the following items specified in this Section. Refer to the individual sections listed below for a complete description of the work required.
 - 1. PLC Programming Enhancement Hours and Site Visits–Section 1.09–Factory Acceptance Testing, System Start-up, and Support Services.
 - 2. Computer Allowance–Section 2.01–SCADA System Computers and Software.
 - 3. Human Machine Interface Enhancement Hours–Section 2.02–Human Machine Interface (HMI) Configuration.
- C. Related Sections and Divisions:
 - 1. Applicable provisions of Division 1 shall govern work in this section.
 - 2. Section 16941–Controls and Instrumentation Drawings.

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1.02 SYSTEM DESCRIPTION

- A. The work includes furnishing, delivering, installing all items furnished, and placing in operation the Supervisory Control and Data Acquisition System (SCADA) for the Washington WWTP.
- B. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all PLC cabinets and required interface hardware and internal wiring, the SCADA System computers, hardware, system drawings, system software, new MCCs at the wastewater treatment plant, MCC modification drawings as necessary, etc. See paragraph 1.08 for other System Supplier requirements.
- C. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.
- D. CONTRACTOR shall be responsible for the placing of circuits and making of electrical and hydraulic connections in accordance with System Supplier-furnished drawings, instructions, and field supervision to ensure proper connection. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise making of connections to power supplies, motor leads, communication circuits, existing control equipment, and any other connections external to the new control equipment; to adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in a manner fully satisfactory to ENGINEER. This will include on-site review of software/hardware controls from the central control point.
- E. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by System Supplier. All switches and control and indicating lights associated with the control panels shall be new and installed in the starter panels.
- F. All drawings and designs shall become property of OWNER upon completion.

1.03 QUALITY ASSURANCE

- A. System Suppliers: Firms regularly engaged in the design and manufacture of SCADA Systems of the size and complexity specified herein and whose systems have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: A firm with at least 10 years of successful installation experience on projects with SCADA System design and installation work similar to that required for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide control panels, power supplies, controllers, relays, wire, connectors, etc., that have been listed and labeled by Underwriters' Laboratories.
- E. NECA Standards: Comply with applicable portions of National Electrical Contractor's Association's Standard of Installation.

1.04 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.
- C. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.
- D. Shop drawing submittals shall be assembled in two phases; in the first submittal, the following information shall be provided in booklet form:
 - 1. Detailed catalog information, descriptive literature, and specifications of hardware. **All items being provided must be specifically noted on this literature.**
 - 2. All field devices and instruments.
 - 3. Project implementation plan, including information on project organization, project management, engineering, programming, configuration, training, start-up, and maintenance services. Plan shall include key personnel on project, point of contact and communication protocol.
 - 4. Overall network schematic showing all controllers and hardware addresses applicable to the system.
 - 5. Wiring diagrams for all supervisory control centers and motor control centers, including modification drawings for existing equipment.
 - 6. PLC I/O Listing.
 - 7. Database with PLC addresses.
- E. The second submittal shall include:
 - 1. Software.
 - 2. PLC programs and software.
 - 3. Control narratives.
 - 4. CRT graphic displays.

5. Trending format.
6. Alarm and status logging format.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01300-Submittals.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
- C. Submit Operation and Maintenance Manuals in accordance with Division 1. The following additional information shall apply:
 1. Manuals shall contain, but not be limited to, the following:
 - a. System Hardware.
 - b. System Software.
 2. Hardware section to include:
 - a. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.
 - b. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.
 - c. Listing of all hardware timers installed in MCCs and SCCs, as well as the ranges set on each timer. Listing shall also include actual timer setting after completion of startup.

1.06 DELIVERY, STORAGE, AND HOLDING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to supervisory control center components, enclosure, and finish.

1.07 DESCRIPTION OF THE WASHINGTON WWTP SCADA SYSTEM

- A. The Washington WWTP is an advanced secondary treatment plant including influent screening, influent pumping, future grit removal, activated sludge biological treatment, final clarification, and post-aeration. Waste biological sludge is dewatered on drying beds.
- B. System Supplier shall be responsible for the development of all required process control functions based on the algorithms described in this specification. Many systems encompass several algorithms for system components. A listing of major process areas that will need software development for operation is as follows. The SCC location for these areas as affected by the algorithm is included.
 1. Influent Screening System (SCC-20).
 2. Influent Wastewater Pumping (SCC-30).
 3. Grit Removal System (Future) (SCC-70).
 4. Aeration System (SCC-70).
 5. Sludge Pumping System (SCC-70).
 6. Final Clarification and RAS System (SCC-70).
 7. Effluent Disinfection (SCC-70).

- C. All process equipment shall be monitored and alarmed as described herein and listed in the I/O tables shown in Section 16990-SCADA System I/O Listing. All analog and process equipment shall be monitored, totalized, indicated, recorded, and stored for reports and historical data.
- D. The individual station SCCs and the listing of control and monitoring functions is shown in the I/O listing in Section 16990-SCADA System I/O Listing. With the exception of the items listed as existing, all equipment shall be provided in this Contract.
- E. Shop drawings of the existing control system will be made available to the successful Bidder for development of the required loop drawings, interface requirements, and wiring requirements.

1.08 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS

- A. This specification, along with the Contract drawings, defines the requirements of a PLC-based process monitoring and control system. System Supplier shall construct a process monitoring and control system specifically for the demanding requirements of a real-time process management and control system.
- B. It is the intent of this specification to define a fully integrated open-type process monitoring and control system, factory tested, delivered to the site ready to function upon connection of power source and field instrument wiring. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be responsible for reviewing the wiring diagrams and control sequences for equipment provided under other Divisions of these specifications and coordinating all interface requirements. CONTRACTOR shall submit to ENGINEER in writing any deficiencies noted during this review. Any changes required by CONTRACTOR due to failure to complete this review shall be the responsibility of CONTRACTOR at no increase in cost to OWNER.
- C. CONTRACTOR shall be responsible for complete coordination in providing all equipment, sensors, and meters supplied with input and output signals and contacts that are compatible with the systems as specified herein. CONTRACTOR shall also be responsible for complete coordination with manufacturers of other systems specified in other divisions of these specifications with which an interface is required. The Contract drawings and I/O listing are symbolic representatives of the required work. It is not intended that the drawings show all appurtenances. CONTRACTOR shall provide a complete and working system according to the true intent and meaning of the drawings, specifications, and standard industry practices.
- D. To ensure a complete and totally integrated system, a single manufacturer who has experience in furnishing similar networked computer-based monitoring and control systems of the same complexity and size for municipal wastewater facilities, shall provide specified equipment and services. The system proposed to meet this specification shall be of field proven design, incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the process monitoring and control system.
- E. Design and specification of devices and completed system shall conform to applicable portions of latest edition of National Electrical Code (NEC).

- F. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels that have individual components that are UL labeled but do not have UL approval as an assembled unit are not acceptable.
- G. Training Program:
 - 1. Submit training plan including course syllabus, personnel who will be conducting the training, and schedule.
 - 2. Provide materials, instructors, and workbooks to complete the training.
 - 3. Training courses shall include:
 - a. Operator training. Course length minimum eight hours. Training shall utilize equipment specified herein following installation and field testing. (Two four-hour sessions with three operators each shall be provided at the WWTP. Training sessions shall occur at a minimum of two-week intervals.)
 - b. Maintenance training for four operators. Course length minimum eight hours. Two four-hour sessions with three operators each shall be provided at the WWTP. Training sessions shall occur at a minimum of two-week intervals.
 - 4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than the process itself.
- H. System Supplier shall meet the following minimum requirements:
 - 1. System Supplier shall have a full-time staff of qualified programmers who are knowledgeable in the configuration of networked computer systems and the PLCs being provided.
 - 2. System Supplier shall have training capabilities and shall have conducted training courses in programming and maintenance.
 - 3. System Supplier shall have an adequate inventory of spare parts.
 - 4. System Supplier shall have a full-time staff of qualified service technicians.
 - 5. System Supplier shall be responsible for the programming and documentation of the system.
 - 6. System Supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.
 - 7. System Supplier shall be responsible for all coordination between the system and the field devices, instrumentation equipment, motor control centers, etc., and equipment furnished with other divisions of this specification. This shall include interface with existing equipment.
- I. All components are to be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The Base Bid supervisory system System Supplier shall be Wunderlich-Malec, Instrument Control Systems, or CIC Engineering. See General Conditions and Supplementary Conditions regarding substitutions to the Base Bid System Suppliers.
- J. System supplier shall not include the development of laboratory, inventory, or maintenance reports as part of the Bid.

1.09 FACTORY ACCEPTANCE TESTING, SYSTEM START-UP, AND SUPPORT SERVICES

- A. Permit ENGINEER and OWNER to observe vendor's staging records or other quality assurance records relating to system(s) supplied. System Supplier shall assemble the system components as a complete process monitoring and control system and demonstrate that the system is operational before shipment from System Supplier factory to the job site. This test shall be witnessed by OWNER and ENGINEER (two personnel).

System Supplier shall provide lodging, meals, and transportation for three days and three nights as a minimum for this witness test in the Bid. All problems, errors, insufficiencies, and failures identified during testing shall be resolved before shipment. This testing shall be as an integrated assembly by simulating each of the specified I/O points and all specified algorithms.

- B. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for test, ENGINEER will make one three-day trip to check operation. If the equipment does not operate according to the specifications, there will be deducted from payments due CONTRACTOR the amount of \$1,500 per day for ENGINEER's time, plus travel and expenses for all additional field and office time spent by ENGINEER checking equipment. OWNER will deduct the amount of these charges from payments made to CONTRACTOR and will make payment to ENGINEER.
- C. Final acceptance and payment will not be made until the system has operated satisfactorily for a minimum of 30 consecutive days. CONTRACTOR shall include in Bid field follow-up to ensure proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:
 - 1. Satisfactory operation of I/O control loops.
 - 2. Satisfactory operation of software.
 - 3. Satisfactory operation of control program.
 - 4. Satisfactory operation of peripheral equipment.
 - 5. The necessary debugging programs have been performed.
 - 6. Data output is reliable.
 - 7. Control loops are operational.
 - 8. Checking and calibrating of systems have been completed.
- D. CONTRACTOR, through System Supplier, shall provide the following support services:
 - 1. Field Service Engineer. Field Service Engineer shall be responsible for programming of system PLCs in the factory and at the site. Field Service Engineer shall be present at the factory acceptance test and be present for start-up of all systems and available throughout the entire construction process until final completion. Service technicians sent for system start-up will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
 - a. Commissioning, installation, start-up, and testing of equipment.
 - b. Revising or rewriting manuals to incorporate an installed and accepted system.
 - c. On-site training.
 - d. Software modifications.
 - 2. In-Factory support shall include consultation following the acceptance testing and shipment. Services shall include, but not be limited to:
 - a. Researching and answering questions related to the system operation, documentation, and system use and functions.
 - b. Program modifications.
 - c. Revising or rewriting manuals.
 - 3. Post start-up support shall include follow-up services during the one-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include an allowance of 60 hours for work on site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. It shall be assumed that this 60 hours includes four trips to the site.

1.10 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 12 gauge steel, and continuous hinged doors, rotating lockable handle 3-point latch on each supervisory equipment compartment door (not screws or bolts) with top and bottom bolts actuated by one rotating handle on large doors. Provide door stop kit for all panel doors, data pockets for wiring diagrams, and minimum 18-inch fluorescent light and switch. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust inhibiting enamel, white interior, and OWNER-selected exterior color. All doors and panels shall be gasketed. All louvers shall be filtered with forced air cooling as necessary by the supplier for conditions where installed. New enclosures shall be a minimum of 20 inches wide, 20 inches deep, and 90 inches high and shall be as manufactured by Hoffman, Lehman, or Saginaw. MCC structures are not acceptable. Where installed next to motor control centers, enclosure painting shall match that of the MCC.
- B. Indication gauges shall be at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of gauge.
- C. Plastic wiring troughs shall have removable covers. Maximum fill for wiring troughs shall be 60%. All wiring in supervisory enclosures and control panels not in wiring troughs shall be bound with continuous-type spiral windings. Terminal strips located adjacent to wiring troughs shall have a minimum of 1-1/2 inches between terminal strip and wiring trough.
- D. Tubing and instruments containing water shall be in separate compartments located and constructed so that leakage or spray at 100 psi pressure cannot touch electrical conductors or devices. Leakage shall be conducted to the floor in duct or pipe.
- E. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal strips shall be located at the bottom or at the top of the enclosure, depending on where the I/O conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. All wiring shall be labeled at each end with corresponding numbers. This numbering shall be shown on the shop and record drawings.
- F. All door-mounted devices shall be furnished flush-mounted, and an exterior engraved phenolic nameplate worded by OWNER (upon receipt of shop drawings) shall be provided for each compartment, device, light, etc. All components within the enclosures shall be identified with interior mounted engraved labels. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.
- G. All panels with DIN rail mounted equipment shall include a minimum of 25% spare DIN rail space.
- H. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminals, wired to terminal strips. Spares shall be provided for all voltage sources within the panel (e.g. 120V, 24V).
- I. Enclosures that include motor controllers shall have a main disconnect for the enclosure.

1.11 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.
- B. All motor control power shall be 120 volt with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- C. Devices powered at 120 volts from supervisory control panels shall be fused. This shall include, but not be limited to, solenoid valves, motor-operated valves, motorized ball valves, flowmeters, scales, transducers, etc.
- D. Provide lightning protection, isolation transformers and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. 120 volt power shall be available at all control points. Lightning protection shall be completely solidstate, self-healing, and not require the use of fuses. Provide a single switch with an indicating light to deenergize the control power for each location. Each panel shall have a GFI, duplex, 20 ampere, 120 volt receptacle.
- E. If enclosure and panel space is needed for future installation of devices, lights, etc., the enclosure and panel shall be constructed for such installation. Supports shall be provided for future equipment, and panel openings shall be made and covered with neat cover plates matching the panel.
- F. Where equipment is necessary to perform a function as called for in one part of this specification, it shall be provided even though the detailed enumeration at various control points may omit listing that equipment.
- G. Where a certain accuracy of sensing and transmitting levels or flows and controlling operations are called for, means must be provided to read or determine that the levels or flows are within the limits or accuracy specified of the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of levels is necessary to set operating points, an indicating device of accuracy consistent with the operation of the system is required.
- H. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.
- I. A condensation heater shall be provided in all control panels located outdoors. Condensation heater shall be as manufactured by Hoffman Model D-AH, X000 series, or equal, sized as required.

1.12 GENERAL CONTROL ALGORITHMS

- A. In general, the following is a definition of I/O at each MCC:
 - 1. Run from MCC or auxiliary starter contact (dry contact).
 - 2. Fail from MCC or starter auxiliary O.L. contact (dry contact).
 - 3. Command Run Maintained start or as required (dry contact).
 - 4. Hand-Auto from MCC or Controller Selector Switch (dry contact), feedback to SCADA.
 - 5. Any command to operate shall be acted upon within 5 seconds, and any status feedback signals shall be received within 5 seconds.

- B. All alarm contacts or system changes following a command must exist or not change for 0 to 5 seconds to activate the SCADA to the alarm state.
- C. All analog and digital inputs shall be monitored and totalized in the PLC. This shall include, but not be limited to, flows (air, water, etc.), weights, pressures, and levels. The PLC shall calculate maximum, minimum, and running average for all analog inputs. Instantaneous values, totals, maximum, minimum, and average values shall be read by the HMI software and be reset on a daily basis as described below. Minimum, maximum, and average values shall be stored in the PLC for the current day and previous day.
- D. PLCs shall calculate equipment runtimes and number of starts for all equipment where run signals are monitored. Runtimes and number of starts shall be read by the HMI software and be reset on a daily basis as described below.
- E. Totalized flow values, chemical usage, and equipment runtimes as described above shall be stored in the PLC for a period of five days. This data shall be available for use by the HMI software for importing into a reporting software package for purposes of daily, weekly, and monthly reporting. The PLC shall indicate the specific date for each of the five previous days.
- F. Daily flow totals, chemical usage, runtimes, number of starts, number of cycles, etc., as described above shall be reset on a daily basis. This reset shall occur based on a time (hour and minute) setpoint stored in the PLC and set through the HMI software. The operator shall set the time when the daily reset will occur. Once this time setpoint matches the current time of the processor clock, the Master PLC shall send a reset signal to all of the remote PLCs to clear any totals that have accumulated locally.
- G. In addition to the totalizers described above, the PLC shall also calculate cumulative totals for all runtimes, number of starts, flows, and chemical (weight) usage. Maximum, minimum, and running average for all analog inputs shall also be included as part of the cumulative total algorithm. Cumulative totals shall totalize until manually reset by the operator. The PLC shall display the date of the last cumulative totalizer reset.
- H. System Supplier shall provide addressing for all hard-coded time delays and PLC settings that are not operator adjustable. This shall include, but not be limited to, time delays for float switches, call-to-run fails, level alarms, pressure alarms, flow alarms, weight alarms, temperature alarms, and data fail alarms. Indication of time remaining for all timers within PLCs shall be made available for indication at the SCADA System.
- I. Float switches shall include time delays to prevent intermittent starting and stopping and/or alarming due to bouncing floats.
- J. Solenoid valves and small motorized ball valves that are not provided with position indication (e.g. opened, closed), shall include hard-coded time delays on the open and close signals to allow operation of the solenoid or valve.
- K. Communication fail alarms shall be provided within each PLC in the system for alarming at the SCADA System.
- L. System Supplier shall provide addressing for all PLC fault codes such that the error number and associated description can be displayed at the SCADA System.

- M. The operator shall be able to set the processor clock and processor date in the master PLC from the HMI software. Clock and date setting shall be transmitted via the Fiber Optic data highway from the master PLC to set the processor clock and date in the remote PLCs based on the setting in the master PLC.
- N. All analog signals shall be scaled to engineering units in the PLC with implied decimal to allow storage in integer registers. System Supplier shall provide all analog ranges, PLC register values, and associated scaling factors to ENGINEER for use with the HMI software. This shall include upper and lower limits of PLC registers (i.e., -32768 to 32767 or 0 to 65535) as well as upper and lower limits for the associated device (i.e., 0 to 150 psi). Analog values specified to be displayed with decimal points shall be scaled by the HMI software.
- O. For all temperature, weight, pressure or level sensing devices, provide a Transducer Fail alarm at the SCADA System for each transducer. Transducer fail shall be defined as the signal from the transducer being out of range or not changing for an operator adjustable time period (0-120 minutes).
- P. Provide "Out of Service" indication for each piece of equipment when that equipment's MCC is not in the Auto position.
- Q. All analog signals shall have associated high and low setpoints and alarms. Alarms shall be tied into the dialer specified herein and the existing alarm bell in the existing Main Control Panel.
- R. PLCs shall be set up so that the ranges of all analog input signals to the PLC I/O cards can be configured from the HMI software. Provide two operator adjustable setpoints for each analog input, one corresponding to 4 mA and the other corresponding to 20 mA. These setpoints are applicable to devices attached to the master and remote PLCs. This feature is intended to be used for start-up and calibration purposes.
- S. All equipment controlled automatically from the SCADA System shall have "Call-to-Run" signals generated from their associated PLCs. These signals shall be displayed at the SCADA System through the HMI software. Each associated PLC shall also generate a "Call-to-Run Fail" if the equipment is called-to-run but does not start within a specific time period. Call-to-run signals may be generated by the master or remote PLC as determined by System Supplier. The "Call-to-Run" signal shall be generated within the PLC software and may not be combined with other fail signals such as hard-wired motor fails, overtemperature, etc.
- T. All valves controlled automatically from the SCADA System shall have "Call-to-Open/Close" signals (as applicable) generated from their associated PLCs. These signals shall be displayed at the SCADA System through the HMI software. Each associated PLC shall also generate a "Call-to-Open/Close Fail" if the valve is called-to-open/close but does not open/close within a specific time period. Call-to-open/close signals may be generated by the master or remote PLC as determined by System Supplier. The "Call-to-Open/Close Fail" signal shall be generated within the PLC software and may not be combined with other fail signals such as hard-wired motor fails, overtemperature, etc.
- U. In cases where the automatic alternation of equipment is provided by the PLC, indication of the lead, lag, and lag-lag pumps (where applicable) shall be provided and displayed at the SCADA System.

- V. All controlled equipment as described herein shall have the capability of manual control from the HMI software through the manipulation of analog or digital variables. This shall be through the use of a "SCADA H-O-A" switch or by forcing a single I/O point as a manual start command. All analog and digital outputs shall be capable of being manually set from the HMI software.
- W. Where a manual reset is required at the SCADA system (i.e. level lockout, pressure lockout, etc.), the HMI software shall be configured to set a discrete reset bit. Once the PLC receives the bit and the alarm condition has cleared, the PLC shall clear the alarm and place the associated equipment back in service.
- X. Provide an analog PLC register for each piece of equipment with a SCADA HOA switch. Register shall be used for color animation associated with that equipment's HMI graphic object. Analog register value shall be as follows: 0 = Off / Out of Service, 1 = In Auto at MCC, 2 = PLC Call-to-Run, 3 = Running, 4 = Failed (Call-to-Run, Starter Overload, etc.). Precedence shall be given to the higher number conditions; for example, if a pump is In Auto but has failed the register value shall be 4.
- Y. The SCADA System shall allow the operator to change all setpoints and operating parameters within the PLCs as described herein. All control algorithms and alarms for equipment shall be programmed in the associated PLC. There shall be no control algorithms or alarms in the computers. Control of each piece of equipment shall be accomplished as described herein and in Part 3–Execution of this section.
- Z. The master PLC shall be set up so that the alarm dialer is activated in the event of a PLC scan fail or in the event that the PLC power supply fails. For the PLC scan fail, there shall be one PLC output hard-wired to a relay that the PLC will energize and deenergize every 15 seconds. This relay shall be wired to two time-delay relays (one N.C.T.O. and one N.O.T.C.) that will be hard-wired to the alarm dialer (one dedicated channel). In the event that either one of the time-delay relays remains in the closed state for longer than 60 seconds, the alarm dialer shall be activated. The PLC power supply shall power an interface relay that, when de-energized, activates the same alarm dialer channel.
- AA. Each PLC shall be set up so that the master PLC will monitor the scan cycle of each PLC. This shall be accomplished by the master PLC setting and resetting a bit internal to the master PLC program every 60 seconds. This bit shall then be sent to each PLC within the wastewater treatment plant. Once this bit is received by the PLC, the PLC shall copy the value of this bit to a second bit internal to the PLC program. This second bit will be read by the master PLC. If the master does not see a change in status of the second bit, a PLC scan fail alarm shall be generated. The master PLC shall provide indication of which PLC is in alarm.
- BB. All alarms shall be tied to the dialer as well as the existing Main Control Panel alarm bell. The assignment of all alarms to the dialer and alarm bell shall be done through the SCADA System and be flexible for operation. The operator shall be able to assign any alarm to two channels on the alarm dialer. In the event of an alarm, the alarm dialer shall inform the operator as to what station or piece of equipment is in alarm. Provide a bit for each alarm that can be manipulated at the SCADA System allowing the operator to enable or disable the alarm from being sent to the alarm dialer. Also provide a bit that can be manipulated at the SCADA system allowing the operator to enable or disable the alarm from being sent to the alarm bell. An alarm silence/acknowledge bit shall also be provided to silence the alarm bell and disable all active alarms from being sent to the dialer.

- CC. The alarm dialer shall be controlled with a SCADA HOA switch and seven day time clock within the PLC. In SCADA Hand the dialer shall be activated and the time clock control shall not be functional. In SCADA Off the dialer shall be inactive. In SCADA Auto there shall be an activation time (hour and minute) and de-activation time (hour and minute) for each day. The time clock shall allow activation on one day and de-activation on another. The state of all dialer channels shall be monitored at the SCADA system.
- DD. Battery status of each master and remote PLC shall be monitored by the SCADA System. In the event of a low battery condition, an alarm shall be generated at the SCADA System.
- EE. The SCADA System shall provide logged data of both alarm and utilization functions for the system. This data shall be capable of being printed out based on demand, hourly use, or 24-hour periods as desired by the operator. The system shall store this 24-hour data for periods of up to one year giving on-demand or as-required monthly reports.
- FF. Alarm functions shall be capable of being printed out listing both time and date of their occurrence, as well as acknowledgment, the operator that acknowledged the alarm, and the current state of the alarm. Any change in alarm state shall also be printed. These alarms shall list both station and type of alarm that has occurred. Again, based on demand, a log or record of 24-hour/30-day records shall be kept and stored both by hard copy as well as hard disk, CD, or tape backup. All alarm points shown on the I/O list as well as those developed in PLC software shall each be indicated individually at the SCADA System (i.e., no common alarms).

1.13 SPARE PARTS

- A. System Supplier shall furnish spare parts for equipment specified herein as listed in Section 16951–Spare Parts.

PART 2–PRODUCTS

2.01 SCADA SYSTEM COMPUTERS AND SOFTWARE

- A. All components of the computers shall be supplied by System Supplier and all software shall be configured as a part of 2.02 Human Machine Interface Configuration. The computers shall perform the following:
 - 1. Process monitoring of system analog and digital signals.
 - 2. Historical logging of measured operating data.
 - 3. Monitoring and operating status of metering equipment and trending of irregular performance.
 - 4. Active color graphic display capabilities.
 - 5. Operator interface to provide easy access for operating personnel to system.
 - 6. Provide flexibility of changing system operating modes with minimal amount of system reconfiguration.
 - 7. Data acquisition.
 - 8. Expansion of main memory to accommodate the specified increase in I/O with the additional capability specified herein.
 - 9. Equipment status and alarm reporting.
 - 10. Increase of inputs/outputs by 200 discrete and 50 analog (hardware memory capabilities).

- B. System Supplier shall include an allowance of \$10,000 in the Lump Sum Base Bid for two desktop computers, one printer, and software (allowance does not include Human Machine Interface (HMI) Software and Computer Software described below. These items shall be included in the Bid). System Supplier shall include in the Lump Sum Base Bid (not part of the allowance) all labor necessary to set up the two desktop computers, printer, and software as described herein and shown on the drawings. Purchase of computer hardware and software shall be held until approved by ENGINEER to ensure system is of current technology at project completion. CONTRACTOR shall not use any computer hardware or software supplied as part of the Contract. Final selection of each system's components shall be made at the time of actual purchase based on latest available technologies. Final cost for this equipment will be adjusted by change order based on actual system costs.
- C. Each SCADA computer shall operate on a network platform that allows simultaneous operation of several units without loss of data. It is the intent of this specification to provide Programmable Logic Controllers (PLCs) for operating and monitoring the system. The SCADA computers will interface with a centralized supervisory control and data acquisition system for process monitoring and report generation. The system shall be a PLC-based polling system, whereby each remote will be monitored on a cycling basis.
- D. The computer hardware shall be installed where shown on the drawings and herein specified complete with all power cabling and interface cabling. Provide APC, or equal, four-port surge protector for each computer. Surge protectors shall include protection for one telephone line. Provide a true on-line UPS for each computer that will provide 30 minutes of operation during a power failure. UPS' shall match those being provided for the Programmable Logic Controllers specified herein.
- E. Computer Software:
 - 1. The following software shall be provided with each desktop computer (unless otherwise noted). Provide service and support for the following software throughout construction and for one full year after project final completion. Service and support shall include software version upgrades and service packs. All software shall include manuals, license, and registration cards:
 - 2. PCAnywhere 32, latest version. Copies shall be provided as specified below in the SCADA Computer Software Schedule. Each copy shall be licensed for host and remote computer.
- F. SCADA Human Machine Interface (HMI) Software:
 - 1. HMI Software shall be provided for the SCADA computers including all documentation and licenses. The SCADA software shall be licensed using software license files that can be easily restored to the system in case of hard drive failure. System Supplier shall provide coordination for addressing system I/O that includes a listing of addresses for each I/O point described as being manipulated or monitored by the operator through the SCADA System for each SCC. System Supplier shall refer to Part 1.12–General Control Algorithms, Part 3–Execution, and Section 16990–SCADA System I/O Listing for minimum requirements. Listing shall be provided as hard copy and in Microsoft Excel spreadsheet file on a compact disk.
 - 2. The software shall be Windows-based with an object-oriented graphics development environment and have an open architecture that utilizes the latest in Windows XP Professional client/server networking technology from Microsoft.
 - 3. The software shall have the ability to filter, scale, and otherwise condition raw PLC data. These functions, plus the ability to generate alarms on raw PLC data, must operate independently from any other subsystem.

4. The formatting of alarm and event displays shall be fully configurable including the amount of information shown in an alarm/event window. The software shall have the ability to filter and/or query alarms based on user-defined alarm groups.
5. The operator display system shall include advanced user interface devices including list boxes, radio buttons, and sliders. These devices shall be an integral part of the product's standard library of objects accessible from the interface builder. The library shall be capable of being added to with user developed objects.
6. The product shall support Microsoft OLE, OPC, and ODBC for communications with report generation database software.
7. The software shall be configured to take advantage of the built-in networking capabilities of the computer operating systems. The SCADA servers (2) shall be directly connected to the PLC fiber optic data highway and shall perform I/O processing to the inplant and remote data.
8. The HMI software shall be InTouch by Wonderware. Refer to the SCADA Computer Software Schedule below for specific software required on each computer. I/O drivers shall utilize OPC or DDE. Computers with I/O drivers shall be redundant nodes. All desktop computers shall have ODBC interface capabilities.

SCADA Computer Software Schedule

Software	SCADA1 (Desktop)	SCADA2 (Desktop)
I/O Driver	☒	☒
InTouch (60,000 Tag Development)	☒	☐
InTouch (60,000 Tag Runtime)	☐	☒
PCAnywhere (Host and Remote)	☒	☒
RSLogix (5,000)	☒	☐

9. Provide comprehensive service and support for all HMI software throughout construction and for one full year after project final completion. Service and support shall include version upgrades and service packs.
10. The HMI software shall not be purchased until approved by ENGINEER or the computer hardware is released for purchase. See item B. above.
11. The software shall include an integral security system that will enable various operator tasks based on the user level and password. Access to all displays and to all command functions shall be based on the operator's security level to protect against unauthorized use. After initial creation, only an assigned user with proper authorization or the system administrator shall modify the password.

G. Engineering:

1. System Supplier shall provide all of the engineering necessary to accomplish and document a system that meets these specifications and is in accordance with the system configuration. The engineering to be performed by System Supplier on this project shall include, but not be limited to, the following categories:

- a. System layouts.
 - b. Control panel layouts.
 - c. Input/output (I/O) configuration and wiring diagrams.
 - d. Programming of PLCs and coordination of addressing with HMI Programming. Coordination shall include address grouping to allow group transfers to the HMI Software.
 - e. Fiber optic data highway layout.
 - f. Network layout.
2. Submittals: In addition to submittals previously described, provide:
 - a. Shop Drawing and Product Data.
 - b. Logic Programs.
 - c. Recommended Spare Parts Lists.
 3. Installation: CONTRACTOR shall install all of the system equipment including, but not limited to: all local I/O enclosures, remote I/O enclosures, and interconnecting cabling. This work shall include all interconnections and wiring from new and existing equipment for completion of the system.

2.02 HUMAN MACHINE INTERFACE (HMI) CONFIGURATION

- A. System Supplier shall include the development of the HMI using the HMI Software specified to be provided as a part of Item 2.01 SCADA System Computers and Software (above). HMI configuration shall include the following features: a process database that allows the computer system to monitor the addressable contents of the various PLCs using the fiber optic data highway system; an integral security system that limits access to various system features to only those users who have proper security clearance; a graphical user interface to allow the operators to view process information and modify system setpoints; and an alarm system to notify the users of abnormal process conditions and archive the pertinent data. Sample screens are included in the Appendix.
- B. System Supplier shall include the following as a part of the HMI Configuration:
 1. Meetings at initiation, 25%, 50%, 75%, and 90% completion of the HMI with System Supplier's programmer and OWNER to review graphical user interface layouts, alarm configuration, and security information. The graphic displays shall also be sent to ENGINEER in Microsoft PowerPoint format on disk at least one week prior to each meeting for review and approval. All meetings will be held at OWNER's office in Washington, Illinois and shall be assumed to be a minimum of 8 hours in duration. Meetings may be attended by any parties associated with the Contract. At a minimum, one representative of System Supplier capable of making binding decisions related to this scope of work shall attend.
 2. An allowance of 40 hours of programming time for software enhancements and modifications to improve operation of the system. This is over and above the programming time required to configure the system to meet these specifications.
 3. Operator training for two operators. Course length shall be a minimum of two days. Two one-day sessions shall be provided at OWNER's facilities. Training sessions shall occur at a minimum of one-month intervals.
- C. The process database shall be configured to access all necessary data from any of the networked PLCs to meet the requirements of the control descriptions in this specification, I/O listings, and descriptions below.
 1. The process data shall be collected from the PLC at the Main SCC. The system shall be set up so that data is monitored by that PLC.
 2. The process information on the system shall be organized into tags that contain not only the specific process data, but also system data such as point description, alarm

setpoints, sampling frequency, etc. The tags shall be available for assignment to or control from the symbols on the graphical user interface screens. The values of the tags shall be used for numerical display, color changes, etc. The following tag types shall be available for configuration as needed to meet the requirements of the control descriptions and the graphical user interface:

- a. Analog input: Reading analog values from PLC and scaling to accommodate implied decimal.
 - b. Analog output: Allows writing to PLC registers.
 - c. Digital input: Monitors state changes in PLC registers.
 - d. Digital output: Allows writing state changes to PLC registers.
 - e. Calculated value: Uses input tags to calculate a derived value.
 - f. Trend buffer: Accepts analog inputs to a FIFO buffer for use in displaying real-time trends.
 - g. Timer: Count down or count up to monitor runtimes of all process equipment.
3. All analog inputs to the system (including PLC calculated totals) shall be historically archived to the SCADA Server's fixed disk using ODBC transfer to database table each day.
 4. All equipment runtimes from timer blocks shall be historically archived to the SCADA Server's fixed disk. Historical data collection for timers shall be configured to be on an exception basis similar to analog values.
 5. The system shall be capable of two-way transfer of data between the process database and other Windows software. The transfer shall take place using SQL calls (to Microsoft ODBC compliant software).
 6. The process database information shall be exported to or imported from ASCII text files that have delimited formats. An operator with sufficient security clearance shall be able to generate text reports of the database information.
- D. The system shall be configured with security levels to restrict access to portions of the system from individual or groups of operators. Security shall be managed by a central SCADA Server. The system shall have a minimum of four security levels with the following access capabilities:
1. Security Levels:
 - a. Level 1: Users may acknowledge alarms and view all status screens.
 - b. Level 2: Users have all clearance as Level 1 users plus may modify alarm setpoints, modify control setpoints, start and stop controlled equipment, assign equipment variables, and run additional programs on the machine.
 - c. Level 3: Users have all clearance as Level 2 users plus may stop the program, make changes to screen layout, modify tag database, and make changes to system algorithms.
 - d. Level 4: Users shall not have any usage limitations (used for manufacturer or system integrator).
 2. The software shall support a minimum of 100 user names within the various levels of security. Each user shall have a unique log-in name and password and shall be assigned a security level. Log-in names, passwords and security levels shall be determined by OWNER. OWNER shall be provided with at least one user account with Level 4 security clearance to allow for future changes in system configuration by others.
 3. The system shall be designed to log each user out of the system automatically after a predetermined time if there is no activity at the workstation or if the operator requests to log out. Upon an operator logging out, the system shall require another valid user to log into the system before any other task can be completed. The name of the operator who acknowledges alarms, changes system setpoints, or starts/stops controlled

- equipment shall be logged to the printer with the message for tracking and accountability purposes.
4. System designer shall restrict access to screens, individual graphical elements, or menu bar selections based on the security level of the user logged into the system.
- E. The HMI shall allow the user to view process information and modify the equipment parameters described in the control descriptions for the various PLCs. Standard Windows graphical elements such as pushbuttons, radio buttons, check boxes, list boxes, scalable text, etc. shall be used in the configuration of the graphical representation of the processes. All networked computers shall be able to view all system information:
1. At all times during the viewing of the graphical user interface, the screen shall display the Windows standard title bar and menu bar at the top of each screen. Access to the functions in those areas shall be determined by the security clearance of the operator who is logged into the system. A row of buttons along the side or top of the screen shall allow system navigation to the full size screens, system information screen, historical trend screens, and alarm screens. A four-line alarm summary with the most current alarms shall be displayed at the bottom of all screens at all times. The remainder of the monitor area shall be reserved for the "full-size" screens described below.
 2. The following screens, as a minimum, are required to be configured for the user interface as full-size windows. These screens shall show symbols of all related equipment that are monitored. These symbols shall be labeled and shall be dynamically colored to represent their current states. Instantaneous and totalized flows associated with the process areas shall also be labeled and shown on these screens. Levels shall be labeled and shown and symbols representing fill levels shall be shown:
 - a. Storm pumping.
 - b. WWTP layout with flows (with ability to move to any major process area from this screen).
 - c. Raw sewage pumping.
 - d. Plant influent sampling.
 - e. Influent screening system.
 - f. Plant influent flow.
 - g. Oxidation ditch system.
 - h. Sludge pumping system (WAS).
 - i. Secondary clarification.
 - j. RAS system.
 - k. Scum system.
 - l. Biosolids storage facilities.
 - m. Process return flow.
 - n. Nonpotable water system.
 - o. Effluent chlorination system.
 - p. Plant effluent flow.
 - q. Plant effluent sampling.
 - r. Generator permissive controls.
 - s. In addition to the drawings listed, the Bid shall include a minimum of 10 additional full-size graphics screens of similar complexity to those listed above.
 - t. HVAC monitoring and control.
 3. The HMI described above shall be configured so that control modifications and/or setpoint adjustments may be made by selecting (clicking on) that piece of equipment with the computer mouse. This shall bring up a small window that overlays the full-size process screen and contains all of the control parameters and status indications for

the piece of equipment selected. Whenever a request is made to change a setpoint or make a control change, a log of that action shall be created that includes the time and date of occurrence, the description of the point, the new value, and the operator who was logged in when the change was made. These windows shall be considered separate from the graphic screens required above and are required for each piece of controlled equipment and each analog that has associated setpoints for the operator to adjust.

4. All screens listed above shall be configured to allow the operator to open a window that overlays the full-size process window with a real-time trend chart of the analog signals displayed on the screen versus time. The real-time chart shall be four hours in duration and shall display the contents of the trend buffer described above. Each analog variable shall display on the screen in a different color. In addition, the configuration of four additional real-time trend charts with four variables each shall be included in the Bid and shall have variables and time durations determined by OWNER.
 5. Provide trending of historical data over time on individual 3/4 size graphic screens. Analog tags to be trended shall be as selected by OWNER, and a minimum of 10 trend screens shall be included in the Bid. Specific layout of each trend screen shall be approved by OWNER. Trend screens shall include two, three or four separate trends per screen. The user shall be allowed to select four fixed chart durations (8 hour, 24 hour, 7 day and 30 day) for each screen, and shall also be able to select a user defined chart duration. Each trend shall be able to display a maximum of 8 analog tags. Trend screens shall have the capability of zooming in to an operator specified time span, and, using a real-time legend, shall show time and analog value for pens associated with that trend.
 6. Provide a full-size screen that summarizes system information made available by the software.
- F. Configure the software to provide alarm monitoring for informing the operators of current alarm conditions throughout the system and logging alarms to a database on the computers fixed disk for archival storage. Alarm information (including alarm acknowledgment) shall be globally available to all nodes on the network.
1. The alarms that shall be included in the system include the following: all digital inputs to the system that indicate a fail state for a piece of process equipment (e.g., pump fails, power fails, etc.); all digital inputs that indicate a level, pressure, or temperature alarm state (e.g., HWL, building low temperature, etc.); analog inputs that exceed alarm limits within the process database; and system alarms generated by the HMI software (e.g., communication failure).
 2. Alarms shall be grouped into two priority levels, and OWNER shall select which alarms are to be assigned to each level. The high priority alarms shall sound the internal computer horn on the SCADA Server until the alarm is acknowledged or cleared from the system.
 3. At the onset of each alarm condition, a log shall be created that indicates the time and date of occurrence, the description of the point in alarm, and the current state or value.
 4. OWNER shall decide which alarms require acknowledgment by an operator prior to being cleared from the system. Those alarms that do not require acknowledgment will be cleared from the alarm system when the state returns to normal condition. Those requiring acknowledgment shall be cleared from the system only after an operator with sufficient security clearance has acknowledged the alarm through the operator interface and the state returns to the normal condition. Whenever an alarm is cleared from the system, a log shall be created with the time and date of occurrence, description of the point in alarm, the current state or value, and the logged-in operator

who acknowledged the alarm (when applicable). Acknowledgment of an alarm shall affect alarm summaries systemwide.

5. Each process alarm condition shall be capable of being taken out of service by the operator if that operator has security clearance allowing alarm acknowledgment. A log indicating time and date of occurrence, point description, and user name shall be created when an alarm is removed from service.
6. The system shall generate a file containing all of the system alarms for each day and shall store those files for 30 days on the fixed disk of the SCADA Server. This file may be accessed by the operator and printed to the system printer.

2.03 INDUSTRIAL CONTROL AND POWER RELAYS

- A. Industrial control and power relays shall be installed in supervisory control centers, motor control centers, industrial control panels, and where required by System Supplier. Relays used to interface with PLC I/O shall be terminal style, interposing/isolation relays. Relays for motor control circuits, hard-wired control logic, and for loads less than 10 amps shall be general purpose, industrial, square base relays. Relays for lighting circuits and small motor loads shall be industrial, electrically held power relays.
- B. Relays shall meet the following requirements.
 1. Interposing/isolation relays.
 - a. Configuration: SPDT or DPDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120VAC or as required by System Supplier.
 - d. Contact rating: 8A (DPDT), 16A (SPDT).
 - e. Operating life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen Bradley, 700-HK, or equal.
 2. General purpose relays.
 - a. Configuration: DPDT or 3PDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120VAC.
 - d. Contact rating: 15A, minimum; $\frac{3}{4}$ HP.
 - e. Operating life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen Bradley, 700-HB, or equal.
 3. Power relays.
 - a. Configuration: Electrically held, 2-12 poles.
 - b. Mounting: DIN rail, square base.
 - c. Voltage: 120VAC.
 - d. Contact rating: 20A continuous; 1 HP.
 - e. Operating life: 10 million cycles.
 - f. UL listed.
 - g. NEMA rated.
 - h. Manufacturer: Allen Bradley, 700-PK, or equal.

2.04 PLC SYSTEMS AND PLC SOFTWARE

- A. Master PLC and Remote PLCs:

1. The master PLC and each Remote PLC shall consist of modular hardware-style PLCs that shall meet the requirements described below under paragraph C. PLC Systems.
 2. Each remote PLC shall have a programmable address and shall accept incoming data that includes this address. In responding with data to the master, it shall include this address. In addition, every remote shall accept and process data that includes a single unique common address.
 3. The master PLC and remote PLCs shall be capable of stand-alone control to maintain programmed logic in the event of a master PLC failure.
 4. The entire system shall be designed to accommodate all of the inputs and outputs listed in the Input/Output (I/O) list plus 25% spare for each type of input and output signal at each location or as indicated, whichever is greater. All spare and unused I/O shall be wired to terminal strips. This wiring shall include all auxiliary devices and components to complete the installation (i.e. interposing relays, wireways, etc.).
 5. The system shall be programmed to implement the control sequences and to provide the monitoring per this specification. It shall be the responsibility of System Supplier to include all of the inputs and outputs required to meet all aspects of this specification, regardless of whether they are specifically included in the I/O listing in this specification.
 6. The remote PLC system I/O shall communicate at a rate sufficient to perform any command to operate control within 5 seconds and receive any status feedback signals within 5 seconds.
 7. The master PLC shall exchange data with the external microcomputer systems and the in-plant PLCs through a fully documented and published protocol such as MOD BUS, or equal. The protocol documentation shall be submitted to OWNER.
 8. All PLCs shall be of expandable construction with all the cards necessary to process the signals specified, but with provisions for expansion.
- B. It shall be the responsibility of System Supplier to ascertain that all of the field devices are compatible and consistent with the new system design. This includes reviewing drawings and data to ascertain the compatibility and consistency of the system with the field devices on such considerations as:
1. Power levels.
 2. Power sources.
 3. Logic schemes.
 4. Signal types and levels.
 5. Interface devices where required.
 6. All other aspects of field devices impacting on the design of the system.
- C. PLC Systems:
1. System Supplier shall provide all the equipment necessary for data gathering, monitoring, and control as required to meet this specification and in accordance with the drawings. The PLC system equipment shall include, but not necessarily be limited to, the following:
 - a. Programmable Logic Controllers (PLC) consisting of CPUs with adequate memory and instructions, local and remote I/O mounting racks, power supplies, input/output modules, communications modules and hardware, and all other components required to make the PLCs perform all of the functions required in this specification. The PLCs shall be mounted in NEMA 12 enclosures as specified herein or as shown on the drawings; see Equipment Enclosures. The new PLC enclosures shall be completely assembled, prewired, and tested at System Supplier's factory.

- b. Fiber optic data highway cable system terminated to interconnecting hardware such as station connectors at the various SCC system locations.
 - c. PLC Data Highway interface cards for each computer connected to the data highway as shown on the drawings.
- 2. PLC Programming and PLC Software: System Supplier shall provide all the PLC programming and PLC software required to meet this specification and shall be in accordance with the system configuration. The software shall include, but not necessarily be limited to, the following:
 - a. PLC logic programs to be written by System Supplier for the PLC systems to accomplish the monitoring and control functions as specified elsewhere in this specification. The supplier shall document and annotate the programs, update them as required after start-up, and then turn the programs over to OWNER in the form of compact disks; two copies are required.
 - b. System Supplier shall provide a commercially available PLC programming and documentation software package as developed by the system manufacturer for documenting and modifying the PLC programs. Modifications shall be accomplished from the Main SCADA server.
 - c. The I/O addressing shall be made available to OWNER during shop drawing review (see item 2.01 SCADA System Computers and Software).
- 3. Engineering:
 - a. System Supplier shall provide all of the engineering necessary to accomplish and document the requirements of this specification and in accordance with the system configuration. The engineering to be performed by System Supplier on this project shall include, but not be limited to, the following categories:
 - (1) PLC system layouts.
 - (2) Panel layouts.
 - (3) Input/output (I/O) configuration and wiring drawings.
 - (4) PLC programming.
 - (5) Fiber optics communication layout.
 - (6) Network layout.
 - b. Submittals: In addition to submittals previously described provide:
 - (1) Shop drawing and product data.
 - (2) PLC logic programs.
 - (3) Recommended spare parts lists.
 - c. Installation: CONTRACTOR shall install all of the system equipment including PLCs and local I/O enclosures and interconnecting cabling as required. This work shall include all interconnection wiring from new and existing equipment as required for the completion of the system.
- 4. The PLC shall be a microprocessor-based controller.
- 5. The PLC processor shall meet the following minimum general specifications:
 - a. Voltage: 100 to 130 VAC.
 - b. Frequency: 47 to 63 Hz.
 - c. Temperature: 0 to 60°C.
 - d. Humidity: 5 to 95% noncondensing.
 - e. RFI: MIL-STD-461B.
 - f. EMI: IEEE 472-1974.
- 6. The PLC processor shall have the following minimum features:
 - a. 1.5 MB of battery-backed static RAM.
 - b. 64 MB nonvolatile memory (compact flash).
 - c. Utilize 32-Bit architecture.
 - d. Solve 1K words of logic in 0.9 milliseconds.
 - e. I/O scan time of 0.225 milliseconds per I/O rack.

- f. Real-time clock.
 - g. Selectable timed interrupts.
 - h. Local I/O capability of 30 modules.
 - i. Memory protection.
 - j. RS-232 and Ethernet communications ports for fiber optic data highway communications.
 - k. Remote I/O capability.
 - l. Status indicators.
7. The PLC must be capable of performing the necessary logic to control the system. PLC capabilities shall include, but not be limited to, the following:
 - a. Discrete input/output (120 VAC or isolated as required).
 - b. Isolated analog input (4-20 mA).
 - c. Isolated analog output (4-20 mA).
 - d. Timers.
 - e. Latch/unlatch relays.
 - f. Counters.
 - g. Comparators (setpoints for analog level).
 - h. Relay ladder logic.
 8. The PLC must be capable of self-diagnosing the following error conditions resulting in orderly shutdown of the unit and annunciation of an error condition.
 - a. Memory parity error.
 - b. Loss of signal communication between master and I/O.
 - c. Loss of logic power.
 - d. Halt or interrupt of memory scan.
 - e. Detection of incomplete relay ladder rungs in memory.
 9. The PLCs shall be of the modular hardware style as manufactured by Allen Bradley Model Compact Logix, or equal, with all accessories required to perform the operations described herein and to communicate with the fiber optic data highway system.
 10. Environmental ratings for all components of the PLC system shall meet or exceed the following requirements:
 - a. Humidity rating of 0 to 95% relative humidity.
 - b. Ambient temperature rating 0 to 55°C.
 11. The vendor shall be able to attest to the fact that the PLC system has been designed and tested to operate in an industrial environment with all its associated electrical noise.
 12. All components comprising the PLC system shall be manufactured by a company regularly engaged in the manufacture of programmable controllers.
 13. The power supply shall be protected against short circuits.
 14. The power supply shall contain its own overcurrent and overvoltage protection.
 15. In the event of power loss, register or ladder information shall be retentive.
 16. To allow monitoring of a malfunctioning machine or process, it shall be possible to connect or disconnect programming equipment at all times, even when the system is running.
 17. Each PLC enclosure shall include, but not be limited to, the following equipment:
 - a. Main PLC processor and remote I/O driver or remote I/O receiver.
 - b. Main power supply.
 - c. Input/output (I/O) modules and housing.
 - d. Computer grade transient and spike suppressor.
 - e. Rail mounted terminal blocks for field wiring terminations.
 - f. Plastic wiring ducts.
 - g. General purpose duplex GFCI receptacle.

- h. 15A, 120/240 VAC, branch circuit breakers to feed to the main PLC controller and the I/O controlled field devices.
 - i. Other accessories required to provide a complete and working PLC system.
 - j. True on-line UPS backup for the SCC.
 - k. Fiber optic patch panel.
 - l. Managed network switch.
 - m. Slot fillers for any unused I/O module slots.
- 18. The main PLC processor shall receive power from its individual power supply, which shall be fed from a dedicated 15 ampere circuit breaker through transient and spike suppressors.
- D. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for three years from start-up.
- E. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations.
 - 1. All wiring within the enclosure shall be through the plastic wiring ducts. All wiring not in ducts shall be in plastic spiral bindings. All I/O devices shall be wired to rail mounted terminal blocks.
 - 2. All field wiring shall terminate at the rail mounted terminal blocks that shall be mounted either at the bottom or at the top of the enclosure back panel depending on where the I/O conduits penetrate the enclosure.
 - 3. The field wiring terminals shall be clearly identified as to which I/O terminals they are wired.
 - 4. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer.
- F. The color code for panel and field wiring shall be as follows:
 - 1. Discrete 120 VAC Input:
 - a. Hot Wire: Red
 - b. Neutral Wire: White
 - c. Switched Wire: Brown
 - 2. Discrete 120 VAC Output:
 - a. Hot Wire: Red
 - b. Switched Wire: Blue
 - 3. 120 VAC Panel Power:
 - a. Hot Wire: Red
 - b. Neutral Wire: White
 - c. Ground Wire: Green
 - 4. Intrinsically Safe: Light Blue.
- G. 24 VDC power supplies shall be provided and installed in the enclosures for powering all analog input signals where required.
- H. Current-to-current isolators shall be provided and installed in remote mounted enclosures for isolating all existing analog input signals. NEMA rating of enclosures shall be as required for the area where installed.
- I. Manufacturer of Accessories:
 - 1. The plastic wiring duct shall be Electrovert "Electro-Duct," Panduit, or equal.
 - 2. Terminal blocks shall be Phoenix Contact UK 5 N, or equal.
 - 3. Wire markers shall meet the requirements of Section 16195-Electrical Identification.

4. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be of the rail mounted-type such as Square D, Class 9080, Type GCB-150, or equal.
 5. Power supplies shall be Sola, rail mount, SPD or SDN Series, or equal.
 6. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.
- J. System Supplier shall provide for the design and layout of the fiber optic communication system between the SCCs. Spare runs of fiber optic cable shall have connectors provided and be run to each terminating location. The fiber optic network shall be set up in a self-healing ring-type configuration. Daisy chaining of the SCC's communication system is not acceptable.
- K. System Supplier shall provide the necessary communication modules within the systems to allow the systems to communicate with the fiber optic cabling.
- L. System Supplier shall provide the necessary fiber optic cable, fiber optic termination units, connector kits, terminator sets, etc., as specified herein, to provide complete and working communication between the SCCs and the computer work stations. Provide a fiber optic patch panel for each PLC. The installation of the fiber optic cable shall be by CONTRACTOR, with supervision by System Supplier.
- M. Each SCC shall have a true on-line UPS backup that will allow for continuous communication with the master for up to 30 minutes following a power failure. Power to each SCC shall be through the UPS and shall be plug connected. UPS power shall be provided, at a minimum, to the following components: PLC and I/O racks, power supplies for PLCs and I/O, indicating lights and devices associated with power fail and communication alarms, and power supplies for loop-powered instruments. Each UPS shall be provided with a relay card that provides a dry contact output to the PLC in the event that the UPS batteries need replacement. UPS shall be APC with relay IO module, or Liebert GXT2 with relay card. Provide a stand or shelf within each SCC panel for the UPS such that the UPS does not sit on the bottom of the enclosure.

2.05 LUMINESCENT DISSOLVED OXYGEN MONITORING SYSTEM

- A. The controller shall accept one or two inputs from Hach digital sensors utilizing MODBUS protocol and shall be multi-parameter, accepting inputs from any Hach digital sensor.
- B. The controller shall have a graphical dot matrix LCD display with 128 x 64 pixels and LED backlighting. The main display readout height shall be 1/2 inch. Auxiliary information readout height shall be 1/8 inch. Menu screens shall contain up to six full lines of conversational text.
- C. The display shall be able to simultaneously display a single reading, dual reading or a calculated value. Simultaneously displayed auxiliary information shall include analog output values, process temperature, the date and time, relay status, diagnostic warnings, or error messages.
- D. The analyzer shall have six calibration methods: 1) "In the Process" Probe method for input of D.O. value obtained from a calibrated portable D.O. meter; 2) "In the Process" Sample method for input of sample D.O. value derived by lab analysis using Winkler Method; 3) "In the Process" Saturated method for use when process is known to be 100% saturated with air (analyzer computes ppm value for calibration); 4) "In Water" Probe, 5) "In Water" Sample; and 6) "In Water" Saturated methods.

- E. The analyzer shall have high alarm, high alarm deadband, low alarm, low alarm deadband, off delay and on delay, and fail low software alarm settings for measured D.O. and temperature.
- F. The analyzer shall have two sets of isolated analog outputs. Each set shall consist of 0-5 VDC/0-1 mA and 4-20 mA. Each output set can be assigned to represent the measured D.O. or temperature. The user shall be able to assign minimum and maximum D.O. values or temperature values that produce the respective minimum and maximum output values. Each output set shall be selectable to track the measurement, hold present output values, or transfer outputs to predetermined values. The display shall indicate an error message for each 4-20 mA output loop that is open.
- G. The analyzer enclosure shall be NEMA 4X with a polycarbonate face panel and epoxy coated cast aluminum door and case. Analyzers shall be installed in fiberglass hinged cover NEMA 4X enclosures with window and quick opening hasps. Enclosure shall include condensation heater, Hoffman Model D-AH501. Provide sun shields for all analyzers.
- H. The analyzer shall be Hach, Model SC100, with 115 volt power supply, single fuse, and FM approved. Provide digital output card for each analyzer to allow MODBUS connection of analyzer to the plant SCADA system. A total of two analyzers shall be provided.
- I. The probe body shall be made up of foamed Noryl and 316 stainless steel with polybutyl methacrolate material sensor. Dissolved oxygen readings shall be performed using luminescent technology consisting of a blue LED, red LED and photo diode.
- J. The LED's shall be enclosed by a chamber with sensor cap to protect them from direct contact with air bubbles and material suspended in wastewater. Sensor cap shall be screw on type with field replaceable design.
- K. The sensors shall automatically compensate for changes in the process temperature. The probe shall be factory calibrated with the option to calibrate manually using a laboratory sample or air calibration.
- L. The sensors shall have an integral 16-foot cable terminated with a quick-disconnect plug and junction box.
- M. The sensor's accuracy shall be ± 0.1 ppm (mg/L) below 1 ppm or ± 0.2 ppm (mg/L) above 1 ppm.
- N. The sensors shall be threaded on the cable end to mate with mounting hardware. Sensors shall be mounted as directed by the manufacturer using pole mount kit, model 57944-00. Pole mount kit shall be provided for each sensor.
- O. The probes shall be Hach, Model 57900-00. Probe shall include three year warranty; sensor cap shall include one year warranty. Provide three year supply of sensor caps, to be shipped at future dates from original installation.
- P. Provide one day of startup service by a factory trained technician. CONTRACTOR shall schedule date and time for the official startup. Provide startup report to OWNER and ENGINEER after completion.

2.06 FLANGE-MOUNTED LIQUID LEVEL TRANSMITTER

- A. The flange mounted liquid level transmitter shall be suitable for measuring up to 6.5% thickened sludge at the location shown on the drawings. The transmitter shall have a 3-inch 316L stainless steel diaphragm with ANSI Class 150 stainless steel flanges.
- B. The sensor shall be isolated mechanically, electronically, and thermally from the process medium and the external environment. The sensor shall be suitable for temperature ranges from -40 to 250°F. The sensor shall include a temperature measurement to compensate for thermal effects. The sensor shall be capable of measure levels in the range of 0 to 250 in H₂O.
- C. The transmitter shall include a 4-20 mA output for remote indication of scum pit level. Transmitter shall include self-diagnostics to detect transmitter failure and alert the user. The transmitter shall include damping as well as zero elevation and suppression.
- D. The transmitter shall be as manufactured by Foxboro, Model PSFLT with IGP20 transmitter, or equal.

FLANGE-MOUNTED LIQUID LEVEL TRANSMITTER SCHEDULE		
Tag No.	Size (Inches)	Maximum Scale (psi)
PT-70-01	4	50

2.07 FLOAT SWITCHES

- A. Float switches when specified herein, shown on the drawings, or necessary to complete an operating system shall be as follows:
 - 1. The float switches shall consist of a 316 type stainless steel housing 5 1/2-inch-diameter, stainless steel mounting clamp, a flexible three-conductor cable with a synthetic rubber jacket, and a mercury switch. Inside the float housing will be a normally open or normally closed, as required, mercury switch potted in epoxy. The electrical load for the switch contacts shall be 23 volts DC/AC into an inductive load. Float switches shall include a three-conductor cable 14 AWG with 105 strands per conductor made for heavy flexing service and underwater use. Cable length shall be 50 feet minimum for a continuous run to the terminating control panel. A green grounding wire shall connect internally to the float housing. Floats shall be US Filter Model 9G-EF, or equal.
 - 2. Weight and buoyancy shall be such that contaminants will not result in the float switch changing operating level more than 1 inch.
 - 3. Operating temperature range shall be 0° to +180°F.
- B. Floats shall be mounted on a stainless steel cable with PVC covered anchor per manufacturer's instructions. All mounting hardware shall be stainless steel and provided with floats.
- C. Provide stainless steel kellum grips for each float cable.
- D. All floats indicated on the drawings or specified herein to be intrinsically safe in design shall be as such. Provide intrinsically safe barriers as specified herein.

2.08 PRESSURE SWITCHES

- A. Pressure switches where called for shall be Square D, Type GAW for pressures as applicable. Dual stage pressure switches, where required, shall be Square D, Type GKW, for pressures as applicable.

2.09 LIMIT SWITCHES

- A. Limit switches (door switches) where called for on the drawings shall be Square D, Class 9007, Type C, or equal. CONTRACTOR shall provide head and body style to fit application.

2.10 OPEN CHANNEL FLOW TRANSMITTERS

- A. Open channel flow transmitters shall utilize an ultrasonic, noncontacting method to measure flow through the flume with an accuracy of $\pm 0.25\%$ of measurement. Flow calculation shall be selectable from a "standard" exponent for the given open channel type, but shall allow field entry of user-selected exponents. A 4-digit local display shall allow operator-selected display of flow rate, level, and 8-digit totalized flow. Flow rate shall be field programmed for units of flow, gpm, mgd, etc. All adjustments shall be by digital values in EEPROM, providing memory storage through power failures without requiring battery backup. Totalized flow shall be stored to EEPROM in order to minimize lost data during a power outage. Field adjustments shall include zero, span, blanking, dampening, low flow totalization suppression, and sampler or totalizer pulse output. Programming shall be performed by a removable, portable keypad module maintaining NEMA 4 enclosure integrity during programming or when removed from the enclosure. Output shall be isolated 4-20 mA DC into a 750 ohm load and a pulse output proportional to totalized flow.
- B. The transducer shall be FM certified as being suitable for Class 1, Division 1, Groups A, B, C, and D. The radiating surface shall be self-cleaning and shall operate without problems in moisture, dust, and frost. It shall be suited for continuous submergence, with the interconnecting cable splice made above flood level. The transducer shall be designed to amplify acoustic output 54 times over normal outputs. Operating range shall be -40°F to 200°F . CONTRACTOR shall coordinate transducer mounting height with maximum water level to be monitored.
- C. The interconnecting cable between transducer and the amplifier shall be provided with the instrument, limited to 1,200 feet, and be run in a conduit separate from other wires or cables. The transducers shall be temperature compensated through an integral temperature sensor. Provide a 120 VAC power source for the amplifier.
- D. The amplifier enclosure shall house the amplifier and digital indicator in a NEMA 4 enclosure suitable for indoor or outdoor installation. For all transmitters located outdoors, transmitter shall be installed in a fiberglass hinged cover NEMA 4X enclosure with window and quick-opening hasps. Enclosure shall include condensation heater, Hoffman model D-AH601, or equal. Provide sun shield for all transmitters located outdoors.
- E. The step screen differential level transmitter (ULT-20-01) shall be provided with two transducers.
- F. The open channel flow transmitter shall be Siemens, Inc., Hydro Ranger, or equal.

2.11 INLINE FLOW METERS

- A. The magnetic flow meters shall be suitable for measuring sludge flows in the range indicated below at the location shown on the drawings. The magnetic flow meters shall consist of a flanged sensor with remote electronics. The electronics shall be remote mounted when the process liquid temperature is 160°F or greater. The tube shall be of 304 stainless steel with Teflon liner. Flanges shall be carbon steel and conform to ANSI B16.1, Class 150. The meter shall be NEMA 4X construction.
- B. Where meter bypass piping is not provided for in-line flow meters, provide one spool piece for each size meter to allow for removal and repair of the meter.
- C. The meters shall utilize bipolar DC coil excitation automatically rezeroing every cycle. Meters shall be provided with grounding rings. Electrodes shall be bullet nose, 316 stainless steel suitable for sludge applications with up to 10% solids.
- D. Power consumption shall not exceed 20 watts. The input impedance of the pre-amplifier shall be 10^{10} ohms or higher, or continuous ultrasonic cleaners shall be provided to prevent accuracy drift because of greasy (nonconductive) coatings.
- E. Meter accuracy shall be plus or minus 0.5% of rate from 1.0 to 30.0 ft/sec and 0.1% of scale below 1.0 ft/sec. The meters shall be wet calibrated in a primary flow laboratory traceable to the National Bureau of Standards.
- F. The meter shall be designed to operate on 120 VAC, 60 Hz. Connections shall be factory potted to assure NEMA 4 as installed ratings. Outputs shall be 4-20 mA into 800 ohms maximum and 24 VDC scaled pulse, 0 to 2 Hz maximum, 150 ohms minimum, suitable for driving a solidstate counter.
- G. Outputs shall be field adjustable for range changes. Response time shall be adjustable from 0.8 to 8.0 seconds. The meters shall be operable in all liquids with 5.0 umho/cm or more conductivity.
- H. The meters shall include empty pipe detection and shall be rated for accidental submergence.
- I. The magnetic flow meters shall be ABB Automation, Magmaster Plus, MFE Series for meters smaller than 8 inches, and MFF Series for meters 8 inches and larger. Meters shall be sized to match the nominal pipe diameter in which they are installed. Provide cable length as required to reach the remote mounted signal converter; CONTRACTOR to coordinate.
- J. Provide with each flow meter a remote signal converter, ABB Automation Model MFE4ER, or equal, to be located where shown on the drawings. Signal converter shall be FM approved and CSA certified.

Tag No.	Size (Inches)	Maximum Scale
MFM-70-01	8	800
MFM-70-02	8	800
MFM-70-03	6	400

2.12 PRESSURE TRANSDUCERS

- A. Pressure transducers shall sense gauge or differential pressure and provide a 4-20 maDC signal proportional to the sensed pressure. The control system will provide 24VDC loop power. Increasing pressure shall result in increasing signal.
- B. Transducers shall be suitable for use in ambient conditions of 0°F to +180°F and 0 to 100% relative humidity.
- C. Accuracy (including linearity, hysteresis, and repeatability) shall be a minimum of $\pm 0.10\%$ of span. Long-term drift shall be less than $\pm 0.1\%$ of the upper range limit over a 12-month period. The transducer output signal shall not change more than 0.0005% of span for a 1V change in the loop voltage. Ambient temperature effect shall be less than ± 0.6 psi for a 10 to 300 psi transducer that experiences a 100°F change in ambient temperature within the normal operating range. Mounting position shall not affect transmitter performance. RFI effect shall be less than 0.1% of span for radio frequencies in the range of 27 to 1,000 MHz and field intensity of 30V/m.
- D. Process connection shall be 316L stainless steel fitting size and type as required by CONTRACTOR. Sensor material shall be 316L stainless steel, with silicone fill fluid. Sensor shall be suitable for use with process liquid/gas temperature from -50°F to +250°F.
- E. Calibrated range shall be determined by the CONTRACTOR based on process conditions. Calibrated range and process conditions used to determine range and span limits shall be included in submittal.
- F. Pressure transducer housing shall be NEMA 4X, epoxy-coated aluminum with a minimum of one 1/2-inch NPT conduit connection. Housing shall provide separation between electronics and field connections.

- G. Digital indicator with transducer configuration pushbuttons shall be provided in the transducer housing. Transducer configuration shall be performed using pushbuttons on the transducer. A Hart communicator or other electronic device **shall not** be required to configure the transducer.
- H. Transducer shall be direct connected to process unless specified otherwise on the drawings. Provide stainless steel bracket and mounting bolts for surface mounting of transducer if wall mounting is specified. Provide stainless steel 2-valve manifold for pressure transducers and three valve manifold with test ports for differential pressure transducers.
- I. Provide stainless steel information tag that indicates instrument number, service, and calibration range.
- J. Pressure transducers shall be Foxboro Model IGP20, ABB, or equal.

2.13 AUTOMATIC DIALER

- A. The dialer shall be a solidstate component capable of dialing up to 16 phone numbers, each up to 24 digits in length. Phone numbers and standard pulse dialing or touch tone DTMF dialing shall be user programmable via the system's keyboard or touch tone phone.
- B. The unit shall have two different categories of speech message capability, all implemented with permanent nonvolatile solidstate circuitry with no mechanical tape mechanisms.

User Field Recorded Messages

The user may record and rerecord his own voice messages for each input channel and for the Station ID. The time for each message shall be adjustable, and recordings may be made at the front panel or from any remote touch tone phone. Provisions shall be included for status only (nonalarmable) messages.

Permanent Resident Nonrecorded Messages

Permanent built-in voice messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the user or installer has not recorded any messages of their own.

- C. The user may optionally elect to alter the following parameters from their standard normal default values via keyboard entry or remotely from any touch tone phone.
- D. Alarm Call Grouping:
 - 1. On alarm, system shall selectively call the correct phone numbers according to the current alarm(s):
 - a. Alarm Response Delay: 0.1 to 999.9 seconds
 - b. Delay Between Alarm Call Outs: 0.1 to 99.9 minutes
 - c. Alarm Reset Time: 0.1 to 99 hours or "NO RESET"
 - d. Incoming Ring Response (answer) Delay: 1 to 20 rings
 - e. Number of Message Repetitions: 1 to 20 repetitions
 - 2. Input Alarm Criteria: Each channel shall be independently configured for "Alarm On Open Circuit," "Alarm On Closed Circuit," "No Alarm."

3. Autocall Test: When enabled, the unit shall place a single round of test calls, both at the time this function is enabled and also at regular subsequent intervals, until this function is disabled at the keyboard.
 4. Runtime Meter: Selected inputs shall accumulate and report the number of hours that its input contacts have been closed.
 5. Remote System Microphone Activation:
 - a. Remote and Local Arming and Disarming of System
 - b. Pulse Totalizer Function
- E. User-entered programming and voice messages shall be kept intact even when all power is removed for up to ten years.
- F. Acknowledgment of an alarm phone call is to be accomplished by pressing a Touch Tone7 "9" as the alarm call is being received, and/or by returning a phone call to the unit after having received an alarm call.
- G. The unit shall continuously monitor the presence of AC power and the status of four contact closure inputs. AC power failure, or violation of the alarm criteria at any input, shall cause the unit to go into alarm status and begin dial-outs.
- H. Upon initiating an alarm phone call, the system is to "speak" only those channels that are currently in "alarm status."
- I. The unit shall be capable of dialing any phone number on command and function as a speaker phone.
- J. Inquiry phone calls shall be able to be made directly to the unit at any time from any telephone, locally or long distance, for a complete status report of all variables being monitored, including power status.
- K. Normal power shall be 105-135 VAC, 15 watts nominal. The product shall contain its own gel cell rechargeable battery that is automatically kept charged when AC power is present. The system shall operate on battery power for a minimum of six continuous hours in the event of AC power failure. A shorter backup time shall not be acceptable. The built-in charger shall be precision voltage controlled, not a "trickle charger" to minimize recharge time and maximize battery life. Low battery shall be indicated at the unit.
- L. The dialer is to use a standard rotary pulse or touch tone "dial up" phone line (direct leased line not to be required) and is to be F.C.C. approved. Connection to the telephone shall be through a 4-pin modular jack (RJ-11).
- M. Gas tube and solidstate surge protection shall be provided on all inputs, including power, phone, and signal lines. These protectors are to be integrally incorporated into the main circuit board for maximum protection. Protectors mounted external to the main circuit board shall not be an acceptable substitute. The supplier shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.
- N. The system shall include expansion connectors to accommodate field upgrades for additional dry contact inputs, remote supervisory control outputs, analog inputs, and communication with remote printers and computers.
- O. All keyboard and front panel switches shall be sealed to prevent contamination. Front panel LEDs shall indicate: Normal Operation, Program Mode, Phone Call in Progress,

Status for each Channel, AC Power Present, AC Power Failure, and Low Discharging or Recharging Battery. On any Inquiry telephone call or On Site status check, the voice shall provide specific warning if no dial-out phone numbers are entered, if the unit is in the "alarm disable" mode, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote phone to listen to local sounds and have a two-way conversation with personnel at the dialer.

- P. The following options shall be provided: 28 additional contact channels (32 channels total).
- Q. The dialer shall be as manufactured by RACO, Verbatim Series VSS, or equal.

2.14 ULTRASONIC LEVEL TRANSMITTERS

- A. Ultrasonic level transmitters shall utilize an ultrasonic, noncontacting method to measure level with an accuracy of $\pm 0.25\%$ of measurement. Level calculation shall be selectable from a "standard" exponent for the given tank type but shall allow field entry of user-selected exponents. A 4-digit local display shall allow operator-selected display of level, and level shall be field programmed for units of feet, inches, etc. All adjustments shall be by digital values in EEPROM, providing memory storage through power failures without requiring battery backup. Levels shall be stored to EEPROM in order to minimize lost data during a power outage. Field adjustments shall include zero, span, blanking, and dampening. Programming shall be performed by a removable, portable keypad module, maintaining NEMA 4 enclosure integrity during programming or when removed from the enclosure. Output shall be 4-20 mADC into a 350 ohm load and a pulse output.
- B. The transducer radiating surface shall be self-cleaning and shall operate without problems in moisture, dust, and frost. It shall be suited for continuous submergence, with the interconnecting cable splice made above flood level. The transducer shall be designed to amplify acoustic output 54 times over normal outputs. Operating range shall be -40°F to 200°F. CONTRACTOR shall coordinate transducer mounting height with maximum water level to be monitored.
- C. The interconnecting cable between transducer and the amplifier shall be provided with the instrument, limited to 1,200 feet, and be run in a conduit separate from other wires or cables. The transmitters shall be temperature compensated through an internal temperature sensor within the transducer. Provide a 120 VAC power source for the amplifier.
- D. The amplifier enclosure shall house the amplifier and digital indicator in a NEMA 4 enclosure suitable for indoor or outdoor installation. For all transmitters located outdoors, transmitter shall be installed in a fiberglass hinged cover NEMA 4X enclosure with window and quick opening hasps. Enclosure shall include condensation heater, Hoffman Model D-AH601. Provide sun shield for all transmitters to be located outdoors.
- E. The level transmitters shall be Siemens, Inc., HydroRanger, or equal.

2.15 THERMOSTATS

- A. Thermostats associated with the SCADA System as specified in Section 16990-SCADA System I/O Listing, shall be provided by System Supplier as specified in Section 16141-Wiring Devices. Thermostats not specified in Section 16990-SCADA System I/O Listing shall be provided as part of Section 16141-Wiring Devices.

2.16 TVSS DEVICES FOR INSTRUMENTATION EQUIPMENT

- A. The incoming power supply of each supervisory control center shall be protected with a transient voltage surge suppression (TVSS) device. TVSS unit shall be as manufactured by Citel Model M18-120, or equal.
- B. Each analog signal entering or leaving a supervisory control panel and leaving a building shall be provided with a DIN-rail mounted surge protection device as manufactured by Citel, Model DL-24, or equal. Each transmitter shall be provided with a surge protection device as manufactured by Citel Model TSP-10, or equal, on the output and Citel Model M18-120, or equal, on the power supply.

2.17 INTRINSIC SAFETY BARRIERS

- A. Instrumentation equipment located in hazardous areas as noted on the drawings shall be wired to intrinsic safety barriers. Safety barriers for discrete devices shall include indicating LED and be DIN-rail mounted, as manufactured by Phoenix, Model PI-EX-ME-2NAM/COC, or equal. Safety barriers for analog devices shall be DIN-rail mounted, as manufactured by Phoenix, Model PI-EX-ME-RPS-I/I, or equal.

2.18 INDUSTRIAL ETHERNET SWITCHES

- A. Managed Ethernet switches shall be provided for networks shown on the drawings that include any of the following: PLCs, VFDs, and any other SCADA system Ethernet based hardware. Managed switches shall be as manufactured by Hirschmann, RS20M series, or SCALANCE X-300 Series, and include the fiber and copper ports as shown on the drawings. Each switch shall include the following.
 - 1. Selectable Ethernet star or ring topology with redundancy (ring configuration) and automatic detection of a failed fiber/ring. The switch shall automatically switch to the back-up ring upon failure of the primary ring.
 - 2. DIN-rail mounting.
 - 3. Store and forward switching.
 - 4. Redundant power inputs.
 - 5. Compliance with the following IEEE standards: 802.1D, 802.1p QoS, 802.3, 802.3u, 802.3x, 802.1w RSTP, and 802.1Q VLAN.
 - 6. SNMP with Web Browsing for switch configuration and monitoring.
 - 7. Dry contact output for indication that the switch has failed.
 - 8. 25% spare copper ports available for future connection.

2.19 PATCH PANELS

- A. Fiber optic patch panels shall be installed in each SCC and shall be used to terminate incoming fiber optic cable serving its associated structure. Patch panels shall be as manufactured by Siemon Company, or equal, model MINI-SWIC3. Each patch panel shall include the following.
 - 1. Wall-mounting enclosure with 6 to 48 fiber port terminations.

2. Fiber port designation labels with removable pocket.
3. Dust proofing grommets, strain relief hardware, cable ties and mounting hardware.
4. Thumb turn enclosure latch.
5. Bend radius guides to ensure proper storage of fiber slack.
6. Adapter plates with the appropriate fiber terminating connectors. Adapters shall be universal to accept multi-mode or single-mode fiber.

2.20 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

- A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards.
- B. Warning labels shall be self-adhesive vinyl, 4 inches by 6 inches, and be as manufactured by Conney Safety products, or equal.

PART 3-EXECUTION

3.01 SCC GENERAL

- A. Control descriptions described herein are specific in nature to equipment associated with the SCCs. CONTRACTOR shall refer to Section 1.12-General Control Algorithms for additional programming requirements.
- B. UPSs installed in all supervisory control centers shall be provided as specified herein with a relay IO module that provides a dry contact output to the PLC in the event that the UPS batteries need replacement. Indication of "Replace UPS Battery" shall be provided at the SCADA system.
- C. Control panels shall have an exterior panel-mounted receptacle and programming port for the Ethernet network, mounted to the front or side of the panel as applicable to the installation. Receptacle and programming port shall be provided to allow for PLC programming via laptop without opening the panel door. Programming port shall match that of the network (e.g., data highway, Ethernet, etc.).
- D. In the event of a power failure at any building, when power is restored, the PLC shall automatically stagger the restart of any controlled equipment that is being called to run by the PLC. The stagger time shall be HMI adjustable from 0 to 600 seconds.
- E. Provide a new power fail relay in each SCC that shall be used for control power fail alarm as well as indication that operation is from the UPS. Provide a white, 30mm, push-to-test indicating light on the front of the enclosure to indicate that power is being supplied by the UPS. Control power fail wiring shall be hard-wired and not through the PLC.

- F. There is a configurable network switch fail contact available at each Hirschmann network switch. This fail contact shall be wired to a relay, which shall be wired to the respective PLC for indication that its associated primary fiber loop has failed. Each network switch shall be configured by System Supplier (via software) to provide this alarm.
- G. Provide nameplate or laminated sheet inside the SCC enclosure indicating which inputs correspond to which PLC LED; nameplate to be an engraved nameplate. See Section 16010-General Electric Requirements

3.02 SCC-20-SCREENING BUILDING

- A. This control panel shall be a minimum of 20 inches wide by 20 inches deep by 90 inches high and be located in the Screening Building where shown on Drawing 20-E-01. This panel shall be used as a termination point for all transmitting and receiving equipment associated with the Screening Building. All control algorithms and alarms described herein shall be programmed into this PLC. Refer to the I/O listing in Section 16990-SCADA System I/O Listing for all required I/O which shall interface with this SCC. A minimum of 25% spares shall be provided for each type of input and output used.
- B. The Influent Sampler (SAM-20-01) shall receive its required contact closure from this PLC for sampling. The operator shall be able to select either influent (UFM-20-01) or effluent (UFM-60-01) flow for controlling sampler operation. The operator shall also be able to select the total flow (in gallons) between pulses. Indication of sampler sampling and number of samples taken per day shall be displayed at the SCADA system. Number of samples taken per day shall be reset with the daily runtime and flow totals. CONTRACTOR shall coordinate the required contact closure duration with the sampler manufacturer.
- C. Metering Pump Control: The phosphorus removal chemical pumps (PRCP-20-01 and PRCP-20-02) shall each receive a flow pace signal from this PLC based on an operator entered ratio input at the SCADA System (0-100%). The operator shall be able to select either the influent (UFM-20-01) or effluent (UFM-60-01) flow for control of the pumps. The chemical feed pump speeds shall be increased and decreased as the selected flow increases and decreases. The operator shall have the ability to set the range of influent/effluent flow over which the pumps are to be controlled. A pump run signal shall be generated from the PLC when a value greater than 2% is sent to the pumps and the pumps are enabled. The metering pumps shall each be manually started and stopped by the operator from the SCADA System. Provide interface relay as required.
- D. Step Screen Control: The operator shall be able to select either a timed mode or differential level mode of control from the SCADA System for the Step Screen (SSE-20-01). The two modes shall operate as follows:
 - 1. In the timed mode, the step screen shall be controlled from a repeat cycle timer within this PLC. The operator shall be able to select from 0 to 4 hours "Off Time" (in minutes) for the unit from the SCADA System. The start contact for the step screen, once the "Off Time" has expired, shall be held momentarily per the manufacturer's recommendations to allow the screen to move off of the home position sensor. The step screen shall make one revolution to move one step and then be shut down automatically by the home position sensor (HPS-20-01) once it returns to the correct position.

2. In the differential level mode, the ultrasonic differential level transmitter (ULT-20-01) shall control the screen. There shall be setup within this PLC a step screen start level setpoint and a high water level (HWL) alarm setpoint based on the step screen's differential level transmitter. When the differential level rises to the start setpoint, the screen start signal shall be held momentarily to move the screen off the home position sensor. The step screen shall be shutdown automatically by the home position sensor once it returns to the correct position, unless the water level in the channel still exceeds either the HWL or the start level. In this case, the step screen shall continue to operate until the water level is lower than these two set points. Once below these setpoints, the step screen shall be shutdown automatically by its home position sensor.
 3. There shall be operator adjustable open and close time setpoints for the flush motorized ball valve (MBV-20-01). The valve shall run on a repeat cycle timer whenever the screen is running.
 4. Power to the motor operated ball valve shall be from this SCC and shall be fused. Valve is powered to open and powered to close.
- E. The Screenings Wash Press (SSE-20-02) shall be controlled from this PLC based on the total number of start cycles from the step screen (SSE-20-01). The operator shall be able to select the number of step screen start cycles before the wash press is called to operate. The number of step screen cycles remaining before activation of the wash press shall be indicated at the SCADA System. There shall be an operator adjustable 0 to 5 minute start delay within this PLC which will delay starting of the wash press for the selected time period once the start cycles setpoint is reached. Once the start delay has expired, the wash press and the three spray wash motor operated ball valves (MBV-20-02, MBV-20-03, and MBV-20-04) shall be controlled as follows:
1. Provide a 14-step sequence with an operator adjustable time delay (0-15 seconds) between each step of the sequence. Each step shall have an operator adjustable (0-120 second) time duration. The sequence shall start at step one and continue through step 14.
 2. The operator shall be able to select either forward or reverse direction of the wash press and which of the motor operated ball valves are open for each step.
 3. It shall possible for all three of the motor operated ball valves to be open during the same step. It shall not be possible for the operator to select both the forward and reverse direction during the same step. It shall be possible for the operator to enter a time duration of zero for any step in the sequence.
 4. Once step 14 of the sequence has been completed, the wash press shall shut down.
 5. Power to the motor operated ball valves shall be supplied from this SCC and shall be fused. Valves are powered to open and powered to close.
- F. In the event of a HWL alarm from the differential level transducer or backup HWL alarm float, the mode of operation described for the Screenings Wash Press (SSE-20-02) above shall cycle through completion and then shall operate as follows:
1. The wash press shall start and run continuously in the forward direction. Once the wash press is started the valves shall cycle as described below.
 2. Every 15 seconds (operator adjustable) of forward run time, each valve shall open for an operator adjustable time period and then close. The valves shall open sequentially and the operator shall be able to assign each valve to one of three steps.
 3. After the water level drops below the HWL, the operation of the wash press shall return to normal.
 4. CONTRACTOR shall verify control description with screening equipment manufacturer.

- G. Provide a single-pole contactor in this SCC and an H-O-A selector switch on the front of this SCC for control of the Screening Building Dumpster Room Exhaust Fan (EF-20-01) and associated dampers. In Hand, the fan shall run continuously. In Auto, the fan shall be controlled from this PLC with a SCADA H-O-A switch. In SCADA Hand the fan shall run continuously. In SCADA Auto the fan shall be controlled as follows:
1. The fan shall be controlled from the control stations at the room door (CS-20-07 and CS-20-08), the room door switch (DS-20-04), and from a PLC-based repeat cycle timer.
 - a. The fan shall be started from either control station start pushbutton or by the room door switch. Once started, the fan shall run for an operator adjustable run time (0-120 minutes). The fan shall be shut down once the run time expires or either stop pushbutton is pressed.
 - b. There shall be an operator adjustable repeat cycle timer with setpoints for On-time (0-10 minutes) and Off-time (0-240 minutes), which shall cycle the fan when the room is not occupied. If the fan is started from the control stations or door switch, the repeat cycle timer shall be reset and its cycle restarted once the fan is shut down from the stop pushbuttons or the run timer.
 2. There is a low temperature thermostat (T-20-03) that shall shut down the fan and send an alarm to the SCADA system whenever the room temperature falls below the setting on the thermostat (SCADA Hand and Auto modes).
 3. The associated dampers shall open when the fan is running. Damper control shall be hard-wired and not through the PLC.
- H. Provide a single-pole contactor in this SCC and an H-O-A selector switch on the front of this SCC for control of the Screening Building Chemical Room Exhaust Fan (EF-20-02) and associated dampers. In Hand, the fan shall run continuously. In Auto, the fan shall be controlled from this PLC with a SCADA H-O-A switch. In SCADA Hand the fan shall run continuously. In SCADA Auto the fan shall be controlled as follows:
1. The fan shall be controlled from the control stations at the room door (CS-20-01 and CS-20-02), the room door switch (DS-20-01), and from a PLC-based repeat cycle timer.
 - a. The fan shall be started from either control station start pushbutton or by the room door switch. Once started, the fan shall run for an operator adjustable run time (0-120 minutes). The fan shall be shut down once the run time expires or either stop pushbutton is pressed.
 - b. There shall be an operator adjustable repeat cycle timer with setpoints for On-time (0-10 minutes) and Off-time (0-240 minutes), which shall cycle the fan when the room is not occupied. If the fan is started from the control stations or door switch, the repeat cycle timer shall be reset and its cycle restarted once the fan is shut down from the stop pushbuttons or the run timer.
 2. There is a low temperature thermostat (T-20-01) that shall shut down the fan and send an alarm to SCADA whenever the room temperature falls below the setting on the thermostat (SCADA Hand and Auto modes).
 3. The associated dampers shall open when the fan is running. Damper controls shall be hardwired and not through the PLC.
- I. The Screening Building Screening Room Supply Fan (SF-20-01) shall be controlled from this PLC with a SCADA H-O-A switch. In SCADA Hand, the fan shall run continuously. In SCADA Auto, the fan shall be controlled as follows:

1. The fan shall be controlled from the control stations at the room doors (CS-20-03, CS-20-04, CS-20-05, and CS-20-06), the room door switches (DS-20-02 and DS-20-03), and from a PLC-based repeat cycle timer.
 - a. The fan shall be started from any control station start pushbutton or by either room door switch. Once started, the fan shall run for an operator adjustable run time (0-120 minutes). The fan shall be shut down once the run time expires or any stop pushbutton is pressed.
 - b. There shall be an operator adjustable repeat cycle timer with setpoints for On-time (0-10 minutes) and Off-time (0-240 minutes), which shall cycle the fan when the room is not occupied. If the fan is started from the control stations or door switches, the repeat cycle timer shall be reset and its cycle restarted once the fan is shut down from the stop pushbuttons or the run timer.
 2. There is a low temperature thermostat (T-20-02) that shall shut down the fan and send an alarm to the SCADA system whenever the room temperature falls below the setting on the thermostat (SCADA Hand and Auto modes).
- J. Generator Interlock:
1. In the event of a power failure to the site (generator running and transfer switch in emergency position), the following equipment shall be shut down and locked out until the transfer switch returns to the "Normal" position: Electric Unit Heaters.
 2. The operator shall have the ability to override this shutdown interlock for each piece of equipment individually to allow it to be powered from the generator. The System Supplier shall provide all interface relays, contactors, etc. required to lock out the above equipment. There shall be a common override selection at SCADA which will allow the generator to be run without shutting down the equipment noted.

3.03 SCC MAIN (SCC-30)–CONTROL BUILDING

- A. The existing 18-inch wide by 48-inch high by 9-inch deep control panel in the generator room shall be reused for this SCC. Remove components on/in the panel as shown on the drawings and provide all new components as required. The existing wetwell bubbler system shall be retained and reused for the wetwell level input (PT-30-01) to the SCADA system. Provide SCC nameplate on front of panel. Provide hole plugs and cover plates as shown on the drawings. This panel shall be used as a termination point for all transmitting and receiving equipment associated with the raw sewage and storm pumps. All control algorithms and alarms described herein shall be programmed into this PLC. Refer to Section 16990-SCADA System I/O Listing for all required I/O which shall interface with this SCC. A minimum of 25% spares shall be provided for each type of input and output used.
- B. Fiber optic converters and associated equipment shall be provided in this SCC to interface the fiber optic data highway with the computer workstations as shown on the SCADA riser.
- C. The new 32 channel alarm dialer specified herein shall be provided in this panel. See Part 1.12-General Control Algorithms of this Section for description of assignment of alarms to the alarm horn and alarm dialer.

- D. The three raw sewage pumps (RSP-30-01, RSP-30-02 and RSP-30-03) shall be controlled from this PLC with a SCADA H-O-A switch. In SCADA Hand, each pump shall have an operator adjustable speed setpoint at which the pump shall run. In SCADA Auto the pumps shall be controlled as follows:
1. There shall be an operator adjustable setpoint within this PLC that shall be the level to be maintained in the wet well. When the level in the wet well rises above this setpoint the pumps shall be controlled as described below.
 - a. The lead pump shall be started and shall ramp up to full speed. After ramping to full speed, the PLC shall vary the speed of the lead pump to maintain the desired wet well level. In the event that the lead pump operates at minimum speed for an operator adjustable time (0 to 5 minutes), the lead pump shall be shut down and the pump sequence rotated (automatic alternation mode).
 - b. If the level in the wet well rises and the lead pump operates at full speed for an operator adjustable time (0 to 5 minutes), the lag pump shall be started and shall ramp up to full speed. After ramping up to full speed, the PLC shall hold the lead pump at full speed and shall vary the speed of the lag pump in order to maintain the wet well level. In the event that the lag pump operates at minimum speed for an operator adjustable time (0 to 5 minutes), the lag pump shall shut down and the lead pump shall continue to operate as described above.
 2. Provide a PLC-based alternator such that the operator can select auto alternation for the RSPs or a fixed alternation sequence. Any time a pump has failed or is out of service (MCC or SCADA H-O-A not in Auto, Call-to-Run Fail), that pump shall be removed from the alternation sequence.
 3. Only two RSPs shall be allowed to run at the same time. The third RSP shall be a standby pump. The standby pump shall be started if the lead or lag RSP is out of service.
- E. The three storm pumps (P4, P5, and P6) shall be controlled from this PLC with a SCADA H-O-A switch. In SCADA Hand, each pump shall run. In SCADA Auto the pumps shall be controlled as follows:
1. There shall be operator adjustable lead and lag storm pump start and stop setpoints based on the wet well. The lead pump shall start when the wetwell level rises above the lead pump start setpoint for an operator adjustable time duration and continue to run until the wetwell level goes below the lead pump stop setpoint for an operator adjustable time duration. The lag pump shall start when the wetwell level rises above the lag pump start setpoint for an operator adjustable time duration and continue to run until the wetwell level goes below the lag pump stop setpoint for an operator adjustable time duration.
 2. Provide a PLC-based alternator such that the operator can select auto alternation of the storm pumps or else a fixed alternation sequence. Any time a pump has failed or is out of service (starter or SCADA H-O-A not in Auto, Call-to-Run Fail), that pump shall be removed from the alternation sequence.
 3. Only two storm pumps shall be allowed to run at the same time. The third storm pump shall be a standby pump. The standby pump shall be started if the lead or lag RSP is out of service.
 4. There shall be a two position selector switch (Transducer–Backup Floats) on the front of this SCC to allow the operator to select either the level transducer or the backup floats for control of the storm pumps. In the “Transducer” mode, the pumps shall be controlled as described above. In the “backup Floats” mode, the pumps shall be controlled as described below. This switch shall be hardwired and not through the PLC.

5. The backup floats shall be enabled from the selector switch described above, when the PLC fails (scan fail), when the level transducer has failed or when the low level/common pumps off float is activated, or when the high level lag pump start float is activated. Provide a red push-to-test indicating light on the front of this SCC to indicate that the system is in the "backup floats" mode and a manual reset push-button to allow the operator to reset the level transducer and PLC system.
6. The three backup floats shall control the pumps as follows. All floats shall be intrinsically safe. This control shall be hardwired and not through the PLC.
 - a. In the event the level in the wet well rises to the lag pump start float (FS-30-03), the two selected pumps shall be started, an alarm shall be indicated at the SCADA System, and control of the pumps shall automatically be switched to the backup floats. The pumps shall stay in the backup floats mode until manually reset by the operator. Once started, the pumps shall continue to operate until the wet well level drops below the low level/common pumps off float (FS-30-01). The pumps shall then be controlled from the lead start float (FS-30-02), and high level/lag start float (FS-30-03). Provide an alarm at the SCADA System when the pumps are being controlled from the backup floats. A start and a stop signal shall be sent to each starter based on the float control.
 - b. Provide a selector switch on the front of this SCC for each pump to allow the operator to select lead, lag, or none. It shall be assumed that one pump will be assigned to each position.
 - c. Provide red push-to-test indicating lights on the front of this SCC for indication of high wet well level and low wet well level.
- F. The alarm bell output shall be activated whenever an unacknowledged alarm is present. The alarm silence pushbutton input shall turn off the alarm bell output, but not acknowledge the alarm. Acknowledging the alarm from the SCADA computer shall also turn off the alarm bell output. Alarm bell and alarm silence pushbutton are existing and are located on the existing Main Control Panel in the Control Building where shown on the drawings.
- G. Provide analog outputs (FI-60-01, FI-65-01) for storm effluent flow signal (UFM-65-01) and plant effluent flow (UFM-60-01) wired to SCC-70 for indication at existing strip chart and chart recorder in existing main control panel.
- H. Provide analog output (FI-20-01) for influent flow signal (FI-20-01) wired to SCC-20 for indication at existing chart recorder in existing main control panel.
- I. Generator Interlock:
 1. In the event of a power failure to the site (generator running and transfer switch in emergency position), the following equipment shall be shutdown and locked out until the transfer switch returns to the "Normal" position:
 - a. Digester Pumps.
 - b. RAS Building MAU.
 - c. Blower No. 3.
 - d. Blower No. 4.
 - e. Sludge Recirculating Pump P7.
 - f. Sludge Recirculating Pump P8.
 - g. Digester Supernatant/Sludge Pumps.

2. The operator shall have the ability to over-ride this shutdown interlock for each piece of equipment individually to allow it to be powered from the generator. The System Supplier shall provide all interface relays, contactors, etc. required to lock out the above equipment. There shall be a common over-ride selection at SCADA which will allow the generator to be run without shutting down the equipment noted.

3.04 SCC-70–RAS PUMPING BUILDING

- A. This control panel shall be a minimum of 30 inches wide by 20 inches deep by 90 inches high and be located in the RAS Pumping Building where shown on Drawing 70-E-01. This panel shall be used as a termination point for all transmitting and receiving equipment associated with the Final Clarifiers, RAS Pumping Building, and the Oxidation Ditches. All control algorithms and alarms described herein shall be programmed into this PLC. Refer to the I/O listing in Section 16990–SCADA System I/O Listing for all required I/O which shall interface with this SCC. A minimum of 25% spares shall be provided for each type of input and output used.
- B. The three RAS pumps (RASP-70-01, RASP-70-02, and RASP-70-03) shall be controlled from this PLC as follows:
 1. The operator shall be able to select either the influent flow (UFM-20-01) or effluent flow (UFM-60-01) for flow pace control of each pump as well as what percentage of the selected flow (0-75%) is to be returned to the oxidation ditches for each pump (0-150% total). The operator shall also have the ability to set the range of the influent/effluent flow over which the RAS pumps are to be controlled. This PLC shall then monitor the selected RAS flowmeter (see paragraph 3 below) for that pump and control the pump speed in order to obtain the selected return flow rate.
 2. As an alternate method of control for RAS to the oxidation ditches, the operator shall be able to select a constant RAS flow rate (gpm) for each pump.
 3. For RAS pump No. 2 (RASP-70-02) the operator shall be able to select either RAS flow meter MFM-70-01 or MFM-70-02 to be interlocked with this pump. RAS pump No. 1 (RASP-70-01) shall always be interlocked with RAS flow meter MFM-70-01 and RAS pump No. 3 (RASP-70-03) shall always be interlocked with RAS flowmeter MFM-70-02. The SCADA System shall not allow more than one RAS pump to be assigned to any given flow meter.
- C. The WAS valve shall be controlled from this PLC with an Open-Close-Auto (O-C-A) switch as follows:
 1. With the O-C-A switch in the “Open” position, the valve shall open. The operator shall be able to set the valve percent open (0-100%) from the SCADA system.
 2. With the O-C-A switch in the “Close” position, the valve shall close.
 3. With the O-C-A switch in the “Auto” position, the valve shall be controlled as follows:
 - a. There shall be an operator adjustable time-of-day wasting setpoint and an operator adjustable time delay between wasting (adjustable 1-7 days) set up with this PLC. The operator shall be able to enable/disable the time-of-day wasting and shall be able to enter the total gallons of sludge to be wasted and the desired WAS flow rate for the wasting setpoint. When the start setpoint is reached, the WAS valve (MOV-70-01) shall open. This PLC shall monitor the WAS sludge flow (MFM-70-03) and modulate the WAS valve position to maintain the desired flow rate. The wasting cycle shall end when the total sludge flow equals the volume entered by the operator. The total sludge wasted for the current sequence shall be indicated at the SCADA system. Once the wasting cycle has been completed, the WAS valve shall close.

- b. The WAS sequence above shall also be able to be manually initiated from the SCADA system in addition to initiation using the time-of-day setpoint.
- D. The approximate Total RAS Flow (gpm) shall be calculated within this PLC and indicated at the SCADA System as the sum of the two individual RAS flows (MFM-70-01 and MFM-70-02). This formula shall also apply for the RAS flow total (gallons). The WAS flow (MFM-70-03) and WS flow total shall be subtracted from these values.
- E. Non-potable Water Pumps (NPW-70-01 and NPW-70-02) shall be controlled from this PLC based on the NPW System Pressure as follows:
 - 1. Provide operator-adjustable lead and lag NPW pump start and stop setpoints based on the NPW system pressure (PT-70-02). When the NPW system pressure goes below the lead NPW system start setpoint, the lead pump shall start and continue to run until the NPW system pressure goes above the lead stop setpoint. If the NPW system pressure continues to fall and goes below the lag NPW system lag start setpoint, the lag pump shall start and continue to run until the NPW system pressure goes above the lag stop setpoint.
 - 2. Provide a PLC-based alternator such that the operator can select auto alternation for the pumps or else a fixed sequence. Any time a pump has failed or is out of service (MCC or SCADA H-O-A not in Auto, Call-to-Run Fail), that pump shall be removed from the alternation sequence.
 - 3. The filter effluent structure low water level float switch (FS-70-01) shall be interlocked with each NPW pump such that an alarm is indicated at SCADA and the pumps shut down upon low water level detection and remain inoperable until the alarm is cleared.
- F. The oxidation ditch aeration system shall be controlled from this PLC as follows:
 - 1. There are two aerators in the oxidation ditch which will provide oxygen and mixing to that basin. Aerators AER-40-01 and AER-40-02 are each controlled from a VFD.
 - 2. A Dissolved Oxygen (D.O.) monitoring system shall be provided in the oxidation ditch for aerator control.
 - 3. There shall be one operator adjustable D.O. setpoint within this PLC for control of the aerators. The D.O. setpoint shall be adjustable from 0.0 to 10.0 ppm. The PLC shall then compare the D.O. signal with the D.O. setpoint and change aerator stages as shown in the table below until the D.O. level in the basin is within the deadband range described below.
 - 4. There shall be an operator adjustable deadband and time delay in this PLC for the D.O. setpoint. The deadband shall be adjustable over a range of up to +/-2 ppm in 0.5 ppm increments. The time delay shall allow the operator to select a 12- to 120-minute delay between each change in aerator stage. The selected D.O. level must be outside the deadband for the selected time delay prior to a change in aerator stage.
 - 5. The PLC shall be setup to ramp over the locked out frequencies set on the VFD which have been blocked following the harmonic frequency analysis performed at start-up by the equipment supplier. This System Supplier shall coordinate these frequencies with the VFD and aerator equipment manufacturer.
 - 6. At no time shall there be less than one aerator in operation in the ditch. This System Supplier shall coordinate the minimum and maximum aerator speeds with the VFD and aerator equipment manufacturer.
 - 7. The default LEAD aerator shall be AER-40-01 and the default LAG aerator shall be AER-40-02. In the event the LEAD aerator fails or is taken out of service (HOA at MCC not in Auto, aerator not running, or SCADA HOA in Off), the PLC shall automatically

8. There shall be an operator adjustable peak flow setpoint (in MGD) within this PLC based on the plant flow. The operator shall be able to select either influent or effluent flow for this setpoint. When the selected flow rises above this setpoint, the PLC shall automatically go to STAGE 9 and remain at that stage until the flow drops below that setpoint and 1 hour has elapsed or until the operator selects an "Peak Flow Reset" from the SCADA System. Under STAGE 9, as shown below, the LAG aerator shall be turned off, and the LEAD aerator shall go to an operator adjustable STORM speed irrespective of the D.O. level and setpoints.

AERATOR STAGING	
Stage	Oxidation Ditch No. 1 AER-40-01 and AER-40-02
1	Lead VFD-LOW Lag VFD-OFF
2	Lead VFD-MEDIUM 1 Lag VFD-OFF
3	Lead VFD-MEDIUM 2 Lag VFD-OFF
4	Lead VFD-HIGH Lag VFD-OFF
5	Lead VFD-HIGH Lag VFD-LOW
6	Lead VFD-HIGH Lag VFD-MEDIUM 1
7	Lead VFD-HIGH Lag VFD-MEDIUM 2
8	Lead VFD-HIGH Lag VFD-HIGH
9	Lead VFD-STORM Lag VFD-OFF
10	Lead VFD-FAILED/OOS Lag VFD-As Required
	OOS = Out of Service

	Frequency Hz*	Aerator Impeller Speed rpm	Hp Per Aerator
LOW	46	28.0	20
MEDIUM 1	50	29.7	24
MEDIUM 2	55	32.5	32
HIGH	60	36.5	40

*Actual speed to be determined by Aerator Manufacturer at start-up in conjunction with harmonic frequency and vibration analysis. See Section 11376 for requirements for frequencies to be locked-out and ramped across.

- G. The Make-Up Air Unit (MAU-70-01) shall operate based on the status of the Exhaust Fan EF-70-01 as specified in the control description for EF-70-01 under MCC-70 below. When the unit is running, there shall be an operator adjustable MAU discharge air (duct) temperature setpoint (55°–90°F). If the outside air temperature (T-70-03) falls below the discharge temperature setpoint, a contact closure shall be sent to the controller on the

MAU to enable the electric heater. This PLC shall send a 4-20 mA signal to the controller on the MAU based on the MAU discharge air (duct) temperature setpoint in order to maintain the desired discharge air temperature (T-70-02). Coordinate analog scaling from PLC to match the SCR controller input at the unit. The 4-20 mA signal shall be disabled when the unit is not running, when the output to the electric heater is at its minimum (4 mA) for an operator adjustable time and the discharge air temperature is above the discharge air temperature setpoint, or when the outside air temperature rises above the outside air temperature setpoint. If MAU-70-01 is running and EF-70-01 is not running (in Auto), or vice versa, an "HVAC Fail" alarm shall be generated.

- H. The scum pump (SCMP-70-01) shall be controlled from this PLC with a SCADA H-O-A switch. In SCADA Hand, the pump shall run continuously, bypassing all controls. In SCADA Auto, there shall be operator adjustable scum pit start and stop level setpoints. When the scum pit level is at the start level (PT-70-01), the pump shall run until the stop level setpoint (PT-70-01) is reached.
- I. The Effluent Sampler (SAM-60-01) shall receive its required contact closure from this PLC for sampling. The operator shall be able to select either influent (UFM-20-01) or effluent (UFM-60-01) flow for controlling sampler operation. The operator shall also be able to select the total flow (in gallons) between pulses. Indication of sampler sampling and number of samples taken per day shall be displayed at the SCADA system. Number of samples taken per day shall be reset with the daily runtime and flow totals. CONTRACTOR shall coordinate the required contact closure duration with the sampler manufacturer.
- J. The gravity thickener motor-operated valves (MOV-75-01, MOV-75-02) shall be controlled from a time-of-day clock within this PLC. There shall be set up within this PLC 24 time-of-day setpoints for each valve, 12 for opening the valve and 12 for closing the valve. The operator shall be able to enable/disable each set of start and stop setpoints.
- K. Generator Interlock:
 - 1. In the event of a power failure to the site (generator running and transfer switch in emergency position), the following equipment shall be shutdown and locked out until the transfer switch returns to the "Normal" position: Electric Unit Heaters.
 - 2. The operator shall have the ability to over-ride this shutdown interlock for each piece of equipment individually to allow it to be powered from the generator. The System Supplier shall provide all interface relays, contactors, etc. required to lock out the above equipment. There shall be a common over-ride selection at SCADA which will allow the generator to be run without shutting down the equipment noted.
- L. If the RAS Pump room temperature (T-70-01) falls below a low temperature setpoint, exhaust fan EF-70-01 shall be shut down.

3.05 EXISTING MAIN CONTROL PANEL

- A. Modify the existing Main Control Panel as shown on the drawings. Provide all required signal conditioners, wiring modifications, demolition work, hole plugs, and all appurtenances.
- B. Reconfigure the existing recorders in the Main Control Panel to accept new signals from SCC-30 as shown on the drawings. The existing recorders are Badger Meter Company, Model 3000, multipen circular chart recorders.

- C. Provide signal isolators as specified herein for extending signals to chart recorders in the Control Building main control panel for the following signals: Storm Influent Flow.

3.06 MCC-20 NOTES (SEE MCC SCHEDULE, SHEET 99-E02)

A. SSE-20-01 Step Screen:

1. With the H-O-A selector switch at the unit in the "Hand" position, the motor shall run continuously. When the unit is put in the Auto mode after being operated in the Hand mode, operation of the unit shall continue until the unit returns to the home position.
2. With the H-O-A selector switch at the unit in the "Off" position, the motor shall be inoperable.
3. With the H-O-A selector switch at the unit in the "Auto" position, the motor shall be controlled from the SCADA System as described under SCC-20 above.
4. There is a high level start float switch (FS-20-01) on the upstream side of the step screen which shall start the screen (Auto mode only) and provide an alarm at the SCADA System when activated. A time delay (0 to 10 sec., adjustable) shall be provided on this signal to prevent intermittent starting due to bouncing float. The screen shall continue to operate until the float switch is deactivated and the unit returns to the home position. This shall override control from the SCADA System.
5. There is an electronic overload protection unit furnished as specified in Division 11 with the step screen which shall be installed in the starter bucket by this CONTRACTOR. When an alarm condition is detected, the motor shall be shutdown (Hand and Auto modes) and an alarm given at the SCADA System. Manual reset from the control station at the unit shall be required to restart the motor once it has been shutdown on an alarm condition.
6. There is a home position sensor (HPS-20-01) furnished with the step screen which shall be interlocked with the motor starter such that once the unit has been started it will continue to operate until it returns to the home position. Intrinsic safety barriers for home position sensor furnished as specified in Division 11 and installed by this CONTRACTOR.
7. There is a NEMA 7 safety stop switch (ES-20-01) furnished with the wash press which shall be interlocked with the step screen and wash press such that when the switch is activated, the units will be shutdown (Hand and Auto modes) and an alarm given at the SCADA System. The units shall be reset by resetting the safety switch.
8. Provide intrinsic safety barrier for the high level float switch which shall be installed in the starter bucket by CONTRACTOR.
9. There is a flush motorized ball valve (MBV-20-01) furnished with the step screen which shall be controlled as described under SCC-20 above.
10. There is a spring-loaded electromechanical brake (BS-20-01) furnished with the step screen which shall be interlocked with the unit such that the brake is applied when the unit is stopped.
11. Provide an extra capacity control power transformer for 120V power to electromechanical brake.
12. All of the above controls shall be hardwired and not through the PLC.
13. CONTRACTOR shall provide the equipment manufacturer with a copy of the wiring diagrams for control of the step screen for their review and approval.

B. SSE-20-02 Screenings Wash Press:

1. With the H-O-A selector switch at the unit in the "Hand" position, the motor shall be controlled from the Forward-Off-Reverse (F-O-R) selector switch also at the unit. Reverse position shall be spring return to center. When in the reverse mode, there shall be an operator adjustable timer (0 to 5 sec.) to limit the amount of time the motor

can be operated in the reverse direction. Once the timer has timed out, the motor shall be shutdown even if the selector switch is held in the reverse position. To restart the motor in the reverse direction, the selector switch shall be required to first be returned to the off position.

2. With the H-O-A selector switch at the unit in the "Off" position, the motor shall be inoperable.
3. With the H-O-A selector switch at the unit in the "Auto" position, the motor shall be controlled from the SCADA System as described under SCC-20 above.
4. There is a high level start float switch (FS-20-01; same float as step screen) on the upstream side of the step screen that shall start the press (Auto mode, forward direction only) when activated. A time delay (0-10 seconds, adjustable) shall be provided on the signal to prevent intermittent starting because of a bouncing float. The wash press shall run continuously until the float switch is deactivated. This shall override control from the SCADA system.
5. There is an instantaneous trip current relay furnished as specified in Division 11 which shall be installed in the starter bucket by CONTRACTOR. Provide an adjustable time delay (0 to 15 seconds) on the shutdown signal to prevent nuisance tripping caused by high starting currents. Manual reset from the control station at the unit shall be required to restart the motor.
6. There is a NEMA 7 safety stop switch (ES-20-01) provided with the wash press that shall be interlocked with the wash press and the step screen such that when the switch is activated, the units will be shut down (Hand and Auto modes) and an alarm given at the SCADA System. The units shall be reset by resetting the safety switch.
7. There are three motorized ball valves (MBV-20-02, MBV-20-03, MBV-20-04) furnished with the screenings wash press which shall be controlled as described under SCC-20 above.
8. All of the above controls shall be hardwired and not through the PLC.
9. CONTRACTOR shall provide the equipment manufacturer with a copy of the wiring diagram for control of this unit for their review and approval.

C. SF-20-01 Screening Room Supply Fan:

1. With the H-O-A selector switch in the "Hand" position, the motor shall start bypassing all controls unless otherwise noted.
2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from the SCADA system as described under SCC-20 above.
4. The associated damper shall open when the fan is running. Provide extra capacity control power transformer for 120V power to associated damper. Provide interposing relays as required for damper operation.

3.07 MCC-70A NOTES (SEE MCC SCHEDULE, SHEET 99-E02)

A. FCD-50-01, FCD-50-02 Final Clarifiers:

1. With the O-O selector switch in the "On" position the motor shall start, bypassing all controls.
2. With the O-O selector switch in the "Off" position the motor shall be inoperable.
3. There are two NEMA 7 torques switches at each unit, one set at 100% for alarm (TS-50-01/TS-50-03) at the SCADA System and the second (TS-50-02/TS-50-04) set at 120% for shutdown as well as alarm at the SCADA System. The shutdown torque switch shall be hardwired to the motor starter to shutdown the unit upon activation of this switch. Manual reset shall be required to restart motor. The shut down torque

switch shall be wired such that momentary power interruptions do not shut down the unit.

B. RASP-70-01, RASP-70-02 and RASP-70-03 RAS Pumps:

1. With the H-O-A selector switch in the "Hand" position, the motor shall start bypassing all controls (unless otherwise noted) and the speed controlled from the HIM on the MCC.
2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from the SCADA System as described under SCC-70 above.
4. Motors have internal thermal overloads which shall shut down the motor in the event of over-temperature (all control modes). Manual reset shall be required to restart motor.
5. Provide an auxiliary run contact such that the seal water motorized valve will be opened whenever the motor is running and closed whenever the motor is not running. Valve requires power to open and power to close. Provide extra capacity control power transformer for 120V power to motorized valve.

C. AER-40-01, AER-40-02 Oxidation Ditch Aerators:

1. With the H-O-A selector switch in the "Hand" position, the motor shall start bypassing all controls and the speed controlled from the HIM on the MCC.
2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from the SCADA System as described under SCC-70 above.
4. Provide auxiliary run contacts which shall be interlocked with the gear box oil and motor space heaters such that these circuits will be de-energized via these contacts when the motor is running. Coordinate with equipment manufacturer for required amp rating of auxiliary contacts.
5. Motor has a low oil pressure cutout switch which shall shut down the motor in the event of low lubrication oil pressure ("Hand" and "Auto" modes). Manual reset shall be required to restart motor. Provide a time delay per the manufacturer's recommendations to allow the motor to come up to speed prior to activating the cutout switch.
6. Motor has internal thermal overloads which shall shut down the motor in the event of overtemperature (all control modes). Manual reset shall be required to restart the motor. Internal thermal overloads shall be wired so that momentary power interruptions do not shut down the motor.
7. Provide an extra capacity control power transformer for 120V power to oil and space heaters.

D. SCMP-70-01 Scum Pump:

1. With the scum pump H-O-A selector switch in the "Hand" position, the motor shall start bypassing all controls unless otherwise noted.
2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled from the SCADA System as described under SCC-70 above.
4. Provide an auxiliary run contact such that the seal water motorized valve will be opened whenever the motor is running and closed whenever the motor is not running. Valve requires power to open and power to close. Provide extra capacity control power transformer for 120V power to motorized valve and presence/absence detector at unit.

E. MIX-40-01, MIX-40-02 Oxidation Ditch Mixers:

1. With the O-O selector switch in the "On" position, the motor shall start bypassing all controls unless otherwise noted.
 2. With the O-O selector switch in the "Off" position, the motor shall be inoperable.
 3. Motor has internal thermal overloads which shall shut down the motor in the event of thermal overload. Manual resets shall be required to restart the motor. Motor also has internal moisture detection that shall be for indication at the MCC and SCADA. The motors shall also shut down on moisture detection. A control module furnished as specified in Division 11 for moisture detection shall be installed in the starter bucket by this CONTRACTOR. Provide control power transformer for this module as required. Provide GFI protection in the MCC for this motor.
- F. EF-70-01 Exhaust Fan:
1. With the H-O-A selector switch in the "Hand" position, the motor shall start bypassing all controls.
 2. With the H-O-A selector switch in the "Off" position, the fan shall be inoperable.
 3. With the H-O-A selector switch in the "Auto" position, the exhaust fan shall run continuously unless shut down by the SCADA system as described under SCC-70 above. The makeup air unit MAU-70-01 fan start/stop signal shall be interlocked with this exhaust fan such that it operates as specified under SCC-70 above when this exhaust fan is running. The associated damper shall open when the exhaust fan is running. Provide auxiliary contacts as required.
 4. Provide extra capacity control power transformer for 120V power to associated damper and interposing relays as required for damper and makeup air unit operation.
- G. NPWP-70-01, NPWP-70-02 Nonpotable Water Pumps:
1. With the H-O-A selector switch in the "Hand" position, the motor shall start bypassing all controls unless otherwise noted.
 2. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
 3. With the H-O-A selector switch in the "Auto" position, the motor shall be controlled as described under SCC-70 above.
- H. There is a pressure switch located on the discharge side of the pump which shall be wired to the starter to shutdown the pump in the event of a high discharge pressure condition (all control modes). A time delay (0 to 30 sec., adjustable) shall be provided on the high pressure signal in order to avoid nuisance tripping due to pressure spikes. There is a presence/absence detector on the suction side of the pump which shall be wired to the starter to shutdown the pump in the event there is no sludge on the suction side of the pump (all control modes). A time delay (0 to 30 sec., adjustable) shall be provided on the presence/absence signal in order to allow the pump to prime. The presence/absence shutdown shall not be active unless the pump is called to run. Manual reset shall be required to restart the motor once it has been shutdown on a high pressure or presence/absence condition.

END OF SECTION

SECTION 16941

CONTROLS AND INSTRUMENTATION DRAWINGS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit drawings in accordance with provisions of Section 01300-Submittals.

1.03 COORDINATION

- A. The requirements set forth in this section are intended to apply to the drawings provided for the motor control specified in Section 16480-Motor Control and Section 16940-Controls and Instrumentation.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 GENERAL REQUIREMENTS

- A. All drawings shall have the following information:
 - 1. Project information including name of OWNER and specific project name acceptable to OWNER and ENGINEER.
 - 2. Drawing title accurately representing what is on the drawing.
 - 3. Unique drawing identifier consisting of a unique drawing number or drawing number with individual sheet number. If sheet numbers are used, total number of sheets must be identified on each sheet.
 - 4. System Supplier company name, address and phone number.
 - 5. Original design information including person responsible for design, date of original design, person responsible for checking of design and date of design check.
 - 6. Revision block indicating revision number, date, description of revision and person responsible for revision.
- B. All drawings shall have line numbers that can be uniquely referenced from other drawings.
- C. All drawings showing wiring shall include unique wire numbers assigned to wiring that is installed between devices in the panel. The wire number shall be shown on the drawings.
- D. All drawings showing relays shall include reference to the drawings where the relay contacts are shown. Spare relay contacts that are not used shall be identified.

3.02 DRAWINGS REQUIRED

- A. Index of Drawings: Index of drawings shall list drawing number, sheet number (if applicable), and drawing title for each drawing in drawing package.
- B. Symbol Sheet: Symbol sheet shall include:
 - 1. Explanation of all symbols used on the drawings, including but not limited to normally open/normally closed contacts, flow switches, limit switches, pressure switches, selector switches, pushbuttons, timers, control relays, solenoids, fuses, circuit breakers, terminal blocks, and contactors. Symbol sheet does not need to be specific to project, but must contain explanation of all symbols used on the drawings (i.e. special symbols used for a particular project must be added to standard symbol sheets).
 - 2. List of abbreviations used on the drawings.
 - 3. Explanation of continuation method for circuits that can not be shown on a single sheet.
- C. Exterior Enclosure Layout Drawing: Exterior layout drawing shall show location of all externally mounted equipment. Exterior layout drawing shall include:
 - 1. Enclosure dimensions, enclosure NEMA rating (i.e. NEMA 1, NEMA 4X Stainless Steel, NEMA 4X non metallic, etc.), and enclosure color or finish.
 - 2. Location and actual depiction of panel latches, hinges, mounting holes and lifting eyes.
 - 3. Location and accurate representation of equipment mounted on enclosure (i.e. switches should look like actual switches being installed, indicating lights should look like actual lights being installed).
 - 4. Equipment nameplate location.
 - 5. Description for each piece of equipment or unique identifier and parts list or bill of material.
 - 6. Nameplate list including nameplate wording, size, construction (i.e. lamicoid with black background and white letters), and mounting method (i.e. stainless steel screws). Label size must include size in inches or reference to a standard sizes included on symbol sheet or elsewhere in drawing package.
 - 7. Identification of area reserved for equipment located inside enclosure, but not actually mounted on enclosure backpanel, such as UPS's, fiber optic break out panels, and lighting packages.
- D. Interior Enclosure Layout Drawing: Interior layout drawing shall show location of all internally mounted equipment. Interior layout drawing shall include:
 - 1. Backpanel dimensions and finish.
 - 2. Location and accurate representation of equipment (i.e. terminal blocks should look like actual terminal blocks, receptacle should look like actual receptacle, etc.).
 - 3. Dimensions of internally mounted equipment are not necessary, but equipment should be drawn to scale such that an accurate representation of the way equipment will be mounted is shown on the drawing.
 - 4. Description for each piece of equipment or unique identifier and parts list or bill of material.
- E. Interconnection Diagram, Network Diagram or Block Diagram: Interconnection diagram, Network Diagram or Block Diagram shall show all cabling between system components and identify any station addressing or node numbers that are assigned to equipment. All cables shall be identified by cable type including specific manufacture and model/part

number. Party responsible for furnishing and installing cable shall also be included. Some examples of cables that must shown are:

1. Antenna cables.
2. Communications cables between system components (fiber and/or copper). This includes fiber optic jumpers between fiber break out boxes and equipment and Ethernet patch cables between switches and devices.
3. Communications cables (fiber and/or copper) between PLCs, controllers, operator interface equipment, and security devices (e.g. card readers, electric strikes, and motion detectors) that are not shown on the elementary schematics.

F. Elementary Schematic: Elementary schematic shall be developed for each motor or supplied equipment and shall include:

1. Nominal voltage, AC or DC designation, number of phases (if AC) and frequency in hertz (if AC) for each source of electrical supply to the enclosure.
2. Prospective short circuit current available at the point of electrical supply to the enclosure.
3. Type of power supply system grounding (e.g. wye phase midpoint grounded, delta phases corner grounded, wye phases midpoint grounded, delta phases ungrounded, etc.)
4. Complete documentation of electrical circuit from supply to motor or supplied equipment. Documentation shall include disconnecting means, main overcurrent protection (when supplied), branch overcurrent protection (when supplied), control circuit and special purpose control protection, motor control, overload protection, local disconnect (when supplied), and motor horsepower and full load amps from nameplate or supplied equipment full load amps. If
5. Documentation of PLC or controller inputs and outputs.
6. Documentation of all circuit breaker/motor protector ratings, fuse sizes, control power transformer VA ratings, dip switch settings, etc.

G. Wiring Diagram: Wiring diagrams shall show all terminations for all cables external to the enclosure. Terminations may be shown on the elementary schematics as long as the termination information is concise and easily understood by the personnel installing the field wiring. Termination information shall be shown for all devices, including devices that are not part of System Suppliers scope of supply. A box with two dots or continuation arrows indicating continuation to a piece of equipment are not acceptable.

H. Calculations Summary: Calculations summary shall include calculations performed to:

1. Determine size of UPS.
2. Determine air conditioning equipment requirement.
3. Determine control power transformer sizing. Control power transformer sizing calculations may be generic based on typical circuits.

I. Functional Testing Recommendations: Testing recommendations shall include description of functional tests that must be performed by operators. Functional test description shall be included for UPS, indicating lights, and other devices whose condition can only be determined by testing.

3.03 SAMPLE DRAWINGS

- A. Sample drawings showing an acceptable format are included in the Appendix. The samples included in the Appendix do not represent the only acceptable method of showing the required information.

END OF SECTION

SECTION 16951

SPARE PARTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Spare parts for applicable sections of Division 16, as noted below.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. UL labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.
- B. NEMA/ANSI Compliance: Comply with National Electrical Manufacturer's Association, American National Standards Institute, and other standards pertaining to material, construction, and testing where applicable.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All electrical equipment and material shall be received and stored with the factory interproof wrapping intact. Provide factory-wrapped waterproof flexible barrier metal for factory packaging of equipment and material to protect against physical damage in transit. When applicable, equipment stored shall be in factory coverings in a clean, dry, indoor space which provides protection against the weather.
- B. All spare parts shall be suitably boxed or wrapped to prevent deterioration and shall be completely identified on the outside.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Spare parts specified herein shall be provided by the manufacturer listed in the section where the equipment is specified.

2.02 PANELBOARDS

- A. Furnish four 20/1 branch circuit breakers.

2.03 MOTOR CONTROL CENTERS

- A. The following shall be furnished:
 - 1. One set of fuses for each VFD size (horsepower) provided.
 - 2. Twenty replacement lamps and lamp replacement tool for push-to-test indicating lights.
 - 3. One replacement relay for each type of relay provided, including time-delay relays.
 - 4. Replacement contacts, along with all related springs, bolts, and other materials necessary to completely rebuild one line contactor of each type furnished.
 - 5. One control power transformer for each size provided.
 - 6. Replacement filters for each size and/or type of filter provided.

2.04 LIGHTING

- A. Furnish 10% spare lamps for each type of lamp provided. Also furnish one of each type of ballast provided.

2.05 CONTROLS AND INSTRUMENTATION

- A. The following shall be furnished.
 - 1. One PLC processor.
 - 2. One PLC power supply for each type provided.
 - 3. 10% of PLC input/output cards for each type provided (analog and discrete), minimum one each.
 - 4. Two transient/spike suppressors.
 - 5. One network switch.
 - 6. 10% of PLC communication cards, minimum of one each.

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SCADA SYSTEM I/O LISTING

STRAND ASSOCIATES INC.
WASHINGTON WWTF PHASE 1 DESIGN SERVICES
CONTRACT 1-2009
SCADA SYSTEM I/O LISTING - SCC-20

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
20	UPS BATTERY		1	0	0	0	2-#14	FROM UPS RELAY CARD IN THIS SCC
20	REPLACE SCC-20 POWER FAIL		1	0	0	0	2-#14	FROM POWER FAIL RELAY IN THIS SCC
20	SCC-20 ETHERNET SWITCH FAILURE		1	0	0	0	2-#14	FROM ETHERNET SWITCH IN THIS SCC
20	MCC-20 POWER FAIL		1	0	0	0	2-#14	FROM VOLTAGE MONITOR IN MCC-20
20	PLC LOW BATTERY		0	0	0	0		FROM LOGIC WITHIN THIS PLC
20	INFLUENT SAMPLER	SAM-20-01						
20	FLOW PACE PULSE	FPP-20-01	0	1	0	0	2-#14	TO INFLUENT SAMPLER IN SCREENING BUILDING SAMPLER ROOM
20	STEP SCREEN NO. 1	SSE-20-01						
20	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC-20
20	FAILED		1	0	0	0	2-#14	FROM STARTER IN MCC-20
20	IN AUTO		1	0	0	0	2-#14	FROM H-O-A SWITCH AT UNIT
20	OVER CURRENT		1	0	0	0	2-#14	FROM OVERCURRENT RELAY IN STARTER BUCKET
20	HOME POSITION	HPS-20-01	1	0	0	0	2-#14	FROM HOME POSITION SENSOR AT UNIT
20	START		0	1	0	0	2-#14	TO STARTER IN MCC-20
20	DIFFERENTIAL LEVEL	ULT-20-01	0	0	1	0	SH. PR.	FROM ULTRASONIC LEVEL TRANSMITTER IN SAMPLER ROOM
20	HIGH WATER LEVEL	FS-20-01	1	0	0	0	2-#14	FROM FLOAT SWITCH UPSTREAM OF SCREEN
20	FLUSH VALVE OPEN	MBV-20-01	0	1	0	0	2-#14	TO MOTORIZED BALL VALVE AT STEP SCREEN
20	FLUSH VALVE CLOSE	MBV-20-01	0	1	0	0	2-#14	TO MOTORIZED BALL VALVE AT STEP SCREEN
20	STEP SCREEN NO. 2 (FUTURE)	SSE-20-03	6	3	1	0		FUTURE
20	SCREENING WASH PRESS NO. 1	SSE-20-02						
20	FORWARD RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC-20
20	REVERSE RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC-20
20	COMMON FAILED		1	0	0	0	2-#14	FROM STARTER IN MCC-20
20	IN AUTO		1	0	0	0	2-#14	FROM H-O-A SWITCH AT UNIT
20	OVERCURRENT		1	0	0	0	2-#14	FROM OVERCURRENT RELAY IN STARTER BUCKET
20	EMERGENCY STOP PULLED	ES-20-01	1	0	0	0	2-#14	FROM EMERGENCY STOP SWITCH AT UNIT
20	FORWARD START/STOP		0	1	0	0	2-#14	TO STARTER IN MCC-20
20	REVERSE START/STOP		0	1	0	0	2-#14	TO STARTER IN MCC-20
20	INPUT WASHWATER VALVE OPEN	MBV-20-02	0	1	0	0	2-#14	TO MOTORIZED VALVE AT WASH PRESS
20	INPUT WASHWATER VALVE CLOSE	MBV-20-02	0	1	0	0	2-#14	TO MOTORIZED VALVE AT WASH PRESS
20	WASHING ZONE WASHWATER VALVE OPEN	MBV-20-03	0	1	0	0	2-#14	TO MOTORIZED VALVE AT WASH PRESS
20	WASHING ZONE WASHWATER VALVE CLOSED	MBV-20-03	0	1	0	0	2-#14	TO MOTORIZED VALVE AT WASH PRESS
20	SCREW WASHWATER VALVE OPEN	MBV-20-04	0	1	0	0	2-#14	TO MOTORIZED VALVE AT WASH PRESS
20	SCREW WASHWATER VALVE CLOSE	MBV-20-04	0	1	0	0	2-#14	TO MOTORIZED VALVE AT WASH PRESS
20	SCREENING WASH PRESS NO. 2 (FUTURE)	SSE-20-04	6	8	0	0		FUTURE
20	PLANT INFLUENT FLOW	UFM-20-01	0	0	1	0	SH. PR.	FROM INFLUENT FLOW METER AT INFLUENT STRUCTURE

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SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
20	PHOSPHORUS REMOVAL CHEMICAL TANK LEVEL (0-11 FT)	ULT-20-02	0	0	1	0	SH. PR.	FROM ULTRASONIC LEVEL TRANSMITTER IN SAMPLER ROOM
20	PHOSPHORUS REMOVAL CHEMICAL FEED PUMP NO. 1	PRCP-20-01						
20	FLOW PACE SIGNAL	FP-20-01	0	0	0	1	SH. PR.	TO CHEMICAL METERING PUMP IN CHEMICAL ROOM
20	ENABLE		0	1	0	0	2~#14	TO CHEMICAL METERING PUMP RECEPTACLE IN CHEMICAL ROOM
20	PHOSPHORUS REMOVAL CHEMICAL FEED PUMP NO. 2	PRCP-20-02	0	1	0	1		SAME AS PRCP-20-01
20	CHEMICAL ROOM 2002							
20	START PUSHBUTTON	CS-20-01	1	0	0	0	2~#14	FROM EAST INTERIOR CONTROL STATION
20	STOP PUSHBUTTON	CS-20-01	1	0	0	0	2~#14	FROM EAST INTERIOR CONTROL STATION
20	RUNNING LIGHT	CS-20-01	0	1	0	0	2~#14	TO EAST INTERIOR CONTROL STATION
20	START PUSHBUTTON	CS-20-02	1	0	0	0	2~#14	FROM EAST EXTERIOR CONTROL STATION
20	STOP PUSHBUTTON	CS-20-02	1	0	0	0	2~#14	FROM EAST EXTERIOR CONTROL STATION
20	RUNNING LIGHT	CS-20-02	0	1	0	0	2~#14	TO EAST EXTERIOR CONTROL STATION
20	DOOR SWITCH	DS-20-01	1	0	0	0	2~#14	FROM EAST DOOR SWITCH
20	LOW TEMPERATURE	T-20-01	1	0	0	0	2~#14	FROM THERMOSTAT IN CHEMICAL ROOM
20	CHEMICAL ROOM EXHAUST FAN	EF-20-02						
20	IN AUTO		1	0	0	0	2~#14	FROM H-O-A SWITCH ON FRONT OF SCC
20	RUNNING		1	0	0	0	2~#14	FROM AUXILIARY CONTACT ON CONTACTOR IN SCC
20	START/STOP		0	1	0	0	2~#14	TO CONTACTOR IN SCC
20	SCREENING ROOM 2003							
20	START PUSHBUTTON	CS-20-03	1	0	0	0	2~#14	FROM EAST INTERIOR CONTROL STATION
20	STOP PUSHBUTTON	CS-20-03	1	0	0	0	2~#14	FROM EAST INTERIOR CONTROL STATION
20	START PUSHBUTTON	CS-20-04	1	0	0	0	2~#14	FROM EAST EXTERIOR CONTROL STATION
20	STOP PUSHBUTTON	CS-20-04	1	0	0	0	2~#14	FROM EAST EXTERIOR CONTROL STATION
20	RUNNING LIGHT	CS-20-04	0	1	0	0	2~#14	TO EAST EXTERIOR CONTROL STATION
20	START PUSHBUTTON	CS-20-05	1	0	0	0	2~#14	FROM WEST INTERIOR CONTROL STATION
20	STOP PUSHBUTTON	CS-20-05	1	0	0	0	2~#14	FROM WEST INTERIOR CONTROL STATION
20	START PUSHBUTTON	CS-20-06	1	0	0	0	2~#14	FROM WEST EXTERIOR CONTROL STATION
20	STOP PUSHBUTTON	CS-20-06	1	0	0	0	2~#14	FROM WEST EXTERIOR CONTROL STATION
20	RUNNING LIGHT	CS-20-06	0	1	0	0	2~#14	TO WEST EXTERIOR CONTROL STATION
20	EAST DOOR SWITCH	DS-20-02	1	0	0	0	2~#14	FROM EAST DOOR SWITCH
20	WEST DOOR SWITCH	DS-20-03	1	0	0	0	2~#14	FROM WEST DOOR SWITCH
20	LOW TEMPERATURE	T-20-02	1	0	0	0	2~#14	FROM THERMOSTAT IN SCREENING ROOM
20	SCREENING ROOM SUPPLY FAN	SF-20-01						
20	IN AUTO		1	0	0	0	2~#14	FROM H-O-A SWITCH ON STARTER IN MCC-20

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SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
20	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC-20
20	STARTER OVERLOAD		1	0	0	0	2-#14	FROM STARTER IN MCC-20
20	START/STOP		0	1	0	0	2-#14	TO STARTER IN MCC-20
20	DUMPSTER ROOM 2001							
20	START PUSHBUTTON	CS-20-07	1	0	0	0	2-#14	FROM SOUTH INTERIOR CONTROL STATION
20	STOP PUSHBUTTON	CS-20-07	1	0	0	0	2-#14	FROM SOUTH INTERIOR CONTROL STATION
20	START PUSHBUTTON	CS-20-08	1	0	0	0	2-#14	FROM SOUTH EXTERIOR CONTROL STATION
20	STOP PUSHBUTTON	CS-20-08	1	0	0	0	2-#14	FROM SOUTH EXTERIOR CONTROL STATION
20	RUNNING LIGHT	CS-20-08	0	1	0	0	2-#14	TO SOUTH EXTERIOR CONTROL STATION
20	DOOR SWITCH	DS-20-04	1	0	0	0	2-#14	FROM SOUTH DOOR SWITCH
20	LOW TEMPERATURE	T-20-03	1	0	0	0	2-#14	FROM THERMOSTAT IN DUMPSTER ROOM
20	DUMPSTER ROOM EXHAUST FAN	EF-20-01						
20	IN AUTO		1	0	0	0	2-#14	FROM H-O-A SWITCH ON FRONT OF SCC
20	RUNNING		1	0	0	0	2-#14	FROM AUXILIARY CONTACT ON CONTACTOR IN SCC
20	START/STOP		0	1	0	0	2-#14	TO CONTACTOR IN SCC
20	SCREENING BUILDING ELECTRIC UNIT HEATER NO. 1 PERMISSIVE	EUH-20-01	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN SCREENING BUILDING
20	SCREENING BUILDING ELECTRIC UNIT HEATER NO. 2 PERMISSIVE	EUH-20-02	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN SCREENING BUILDING
20	SCREENING BUILDING ELECTRIC UNIT HEATER NO. 3 PERMISSIVE	EUH-20-03	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN SCREENING BUILDING
20	SCREENING BUILDING ELECTRIC UNIT HEATER NO. 4 PERMISSIVE	EUH-20-04	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN SCREENING BUILDING
20	SCREENING BUILDING ELECTRIC UNIT HEATER NO. 5 PERMISSIVE	EUH-20-05	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN SCREENING BUILDING
	TOTALS		58	38	4	2		

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SCADA SYSTEM I/O LISTING - SCC-30

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
30	RAW SEWAGE PUMP NO. 1	RSP-30-01						
30	RUNNING		1	0	0	0	2~#14	FROM VFD IN CONTROL BUILDING HALLWAY
30	VFD FAILED		1	0	0	0	2~#14	FROM VFD IN CONTROL BUILDING HALLWAY
30	INTERNAL THERMAL OVERLOAD		1	0	0	0	2~#14	FROM VFD IN CONTROL BUILDING HALLWAY
30	IN AUTO		1	0	0	0	2~#14	FROM VFD IN CONTROL BUILDING HALLWAY
30	START/STOP		0	1	0	0	2~#14	TO VFD IN CONTROL BUILDING HALLWAY
30	SPEED INDICATION		0	0	1	0	SH. PR.	FROM VFD IN CONTROL BUILDING HALLWAY
30	SPEED CONTROL		0	0	0	1	SH. PR.	TO VFD IN CONTROL BUILDING HALLWAY
30	RAW SEWAGE PUMP NO. 2	RSP-30-02	4	1	1	1		SAME AS RSP-30-01
30	RAW SEWAGE PUMP NO. 3	RSP-30-03	4	1	1	1		SAME AS RSP-30-01
30	EMERGENCY GENERATOR							
30	RUNNING		1	0	0	0	2~#14	FROM EXISTING GENERATOR CONTROL PANEL
30	TROUBLE		1	0	0	0	2~#14	FROM EXISTING GENERATOR CONTROL PANEL
30	PHASE A CURRENT	CT-30-01	0	0	1	0	SH. PR.	FROM CURRENT TRANSFORMER AT GENERATOR CIRCUIT BREAKER
30	AUTOMATIC TRANSFER SWITCH							
30	NORMAL POSITION		1	0	0	0	2~#14	FROM EXISTING ATS IN MAIN POWER PANEL
30	STANDBY POSITION		1	0	0	0	2~#14	FROM EXISTING ATS IN MAIN POWER PANEL
30	STORM INFLUENT FLOW	CFM-30-01	0	0	1	0	SH. PR.	FROM SIGNAL SPLITTER AT MAIN CONTROL PANEL
30	UTILITY POWER FAIL		1	0	0	0	2~#14	FROM CUSTOMER METERING MODULE IN MDP
30	SCC-30 POWER FAIL		1	0	0	0	2~#14	FROM POWER FAIL RELAY IN THIS SCC
30	SCC-30 ETHERNET SWITCH FAILURE		1	0	0	0	2~#14	FROM ETHERNET SWITCH IN THIS SCC
30	REPLACE UPS BATTERY		1	0	0	0	2~#14	FROM UPS RELAY IN THIS SCC
30	WET WELL FLOODED		1	0	0	0	2~#14	FROM JUNCTION BOX IN MECHANICAL ROOM
30	LOW BLOWER AIR PRESSURE		1	0	0	0	2~#14	FROM EXISTING PRESSURE SWITCH
30	DIGESTER PUMP NO. 1							
30	GENERATOR PERMISSIVE		0	1	0	0	2~#14	TO EXISTING STARTER AT AERATION TANK
30	DIGESTER PUMP NO. 2		0	1	0	0		SAME AS DIGESTER PUMP NO. 1
30	DIGESTER NO. 1 HIGH WATER LEVEL	FS-80-01	1	0	0	0	2~#14	FROM FLOAT SWITCH AT DIGESTER NO. 1
30	DIGESTER NO. 2 HIGH WATER LEVEL	FS-80-02	1	0	0	0	2~#14	FROM FLOAT SWITCH AT DIGESTER NO. 2
30	DIGESTER NO. 3 HIGH WATER LEVEL	FS-80-03	1	0	0	0	2~#14	FROM FLOAT SWITCH AT DIGESTER NO. 3
30	DIGESTER NO. 4 HIGH WATER LEVEL	FS-80-04	1	0	0	0	2~#14	FROM FLOAT SWITCH AT DIGESTER NO. 4
30	CONTROL BUILDING BASEMENT FLOODING		1	0	0	0	2~#14	FROM SUMP PUMP CONTROL PANEL IN BASEMENT
30	NORTH FILTER OVERFLOW		1	0	0	0	2~#14	FROM JUNCTION BOX IN MECHANICAL ROOM
30	STORM EFFLUENT FLOW	FI-65-01	0	0	0	1	SH. PR.	TO EXISTING STORM EFFLUENT STRIP CHART IN MAIN
30	PLANT EFFLUENT FLOW	FI-60-01	0	0	0	1	SH. PR.	TO EXISTING PLANT EFFLUENT CHART RECORDER IN MAIN CONTROL PANEL
30	WETWELL LEVEL	PT-30-1	0	0	1	0	SH. PR.	FROM EXISTING PT-1 IN THIS SCC

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SCADA SYSTEM I/O LISTING - SCC-30

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
30	ALARM BELL		0	1	0	0	2-#14	TO EXISTING ALARM BELL AT MAIN CONTROL PANEL
30	ALARM DIALER		0	32	0	0	64-#14	TO DIALER IN THIS SCC
30	ALARM DIALER LOW BATTERY		1	0	0	0	2-#14	FROM DIALER IN THIS SCC
30	INFLUENT FLOW	FI-20-01	0	0	0	1	SH. PR.	TO EXISTING INFLUENT FLOW RECORDER AT MAIN CONTROL PANEL
30	ALARM SILENCE PB		1	0	0	0	2-#14	FROM EXISTING SILENCE PB ON MAIN CONTROL PANEL
30	STORM PUMP P4							
30	RUNNING		1	0	0	0	2-#14	FROM STARTER AT UNIT
30	FAILED		1	0	0	0	2-#14	FROM RELAY IN STARTER AT UNIT
30	IN AUTO		1	0	0	0	2-#14	FROM H-O-A SWITCH ON STARTER AT UNIT
30	START/STOP		0	1	0	0	2-#14	TO STARTER AT UNIT
30	STORM PUMP P5							
30	RUNNING		1	0	0	0	2-#14	FROM STARTER AT UNIT
30	FAILED		1	0	0	0	2-#14	FROM RELAY IN STARTER AT UNIT
30	IN AUTO		1	0	0	0	2-#14	FROM H-O-A SWITCH ON STARTER AT UNIT
30	START/STOP		0	1	0	0	2-#14	TO STARTER AT UNIT
30	STORM PUMP P6		3	1	0	0		SAME AS P5
30	RAW SEWAGE WET WELL							
30	LOW LEVEL/Common Pumps Off Float	FS-30-01	1	0	0	0	2-#14	FROM FLOAT SWITCH IN WET WELL
30	LEAD PUMP ON FLOAT	FS-30-02	1	0	0	0	2-#14	FROM FLOAT SWITCH IN WET WELL
30	HIGH LEVEL/LAG PUMP ON FLOAT	FS-30-03	1	0	0	0	2-#14	FROM FLOAT SWITCH IN WET WELL
30	BLOWER NO. 3							
30	GENERATOR PERMISSIVE		0	1	0	0	2-#14	TO EXISTING STARTER IN PUMP AND BLOWER BUILDING MCC
30	BLOWER NO. 4		0	1	0	0		SAME AS BLOWER NO. 3
30	SLUDGE RECIRCULATING PUMP P7							
30	GENERATOR PERMISSIVE		0	1	0	0	2-#14	TO EXISTING STARTER IN PUMP AND BLOWER BUILDING MCC
30	SLUDGE RECIRCULATING PUMP P8		0	1	0	0		SAME AS PUMP P7
30	DIGESTER SUPERNATANT/SLUDGE PUMP NO. 1							
30	GENERATOR PERMISSIVE		0	1	0	0	2-#14	TO EXISTING STARTER IN PUMP AND BLOWER BUILDING MCC
30	DIGESTER SUPERNATANT/SLUDGE PUMP NO. 2		0	1	0	0		SAME AS PUMP NO. 1
	TOTALS		42	47	6	6		

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SCADA SYSTEM I/O LISTING - SCC-70

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
70	RAS PUMP NO. 1	RASP-70-01						
70	RUNNING		1	0	0	0	2~#14	FROM VFD IN MCC-70A
70	VFD FAILED		1	0	0	0	2~#14	FROM VFD IN MCC-70A
70	INTERNAL THERMAL OVERLOAD		1	0	0	0	2~#14	FROM VFD IN MCC-70A
70	IN AUTO		1	0	0	0	2~#14	FROM H-O-A SWITCH IN MCC-70A
70	START/STOP		0	1	0	0	2~#14	TO VFD IN MCC-70A
70	SPEED INDICATION		0	0	1	0	SH. PR.	FROM VFD IN MCC-70A
70	SPEED CONTROL		0	0	0	1	SH. PR.	TO VFD IN MCC-70A
70	RAS PUMP NO. 2	RASP-70-02	4	1	1	1		SAME AS RASP-70-01
70	RAS PUMP NO. 3	RASP-70-03	4	1	1	1		SAME AS RASP-70-01
70	RAS PUMP NO. 4 (FUTURE)	RASP-70-04	4	1	1	1		FUTURE
70	RAS PUMP NO. 5 (FUTURE)	RASP-70-05	4	1	1	1		FUTURE
70	NPW PUMP NO. 1	NPWP-70-01						
70	RUNNING		1	0	0	0	2~#14	FROM STARTER IN MCC-70A
70	FAILED		1	0	0	0	2~#14	FROM STARTER IN MCC-70A
70	IN AUTO		1	0	0	0	2~#14	FROM H-O-A IN MCC-70A
70	START/STOP		0	1	0	0	2~#14	TO STARTER SWITCH IN MCC-70A
70	NPW PUMP NO. 2	NPWP-70-02	3	1	0	0		SAME AS NPW-70-01
70	PLANT WATER STRAINER	STR-70-01						
70	IN AUTO		1	0	0	0	2~#14	FROM STR-70-01 CONTROL PANEL
70	MOTOR FAIL		1	0	0	0	2~#14	FROM STR-70-01 CONTROL PANEL
70	MOTOR RUNNING		1	0	0	0	2~#14	FROM STR-70-01 CONTROL PANEL
70	BW VALVE OPEN		1	0	0	0	2~#14	FROM STR-70-01 CONTROL PANEL
70	HIGH DIFFERENTIAL PRESSURE		1	0	0	0	2~#14	FROM STR-70-01 CONTROL PANEL
70	NPW SYSTEM PRESSURE	PT-70-02	0	0	1	0	SH. PR.	FROM NPW SYSTEM PRESSURE TRANSMITTER
70	NPW SYSTEM LOW PRESSURE	PS-70-02	1	0	0	0	2~#14	FROM NPW SYSTEM PRESSURE SWITCH
70	NPW PUMP LOW WATER LEVEL SHUTDOWN	FS-70-01	1	0	0	0	2~#14	FROM LOW WATER LEVEL FLOAT SWITCH IN FILTER EFFLUENT STRUCTURE
70	SCUM PUMP	SCMP-70-01						
70	RUNNING		1	0	0	0	2~#14	FROM STARTER IN MCC-70A
70	FAILED		1	0	0	0	2~#14	FROM STARTER IN MCC-70A
70	IN AUTO		1	0	0	0	2~#14	FROM H-O-A SWITCH IN MCC-70A
70	START/STOP		0	1	0	0	2~#14	TO STARTER IN MCC-70A
70	HIGH PRESSURE SHUTDOWN	PS-70-01	1	0	0	0	2~#14	FROM PRESSURE SWITCH AT UNIT
70	LOSS OF SLUDGE SHUT DOWN	PB-70-01	1	0	0	0	2~#14	FROM PRESENCE/ABSENCE DETECTOR AT UNIT
70	SCUM PIT							
70	LEVEL (0-6 FEET)	PT-70-01	0	0	1	0	SH. PR.	FROM PRESSURE TRANSDUCER IN RAS PUMP ROOM
70	FINAL CLARIFIER NO. 1	FCD-50-01						

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SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
70	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC-70A
70	FAILED		1	0	0	0	2-#14	FROM STARTER IN MCC-70A
70	HIGH TORQUE ALARM	TS-50-01	1	0	0	0	2-#14	FROM TORQUE SWITCH AT UNIT
70	HIGH TORQUE SHUTDOWN	TS-50-02	1	0	0	0	2-#14	FROM TORQUE SWITCH AT UNIT
70	FINAL CLARIFIER NO. 2	FCD-50-02	4	0	0	0	2-#14	SAME AS FCD-50-01
70	FINAL CLARIFIER NO. 3 (FUTURE)	FCD-50-03	4	0	0	0	2-#14	FUTURE
70	FINAL CLARIFIER NO. 4 (FUTURE)	FCD-50-04	4	0	0	0	2-#14	FUTURE
70	FINAL CLARIFIER NO. 5 (FUTURE)	FCD-50-05	4	0	0	0	2-#14	FUTURE
70	FINAL CLARIFIER NO. 6 (FUTURE)	FCD-50-06	4	0	0	0	2-#14	FUTURE
70	WAS MOTORIZED VALVE	MOV-70-01					2-#14	FROM HOA SELECTOR SWITCH AT UNIT
70	IN AUTO		1	0	0	0	SH. PR.	FROM HOA SWITCH ON VALVE ACTUATOR
70	POSITION DEMAND	ZC-70-01	0	0	0	1	SH. PR.	TO MOTORIZED VALVE IN RAS PUMPING ROOM
70	POSITION FEEDBACK	ZT-70-01	0	0	1	0	SH. PR.	FROM MOTORIZED VALVE IN RAS PUMPING ROOM
70	RAS FLOW NO. 1	MFM-70-01						
70	INSTANTANEOUS FLOW		0	0	1	0	SH. PR.	FROM FLOW TRANSMITTER IN RAS PUMPING ROOM
70	TOTALIZED FLOW		1	0	0	0	2-#14	FROM FLOW TRANSMITTER IN RAS PUMPING ROOM
70	RAS FLOW NO. 2	MFM-70-02						
70	INSTANTANEOUS FLOW		0	0	1	0	SH. PR.	FROM FLOW TRANSMITTER IN RAS PUMPING ROOM
70	TOTALIZED FLOW		1	0	0	0	2-#14	FROM FLOW TRANSMITTER IN RAS PUMPING ROOM
70	WAS FLOW	MFM-70-03						
70	INSTANTANEOUS FLOW		0	0	1	0	SH. PR.	FROM FLOW TRANSMITTER IN RAS PUMPING ROOM
70	TOTALIZED FLOW		1	0	0	0	2-#14	FROM FLOW TRANSMITTER IN RAS PUMPING ROOM
70	RAS FLOW NO. 3 (FUTURE)	MFM-70-04						
70	INSTANTANEOUS FLOW		0	0	1	0		FUTURE
70	TOTALIZED FLOW		1	0	0	0		FUTURE
70	RAS FLOW NO. 4 (FUTURE)	MFM-70-05						
70	INSTANTANEOUS FLOW		0	0	1	0		FUTURE
70	TOTALIZED FLOW		1	0	0	0		FUTURE
70	OXIDATION DITCH AERATOR NO. 1	AER-40-01						
70	RUNNING		1	0	0	0	2-#14	FROM VFD IN MCC-70A
70	VFD FAILED		1	0	0	0	2-#14	FROM VFD IN MCC-70A
70	INTERNAL THERMAL OVERLOAD		1	0	0	0	2-#14	FROM VFD IN MCC-70A
70	IN AUTO		1	0	0	0	2-#14	FROM H-O-A SWITCH IN MCC-70A
70	LOW OIL PRESSURE	PS-40-01	1	0	0	0	2-#14	FROM PRESSURE SWITCH AT UNIT
70	START/STOP		0	1	0	0	2-#14	TO VFD IN MCC-70A
70	SPEED INDICATION		0	0	1	0	SH. PR.	FROM VFD IN MCC-70A
70	SPEED CONTROL		0	0	0	1	SH. PR.	TO VFD IN MCC-70A
70	OXIDATION DITCH AERATOR NO. 2	AER-40-02	5	1	1	1		SAME AS AER-40-01

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SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
70	OXIDATION DITCH AERATOR NO. 3 (FUTURE)	AER-40-03	5	1	1	1		FUTURE
70	OXIDATION DITCH AERATOR NO. 4 (FUTURE)	AER-40-04	5	1	1	1		FUTURE
70	OXIDATION DITCH AERATOR NO. 5 (FUTURE)	AER-40-05	5	1	1	1		FUTURE
70	OXIDATION DITCH AERATOR NO. 6 (FUTURE)	AER-40-06	5	1	1	1		FUTURE
70	OXIDATION DITCH MIXER NO. 1	MIX-40-01						
70	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC-70A
70	FAILED		1	0	0	0	2-#14	FROM STARTER IN MCC-70A
70	INTERNAL THERMAL OVERLOAD		1	0	0	0	2-#14	FROM SENSOR AT UNIT/MCC-70A
70	MOISTURE		1	0	0	0	2-#14	FROM SENSOR AT UNIT/MCC-70A
70	OXIDATION DITCH MIXER NO. 2	MIX-40-02	4	0	0	0		SAME AS MIX-40-01
70	OXIDATION DITCH MIXER NO. 3 (FUTURE)	MIX-40-03	4	0	0	0		FUTURE
70	OXIDATION DITCH MIXER NO. 4 (FUTURE)	MIX-40-04	4	0	0	0		FUTURE
70	OXIDATION DITCH MIXER NO. 5 (FUTURE)	MIX-40-05	4	0	0	0		FUTURE
70	OXIDATION DITCH MIXER NO. 6 (FUTURE)	MIX-40-06	4	0	0	0		FUTURE
70	DISSOLVED OXYGEN CONTROLLER	DOC-40-01						
70	DISSOLVED OXYGEN		0	0	1	0	SH. PR.	FROM DO TRANSMITTER AT OXIDATION DITCH
70	TEMPERATURE		0	0	1	0	SH. PR.	FROM DO TRANSMITTER AT OXIDATION DITCH
70	DISSOLVED OXYGEN CONTROLLER (FUTURE)	DOC-40-02	0	0	2	0		FUTURE
70	DISSOLVED OXYGEN CONTROLLER (FUTURE)	DOC-40-03	0	0	2	0		FUTURE
70	MCC-70 POWER FAIL		1	0	0	0	2-#14	FROM VOLTAGE MONITOR IN MCC-70A
70	SCC-70 POWER FAIL		1	0	0	0	2-#14	FROM POWER FAIL RELAY IN THIS SCC
70	SCC-70 ETHERNET SWITCH FAILURE		1	0	0	0	2-#14	FROM ETHERNET SWITCH IN THIS SCC
70	REPLACE UPS BATTERY		1	0	0	0	2-#14	FROM UPS RELAY CARD IN THIS SCC
70	MAKE UP AIR UNIT	MAU-70-01						
70	FAN RUNNING		1	0	0	0	2-#14	FROM MAU STARTER ON UNIT
70	FAN STARTER OVERLOAD		1	0	0	0	2-#14	FROM MAU STARTER ON UNIT
70	ELECTRIC HEATER ENABLE/DISABLE		0	1	0	0	2-#14	TO MAU CONTROLLER AT UNIT
70	DISCHARGE AIR TEMPERATURE CONTROL	T-70-02	0	0	1	0	SH. PR.	FROM DISCHARGE AIR TEMPERATURE SENSOR IN MAU DISCHARGE DUCTWORK
70	RAS PUMPING BUILDIGN OUTSIDE AIR TEMPERATURE	T-70-03	0	0	1	0	SH. PR.	FROM TEMPERATURE SENSOR ON THE EXTERIOR OF THE RAS PUMPING BUILDING
70	DISCHARGE AIR TEMPERATURE CONTROL		0	0	0	1	SH. PR.	TO MAU CONTROLLER AT UNIT
70	RAS PUMP ROOM EXHAUST FAN	EF-70-01						
70	IN AUTO		1	0	0	0	2-#14	FROM H-O-A SWITCH IN MCC-70A
70	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC-70A
70	STARTER OVERLOAD		1	0	0	0	2-#14	FROM STARTER IN MCC-70A
70	LOW TEMPERATURE SHUTDOWN		0	1	0	0	2-#14	TO STARTER IN MCC-70A

STRAND ASSOCIATES INC.
WASHINGTON WWTF PHASE 1 DESIGN SERVICES
CONTRACT 1-2009
SCADA SYSTEM I/O LISTING - SCC-70

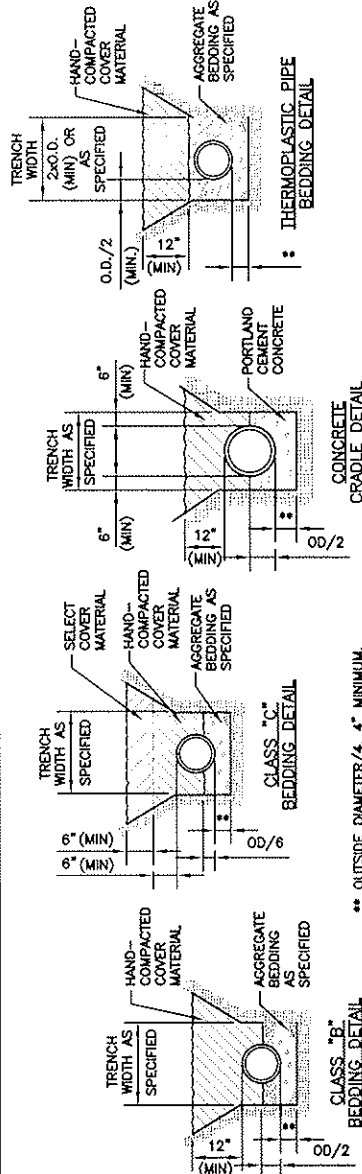
SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
70	SUMP PUMPS HIGH WATER LEVEL		1	0	0	0	2-#14	FROM SUMP PUMP CONTROL PANEL IN RAS PUMPING BUILDING
70	SEP HIGH WATER LEVEL		1	0	0	0	2-#14	FROM SEP CONTROL PANEL IN RAS PUMPING BUILDING
70	RAS PUMPING BUILDING TEMPERATURE	T-70-01	0	0	1	0	SH. PR.	FROM ANALOG THERMOSTAT
70	RAS PUMPING BUILDING ELECTRIC UNIT HEATER NO. 1 PERMISSIVE	EUH-70-01	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN RAS PUMPING BUILDING
70	RAS PUMPING BUILDING ELECTRIC UNIT HEATER NO. 2 PERMISSIVE	EUH-70-02	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN RAS PUMPING BUILDING
70	RAS PUMPING BUILDING ELECTRIC UNIT HEATER NO. 3 PERMISSIVE	EUH-70-03	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN RAS PUMPING BUILDING
70	RAS PUMPING BUILDING ELECTRIC UNIT HEATER NO. 4 PERMISSIVE	EUH-70-04	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN RAS PUMPING BUILDING
70	RAS PUMPING BUILDING ELECTRIC UNIT HEATER NO. 5 PERMISSIVE	EUH-70-05	0	1	0	0	2-#14	TO UNIT THERMOSTAT IN RAS PUMPING BUILDING
70	EFFLUENT SAMPLER	SAM-60-01						
70	FLOW PACE PULSE	FPP-60-01	0	1	0	0	2-#14	TO EFFLUENT SAMPLER AT CHLORINE CONTACT TANK
70	PLANT EFFLUENT FLOW	UFM-60-01	0	0	1	0	SH. PR.	FROM ULTRASONIC FLOWMETER AT CHLORINE CONTACT TANK
70	STORM EFFLUENT FLOW	UFM-65-01	0	0	1	0	SH. PR.	FROM EXISTING STORM EFFLUENT FLOW TRANSMITTER IN CHLORINE BUILDING
70	HIGH PLANT EFFLUENT LEVEL/EFFLUENT FLOW INACCURATE	FS-60-01	1	0	0	0	2-#14	FROM FLOAT SWITCH AT CHLORINE CONTACT TANK
70	GRAVITY THICKENER NO. 1 MOTOR OPERATED VALVE	MOV-75-01						
70	IN AUTO		1	0	0	0	2-#14	FROM HOA SWITCH ON VALVE ACTUATOR
70	OPEN COMMAND		0	1	0	0	2-#14	TO VALVE ACTUATOR AT GRAVITY THICKENER NO. 1
70	CLOSE COMMAND		0	1	0	0	2-#14	TO VALVE ACTUATOR AT GRAVITY THICKENER NO. 1
70	OPENED		1	0	0	0	2-#14	FROM VALVE ACTUATOR AT GRAVITY THICKENER NO. 1
70	CLOSED		1	0	0	0	2-#14	FROM VALVE ACTUATOR AT GRAVITY THICKENER NO. 1
70	GRAVITY THICKENER NO. 2 MOTOR OPERATED VALVE	MOV-75-02	3	2	0	0		SAME AS MOV-75-01
	TOTALS		140	26	30	13		

DRAWINGS

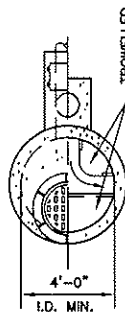
NOTES

1. DETAILS RELATIVE TO ITEMS SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
2. VARIATIONS IN DIMENSIONS AND DESIGN MAY BE PERMISSIBLE, PROVIDING EQUIVALENT CAPACITY AND STRENGTH ARE ATTAINED.
3. ALL CONCRETE FILLETS SHALL BE HAND TROWELED WITH A 1/4" FT. SLOPE.
4. INSIDE DIMENSIONS FOR MANHOLES: USE MINIMUM 4" DIAMETER FOR SEWER LESS THAN 18" IN DIAMETER; USE MINIMUM 5" DIAMETER FOR SEWER 18" THRU 24" IN DIAMETER; USE MINIMUM 6" DIAMETER OR MINIMUM 6" SQUARE FOR SEWER OVER 24" IN DIAMETER.
5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.
6. DROP TYPE ENTRANCE TO STANDARD MANHOLE WILL BE PAID FOR SEPARATELY IF SO LISTED IN THE BID.
7. SEE DRAWINGS FOR DROP TYPE ENTRANCES FOR SANITARY SEWERS LARGER THAN 15".
8. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF REGULATORY BODIES OF THE STATE AND APPLICABLE MUNICIPAL ORDINANCES.
9. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.
10. FLAT SLAB TOPS SHALL BE DESIGNED FOR H-20 TRUCK LOADING AND SHALL MEET REQUIREMENTS OF ASTM C-478.
11. BASE SLABS SHALL BE REINFORCED AS FOLLOWS: REINFORCING SHALL BE PLACED IN EACH DIRECTION AT 2" CLEAR FROM TOP SURFACE OF SLAB. REINFORCING SHALL BE GRADE 60. USE OF CAST-IN-PLACE SLAB SHALL NOT RELIEVE CONTRACTOR OF REQUIREMENTS TO PROVIDE WATERTIGHT JOINTS.
12. FLAT SLABS SHALL BE PROVIDED IN SHALLOW DEPTH SITUATIONS IN LIEU OF ECCENTRIC CONES.

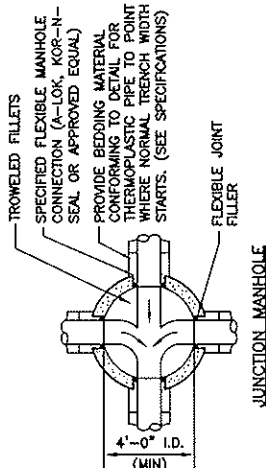
INSIDE DIA.	DEPTH	REINF.
4"	≤ 30"	#3@8"
5"	≤ 20"	#3@8"
6"	20'-30"	#4@10"
6"	≤ 20"	#4@10"
6"	20'-25"	#4@8"
6"	25'-30"	#4@6"



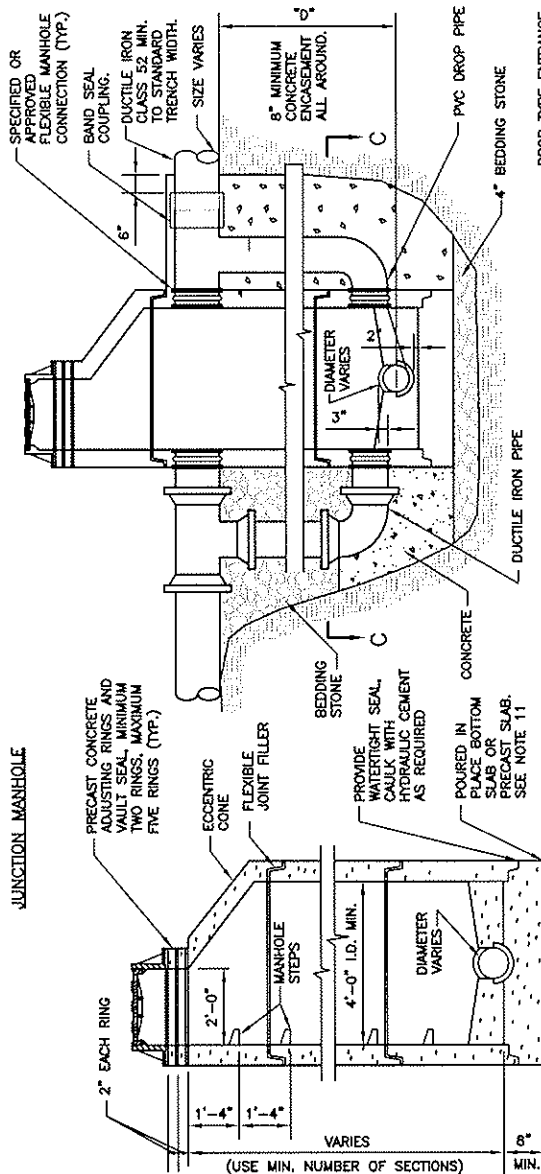
** OUTSIDE DIAMETER/4, 4" MINIMUM.



HALF SECTION C-C



JUNCTION MANHOLE



DROP TYPE ENTRANCE OPTIONS TO STANDARD MANHOLE

STANDARD PRECAST MANHOLE

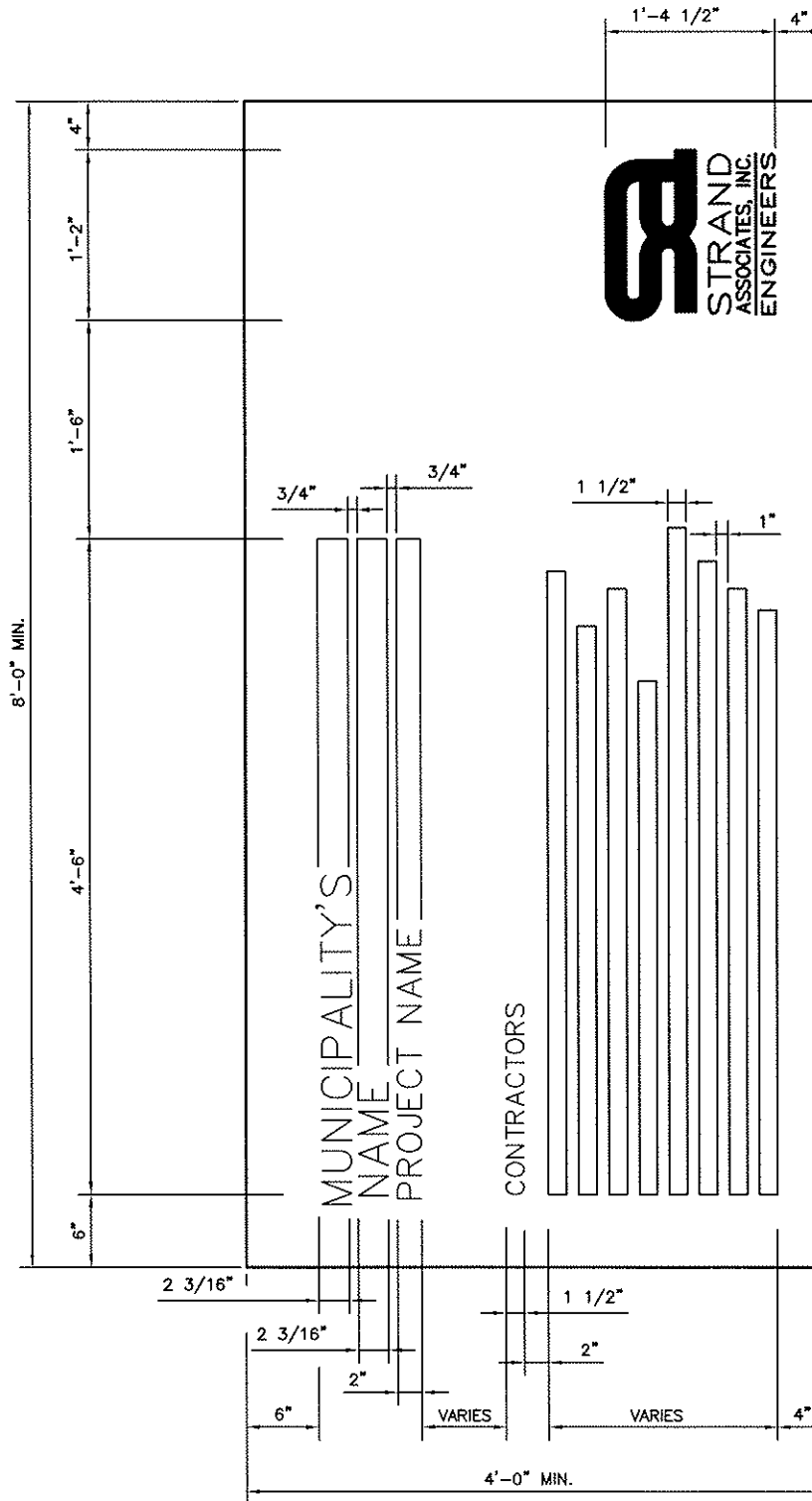
SANITARY SEWER APPURTENANCES

STANDARD DETAIL

STRAND
ASSOCIATES, INC.[®]
ENGINEERS

01-975-43A

DECEMBER 2003



NOTES:

BLUELINE FOR LOGO WILL BE FURNISHED TO CONTRACTOR FOR SIGN PAINTING.

SEE SPECIFICATIONS FOR SIGN CONSTRUCTION DETAILS AND SPECIAL REQUIREMENTS

STANDARD COLORS ARE TO BE AS NOTED:

"SA" LOGO = SLATE GRAY
LETTERING = BLACK
BACKGROUND = WHITE

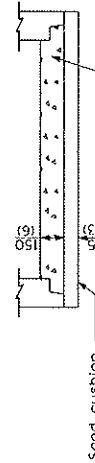
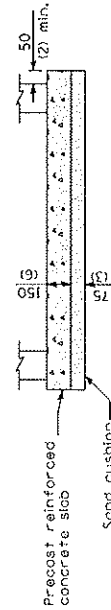
PROJECT SIGN LAYOUT

STANDARD DETAIL



01-975-158A

DECEMBER 2003



Precast reinf. conc. slab when the precast reinf. conc. section alternate is used.

ALTERNATE BOTTOM SLAB

Illinois Department of Transportation

ISSUED 3-1-97

PASSED April 1, 2006

APPROVED April 1, 2006

ENGINEER Scott Smith

DESIGNER Michael D. Hume

BY Michael D. Hume

DATE 4/1/06

DATE	REVISIONS
4-1-06	Revised detail for concrete fill in elevation views.
1-1-97	Revised Standard 1527-10.

MANHOLE TYPE A

STANDARD 602401-01

ALTERNATE MATERIALS FOR WALLS	D	C	T (min.)
Concrete Masonry Unit	1.2 m (4'-0") 1.5 m (5'-0")	750 (30) 1.15 m (3'-9")	125 (5) 125 (5)
Brick Masonry	1.2 m (4'-0") 1.5 m (5'-0")	750 (30) 1.15 m (3'-9")	200 (8) 200 (8)
Prestressed Reinforced Concrete Section	1.2 m (4'-0") 1.5 m (5'-0")	750 (30) 1.15 m (3'-9")	100 (4) 125 (5)
Cast-in-place Concrete	1.2 m (4'-0") 1.5 m (5'-0")	750 (30) 1.15 m (3'-9")	150 (6) 150 (6)

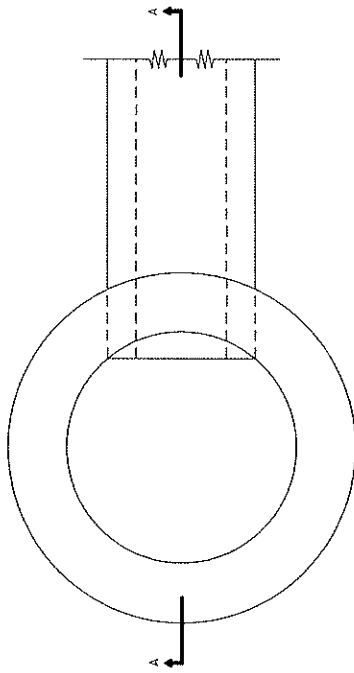
GENERAL NOTES

See Standard 602701 for details of steps.

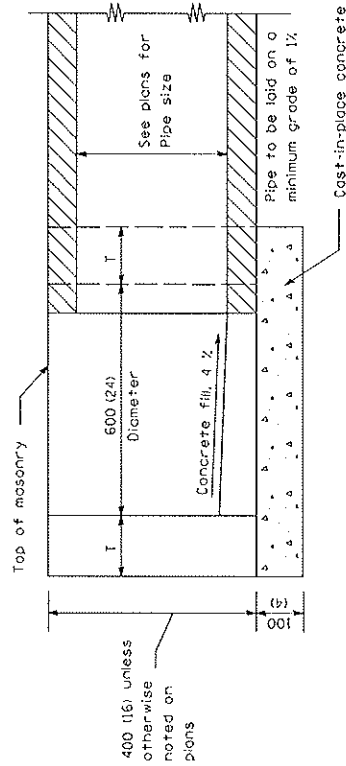
* Dimension "C" for Precast Reinforced Concrete Sections may vary from the dimension given to plus 150 mm (6").

*** See Standard 602601 for Optional Precast Reinforced Concrete Flat Slab Top.

All dimensions are in millimeters (inches) unless otherwise shown.

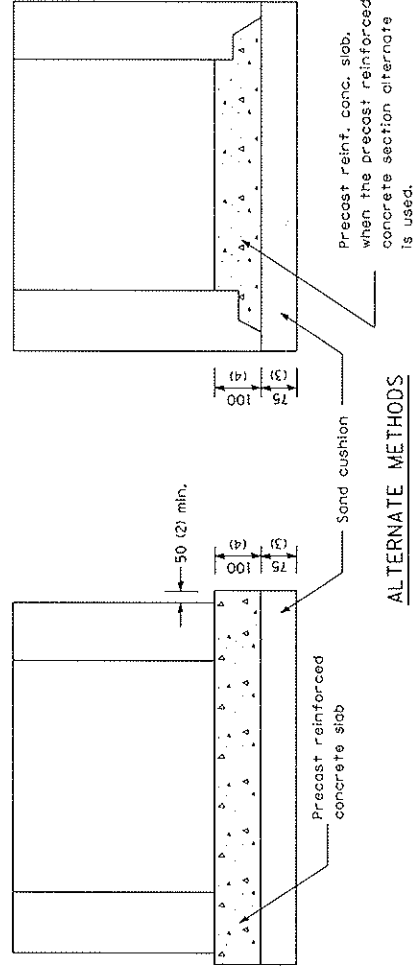


PLAN



SECTION A-A

ALTERNATE MATERIALS FOR WALLS		T
BRICK MASONRY		200 (8)
CAST-IN-PLACE CONCRETE		150 (6)
CONCRETE MASONRY UNIT		125 (5)
PRECAST REINFORCED CONCRETE SECTION		75 (3)



ALTERNATE METHODS

All dimensions are in millimeters (inches) unless otherwise shown.

REVISIONS		INLET - TYPE A	
DATE	REVISIONS		
4-1-06	Added concrete fill in bottom of inlet.		
1-1-97	Renum. Standard 1683-5		
		STANDARD 602301-01	

Illinois Department of Transportation PASSED April 1, 2008 ENGINEER <i>Scott S. Smith</i> APPROVED <i>Michael J. Smith</i> REGISTERED PROFESSIONAL ENGINEER NUMBER OF DESIGN AND INSTRUMENT	ISSUED 1-1-97
	2008
	2006
	2004

SOILS INFORMATION

**GEOTECHNICAL ENGINEERING REPORT
OF
SITE INVESTIGATION
WASHINGTON SEWAGE TREATMENT
PLANT #2 IMPROVEMENTS
WASHINGTON, ILLINOIS
BY
WHITNEY & ASSOCIATES
PEORIA, ILLINOIS**

**PREPARED
FOR**

Mr. Ken Newman, P.E.
City of Washington
115 West Jefferson Street
Washington, Illinois 61571

DATE

December 6, 2006

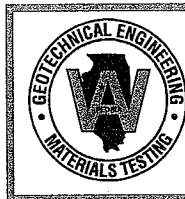
**WHITNEY & ASSOCIATES
PEORIA, ILLINOIS**

TELEPHONE

309-673-2131

TESTS * INVESTIGATIONS
ANALYSIS * DESIGN * EVALUATIONS
CONSULTATION * REPORTS * INSPECTIONS
ARBITRATION * EXPERT WITNESS TESTIMONY

SOILS * PORTLAND CEMENT CONCRETE
BITUMINOUS CONCRETE * STEEL
ASPHALT * AGGREGATES * EMULSIONS
POZZOLANIC MATERIALS * LIME

**WHITNEY & ASSOCIATES**

INCORPORATED

2406 West Nebraska Avenue
PEORIA, ILLINOIS 61604-3193

TELEFAX

309-673-3050

GEOTECHNICAL ENGINEERING
CONSTRUCTION QUALITY CONTROL
SUBSURFACE EXPLORATIONS
ENVIRONMENTAL INVESTIGATIONS

MONITORING WELL INSTALLATIONS
BUILT-UP ROOF INVESTIGATIONS
WELDER CERTIFICATIONS
INSURANCE INVESTIGATIONS

December 6, 2006

Mr. Ken Newman, P.E.
City of Washington
115 West Jefferson Street
Washington, Illinois 61571

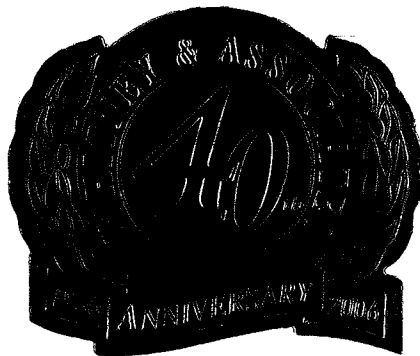
Re: Geotechnical Engineering
Report Of Site Investigation
Washington Sewage Treatment
Plant #2 Improvements
Washington, Illinois

Dear Mr. Newman:

Pursuant to your request, our geotechnical engineering firm has performed a subsurface soils and ground water investigation in conjunction with an evaluation of these subsurface conditions for the above referenced project.

The results of our foundation investigation and evaluation indicate that conventional, reinforced concrete spread foundation systems are appropriate for the proposed sewage treatment plant improvements. Only a few minor excavation and/or construction problems are anticipated at the proposed site as a result of the subsurface soil and ground water conditions, providing all of the recommendations presented in this report are satisfied.

If any questions or comments arise in regard to this geotechnical engineering report, or if any additional information is desired, please do not hesitate to contact us at your convenience.



Respectfully submitted,

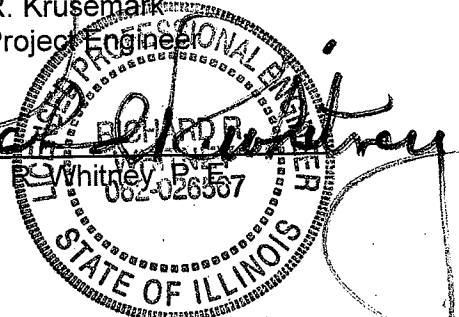
WHITNEY & ASSOCIATES

(By)

James R. Krusemark
James R. Krusemark
Senior Project Engineer

(By)

Richard Whitney
Richard Whitney, P.E.
062-026567



JRK/RRW:rma

Enclosures

Cc: Mr. Brian Molenaar, P.E.
Strand Associates, Inc.

WHITNEY & ASSOCIATES
PEORIA, ILLINOIS

**GEOTECHNICAL ENGINEERING REPORT
OF
SITE INVESTIGATION
WASHINGTON SEWAGE TREATMENT
PLANT #2 IMPROVEMENTS
WASHINGTON, ILLINOIS
BY
WHITNEY & ASSOCIATES
PEORIA, ILLINOIS**

INTRODUCTION

This geotechnical engineering report presents a summary of the results of a subsurface soils and ground water investigation at the site for the proposed Sewage Treatment Plant #2 Improvements in Washington, Illinois.

Included in this report are the results of our field and laboratory tests as well as a summary of the data that was obtained during the investigation. In addition, this geotechnical engineering report includes our recommendations relevant to the proposed site development, foundation construction and potential construction problems which may occur as a result of either adverse soil and/or ground water conditions present at the proposed site.

SCOPE OF THE INVESTIGATION

This subsurface soils and ground water investigation included the drilling of twelve (12) exploratory soil borings for the proposed treatment plant improvements on November 27 and 28, 2006, which extended to depths ranging from sixteen (16) to

thirty-three (33) feet below the existing ground surface. During the drilling and sampling phase of the investigation, tests, visual classifications and analyses of the various soil types encountered were performed by our personnel and their results were recorded on the enclosed Soil Boring Logs.

The soil samples that were obtained in the field were taken to our materials testing laboratory where they were further subjected to engineering tests and evaluation. An analysis of the field and laboratory tests was made by our geotechnical engineer, and this engineering report was prepared which presents our recommendations and our substantiating data regarding the earthwork operations and foundation construction.

EXISTING SITE AND SUBSURFACE CONDITIONS

At the present time, the proposed building sites exist as undeveloped areas within primarily the western and eastern areas of the existing sewage treatment plant. In the areas of the exploratory borings, approximately four (4) to seven (7) inches of sandy clay to sandy loam organic topsoil was noted at the existing surface grades. Active underground piping, electrical and control lines are known to exist within the western portion of the site which will most likely require removal or relocation. On the other hand, no active overhead utility lines were noted at the site which would require relocation or removal. These observations by our drill crew personnel must be verified by others prior to the preparation of the final plans and specification documents.

SUBSURFACE SOIL CONDITIONS

As may be observed from an inspection of the Soil Boring Logs included in the Appendix of this report, considerable variation in the composition exists within the

soils encountered near the existing surface grades, which are most likely due to previous site development at this facility. Near the existing surface grades, cohesive soils were typically noted to depths ranging from approximately four (4) to seven (7) feet below the existing surface grades. These soils were primarily classified as sandy clay and sandy clay loam soils with varying amounts of fine-grained gravel as well as some silty clay, silty clay loam and silty clay glacial till soil types. Cohesionless soils were however noted near the surface grades in Boring B-1 and generally below the cohesive soils discussed above which ranged in classification from fine- to coarse-grained sands with varying amounts of fine- to coarse-grained gravel and silty clay to coarse-grained gravel and cobbles. As the exploratory borings were extended into the subsoils, preconsolidated glacial till soils were encountered at depths ranging from approximately four (4) to twelve (12) feet (Elevations 639 to 630) and typically extended in depth until the exploratory borings were discontinued by our drill crew personnel. Seams or pockets of fine- to medium-grained and medium- to coarse-grained sand or silt were however noted at the lower extent of Borings B-2, B-5, B-8 and B-9.

The consistency of the normally consolidated soils and cohesive fill material encountered near the existing surface grades ranged from medium to hard and the relative density of the surficial granular soils ranged from very loose to dense. Upon penetration of the preconsolidated soils, the consistency of the glacial till was classified as stiff to hard with the limited cohesionless sands encountered within the strata classified as medium-density to dense. Standard penetration tests, designated as "N" values, ranged between 3 and 48 blows per foot within the soils encountered during the scope of this site investigation.

Review of the soil samples collected during this site investigation did not reveal any unusual odor or visual indication for potential contamination of the subsurface soils.

An acceptable range of natural moisture contents prevail within the soils encountered at the site. The natural moisture contents of the cohesive soils ranged from 7 to 24 percent and, in general, would be considered somewhat near an estimated optimum moisture content range of approximately 14 to 17 percent for the typical soil types encountered. Upon penetration of the glacial till soils, natural moisture contents ranging from approximately 11 to 16 percent were recorded and these soils would likewise be considered near to slightly above their respective optimum moisture content range.

GROUND WATER CONDITIONS

It may also be observed from an inspection of the Soil Boring Logs that ground water was encountered at the site. The ground water elevations in the open bore holes were checked after the completion of the drilling operations and after a time lapse of 24+ hours. These readings and site observations indicate that perched ground water accumulations exist near the glacial till interface at depths ranging from five (5) to twelve (12) feet below the existing surface grades. Some variation in the ground water levels may be experienced however, due to typical climatic variations.

A few minor excavation and/or construction problems may be anticipated at the proposed site as a result of the ground water conditions due to the fact that the ground water levels appear to exist within the proposed vertical limits of the lower level construction. Pumping of seepage and ground water accumulations may be anticipated from those excavations which extend beyond a depth of approximately

seven (7) to nine (9) feet below the existing surface grades and are allowed to remain open for an extended period of time.

DISCUSSIONS

FIELD DRILLING PROCEDURES

The exploratory soil borings were made with a truck-mounted, rotary auger drill rig using six-inch diameter, hollow-stem, continuous-flight auger attachments. By using these hollow-stem augers, it was possible for the drill crew to retrieve relatively undisturbed soil samples in advance of the auger cutting head as well as determine the approximate depth at which ground water was encountered. Also by using the hollow stem augers, the depth of water could be obtained upon removal of the augers from the open holes after a time lapse of at least 24 hours.

FIELD SAMPLING PROCEDURES

Representative soil samples were obtained at approximately two and one-half (2.5) feet intervals throughout each of the soil borings to a depth of 16 feet whereupon five (5) feet intervals were utilized until the borings were discontinued by our drill crew personnel. Standard split-barrel soil samplers (ASTM D1586) were used in the investigation to obtain the soil samples at the various sampling intervals. In addition, the standard split-barrel samplers were used to determine the number of blows "N" of standard penetration into the subsoils, using a 140-pound hammer dropping freely 30 inches per stroke. The results of these standard penetration tests indicate a comparative consistency of the soils and thereby provide a basis for estimating the relative shear strength and compressibility characteristics of the soil profile components.

LABORATORY TESTING PROCEDURES

The representative cohesive soil samples which were obtained during the field investigation were tested in unconfined compression with the aid of a

calibrated compression testing machine to determine their relative shear strength characteristics. A calibrated, hand penetrometer was also used to assist our soil mechanics engineer in determining the relative consistency of the soils encountered at the various soil strata. Natural moisture content and dry density tests were also conducted on the representative soil samples obtained. The results of all of the field and laboratory tests are shown on the enclosed Soil Boring Logs included in the Appendix of this report. All tests were conducted in accordance with current ASTM Specifications and Procedures.

SOIL CLASSIFICATION

The United States Bureau of Soils and Chemistry Classification System was used to describe the soils encountered in the various soil borings. The soils were identified in the field and further verifications of these classifications were made in the laboratory. The soils encountered in the borings have been described in accordance with the standard textural classification chart. All of the soils were classified visually. Also included in the Appendix of this report is a Soil Mechanics Classification System sheet which will aid in clarifying the descriptions of the various soils.

The enclosed Soil Boring Logs provide descriptions of the subsurface conditions at the exploratory boring locations and variations from these conditions may be encountered throughout the site. The lines of stratification indicated on the Soil Boring Logs represent the approximate boundaries of the soil types although the transition between the materials may be gradual.

SOIL BORING LOCATIONS AND ELEVATIONS

The locations of the exploratory soil borings with respect to the proposed plant improvements were established by personnel from Whitney & Associates in conjunction with Mr. Ken Newman and personnel from Strand Associates. A Plot Plan

sheet illustrating the locations of the exploratory soil borings with respect to the site has been included in the Appendix of this report. The ground surface elevations of the borings as indicated on the Soil Boring Logs have been referenced to the U.S.G.S. datum from given benchmark elevations at the treatment plant. Corresponding depths below the existing ground surface have also been depicted on the Soil Boring Logs.

DESIGN CONSIDERATIONS

A few preliminary design parameters relating to the types of structures were known at the time of the preparation of this report. It is our understanding that the proposed sewage treatment plant improvements are to consist of the construction of an oxidation ditch and two (2) clarifiers within the west central portion of the site and a chlorine contact tank towards the southern limits of the existing site. Conventional reinforced concrete construction is anticipated for these structures with base elevations ranging from approximately ten (10) to seventeen (17) feet below the existing surface grades proposed for these improvements. It is also our understanding that the proposed improvements will include a slab-on-grade, screening building near the northwest portion of the site and sludge drying beds proposed within the eastern limits of the site.

RECOMMENDATIONS

The following recommendations are made in regard to the proposed site and foundation work. These recommendations are based on the data which was obtained in the subsurface investigation and the laboratory tests which were conducted on select representative soil samples.

EARTHWORK OPERATIONS

The contractor shall be responsible for designing and constructing stable, temporary excavations and should slope or bench the lower level excavations

as required to maintain stability of the excavation sides. In no case should the slope height, inclination or excavation depth, including utility excavation trench depths, exceed those specified in local, state and federal safety regulations. The contractors "responsible person" as defined in the OSHA Safety Standards should evaluate the soil conditions exposed in the excavations as a part of the contractors safety procedures. Materials removed from the excavation should not be stockpiled immediately adjacent to the excavation as the imposed load could cause a failure of the excavation walls. We are providing this information solely as a service for our client and under no circumstances should it be interpreted to indicate that Whitney & Associates is assuming any responsibility for construction site safety or the contractors activities.

Based on the results of this site investigation, it is our opinion that the cohesive soils and cohesionless sands and gravels encountered to an approximate depth of seven (7) to twelve (12) feet below the existing surface grades would be classified as an OSHA Type "C" soil classification due to the ground water conditions and granular nature of this strata. On the other hand, it is our opinion that the preconsolidated glacial till soils encountered below these approximate depths would be considered a Type "A" soil. Excavation observation must be conducted however to determine the potential presence of silt or sand seams/pockets at which time the soil classification should be down graded. It is also our opinion that a seismic Site Class "D" is appropriate for the proposed building site in accordance with International Building Code site classification criteria.

As indicated previously, seepage and ground water accumulations may be anticipated from those excavations which extend beyond a depth of approximately seven (7) to nine (9) feet below the existing surface grades. The establishment of

sump pits and ground water pumping will be required for the lower level excavations and construction operations. The seepage water infiltration can be expected to be significantly greater in those areas wherein cohesionless sands and gravels exist above the glacial till soils and reduced in those areas where cohesive soils are encountered.

It is recommended that the soils required to backfill the below grade excavations consist of select, on-site soils or pit-run sands and gravels placed in eight (8) inch thick layers and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D-698) in non-structural areas and to 98 percent of standard Proctor maximum dry density in those areas subjected to structural loading.

The earth pressures acting on the below grade walls will be influenced by the structural design of the walls, the conditions of wall restraint, methods of compaction and integrity of the materials being restrained. The following estimated lateral earth pressure values are offered for design evaluation for the on-site soils or imported sands and gravels.

ESTIMATED EARTH PRESSURE COEFFICIENTS

ON-SITE COHESIVE SOILS

EARTH PRESSURE CONDITION	ESTIMATED BACKFILL COEFFICIENT	EQUIVALENT FLUID PRESSURE (PSF/FT)
Active (k_A)	0.50	65
At Rest (k_O)	0.65	85
Passive (k_P)	2.00	250

COHESIONLESS SANDS AND GRAVELS

EARTH PRESSURE CONDITION	NATIVE OR BACKFILL COEFFICIENT	EQUIVALENT FLUID PRESSURE (PCF)
Active (k_A)	0.35	45
At Rest (k_o)	0.50	65
Passive (k_p)	3.00	375

The lateral earth pressure parameters indicated above are based on horizontal backfill compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D-698) resulting in an estimated in-place backfill weight of 125 to 130 pounds per cubic foot for the anticipated soils. No surcharge, hydrostatic pressure or loading from heavy equipment has been included in these estimated soil design parameters.

Where engineered structural fills will be required to satisfy the proposed subgrade elevations, it is recommended that the existing organic topsoil be removed to an average depth of approximately six (6) inches. Should any deleterious or unstable soils be encountered during initial site development, it is recommended that these materials be removed and replaced with the engineered structural fills as discussed below. It is further recommended that the engineered structural fills required to establish the proposed subgrade elevations consist of select, on-site soils placed in eight (8) inch thick layers and compacted to 98 percent of standard Proctor maximum dry density (ASTM D-698).

Positive surface water management practices must be established and maintained at this site which includes, but is not limited to, the diversion of surface waters away from the structures to minimize, if not eliminate, erosion and/or sloughing of the excavations as well as additional ground water pumping requirements.

FOUNDATION DESIGN INFORMATION

It is recommended that the proposed Sewage Treatment Plant #2 Improvements in Washington, Illinois, be supported on conventional, reinforced concrete spread foundation systems established on the native soils or satisfactory fill materials. It is further recommended that the foundation bases at the various elevations be proportioned in accordance with the following foundation design recommendations.

FOUNDATION DESIGN RECOMMENDATIONS

STRUCTURE DESIGNATION	SOIL BORING NUMBERS	APPROXIMATE BASE ELEVATION	SOIL BEARING PRESSURE - PSF
Screening Building	B-1	643	2500
Oxidation Ditch	B-2, B-3 And B-4	634	3000
Clarifiers	B-5, B-6, B-7, B-8 And B-9	629	4500
Chlorine Tank	B-10	630 *	4000
Drying Beds	B-11 And B-12	639	1000

*Extend Foundation Base To Glacial Till Soils At An Approximate Elevation of 630.

The weight of the concrete in the foundations and the depth of surcharge below the existing ground surface have been taken into consideration and compensated for in the bearing value specified. The bearing pressures recommended are net pressures in that they reflect the bearing capacities of the soils at the depths specified with the approximate factors of safety included.

It is recommended that the bases of all shallow spread foundations be established at a minimum depth of forty-two (42) inches below the final, exterior

ground surface elevations to satisfy normal frost penetration requirements. It is further recommended that these foundation excavations be backfilled with compacted cohesive soils as soon as the walls have achieved adequate strength.

Due to considerable variation in the bearing capacity and composition of the soils encountered at the site, it is highly recommended that personnel from our geotechnical engineering firm be retained during construction of the foundation systems to perform in-situ soil bearing tests to confirm the proposed foundation design in conjunction with compaction testing of the engineered structural fills.

SETTLEMENT ANALYSIS

A preliminary evaluation of the potential settlements for the recommended concrete foundations has been made by our geotechnical engineer and it has been estimated that total settlement should not exceed one (1.0) inch for the spread foundations. Differential settlements of less than one-half (0.5) of an inch may be anticipated for the spread foundations provided that all requirements as set forth in this report are satisfied.

PAVEMENT DESIGN RECOMMENDATIONS

It is recommended that the service drive areas for the proposed improvement be constructed in accordance with the following minimum pavement design parameters, assuming that the soils have been compacted to a minimum of 98 percent of standard Proctor maximum dry density (ASTM D-698). Proofrolling of the prepared subgrade soils is also recommended to verify the subgrade integrity prior to the aggregate base course materials. It is further recommended that a Portland cement concrete pavement system be utilized in all areas of tight turning, braking or concentrated loading conditions.

MINIMUM PAVEMENT DESIGN RECOMMENDATIONS

<u>STRUCTURAL COMPONENT</u>	<u>HEAVY DUTY FLEXIBLE PAVEMENT</u>	<u>HEAVY DUTY RIGID PAVEMENT</u>
SUBGRADE:	98% Of ASTM D-698	98% Of ASTM D-698
SUBGRADE THICKNESS:	12" Minimum	12" Minimum
BASE COURSE:	10" of CA/CM-6 Gravel or Recycled Aggregates	None
SURFACE COURSE:	Four (4.0) inches of Class I, bituminous concrete surface using crushed limestone coarse aggregate chips (93% of maximum Theoretical density; minimum compaction requirements.)	Six (6) inches of Portland Cement Concrete utilizing crushed limestone coarse aggregate (6-8 percent entrained air content).

Illinois Department of Transportation, Division Of Highways Designation
See Standard Specifications For Road And Bridge Construction. (01/01/02 Edition)

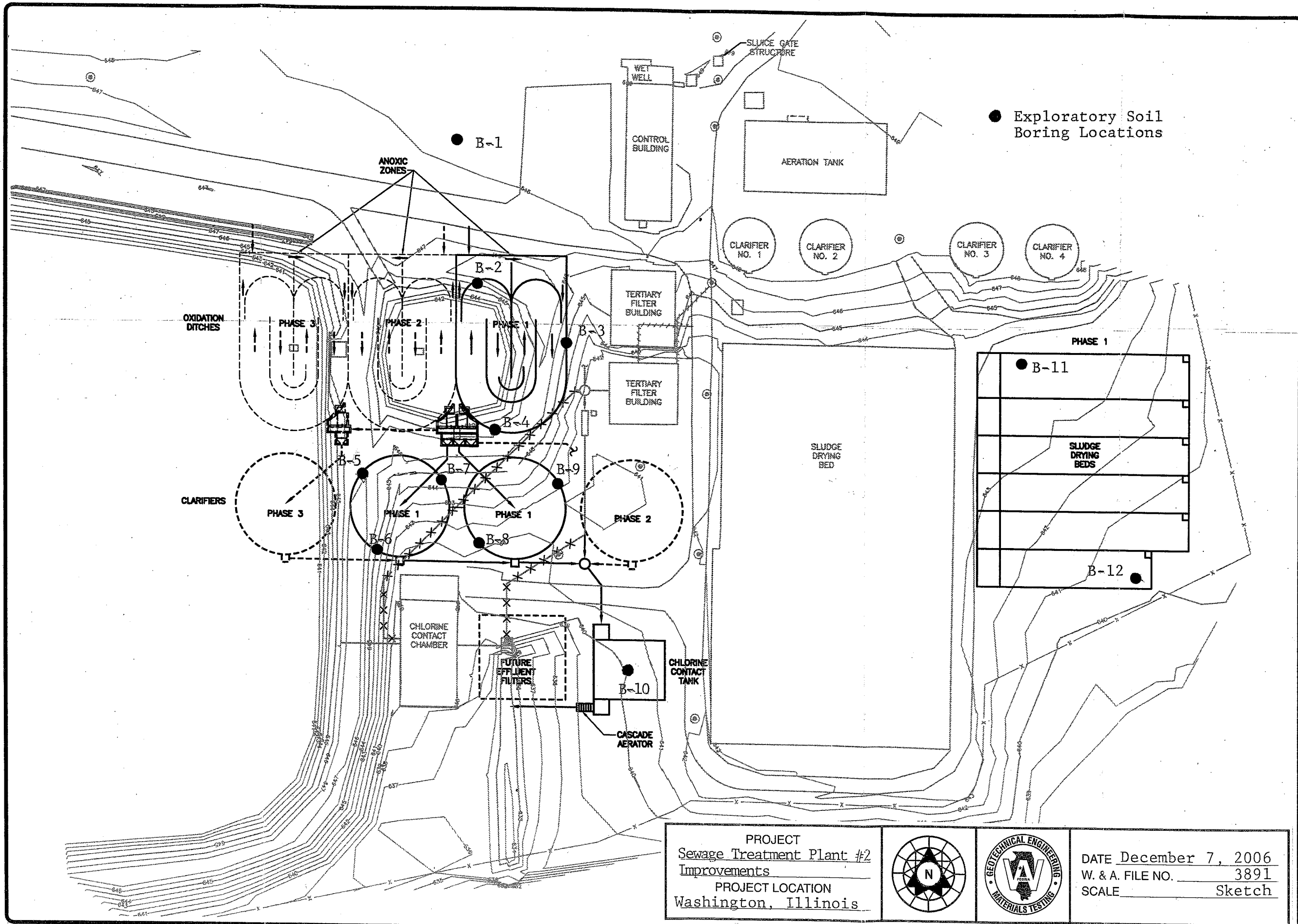
SUMMARY

A subsurface exploration and evaluation of the soil and ground water conditions has been conducted at the site for the proposed Sewage Treatment Plant #2 Improvements in Washington, Illinois

Site development and foundation design criteria have been recommended and potential design and construction problems have been discussed in some detail. The exploration and analyses of the foundation conditions reported in this engineering report are considered of sufficient detail and scope to form a reasonable basis for design evaluation. The observations and comments submitted within this geotechnical engineering report are based upon the subsurface soil and ground water information which was obtained as well as the preliminary design details which have been furnished by the Owner's representative.

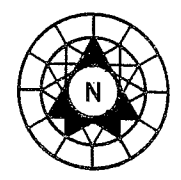
Any revisions in the plans for the proposed structure from those enumerated in this geotechnical engineering report should be brought to the attention of our soil mechanics and foundation engineer so that it can be determined if changes or alterations in the recommendations will be required and additional evaluations reviewed or proposed. Should deviations from the noted subsurface conditions be encountered during construction, it is mandatory that they be brought to the attention of our personnel for further evaluation. On-site observation and testing by personnel from our geotechnical engineering firm is also considered essential to verify and substantiate the design criteria set forth in this geotechnical engineering report.

* * * * *



PRELIMINARY SITE PLAN
SEWAGE TREATMENT PLANT NO. 2
CITY OF WASHINGTON
TAZEWELL COUNTY, ILLINOIS

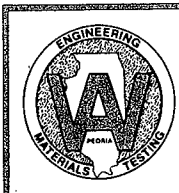
PROJECT
 Sewage Treatment Plant #2
 Improvements
 PROJECT LOCATION
 Washington, Illinois



DATE December 7, 2006
 W. & A. FILE NO. 3891
 SCALE Sketch



FIGURE 1
 1-879-003



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2406 West Nebraska Avenue
PEORIA, ILLINOIS 61604

BORING LOG

BORING NO. B-01

DATE 11-28-06

W. & A. FILE NO. 3891

SHEET 1 OF 14

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS LOCATION Washington, Illinois

BORING LOCATION See Plot Plan Sheet DRILLED BY Fehl

BORING TYPE Hollow Stem Auger WEATHER CONDITIONS Partly Cloudy & Mild

SOIL CLASSIFICATION SYSTEM U.S.B.S.C. SEEPAGE WATER ENCOUNTERED AT ELEVATION None

GROUND SURFACE ELEVATION 648.1 GROUND WATER ELEVATION AT 24+ HRS. 643.3

BORING DISCONTINUED AT ELEVATION 632.1 GROUND WATER ELEVATION AT COMPLETION None

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Qp	Qu	Dd	Mc
Brown SANDY CLAY LOAM Organic Topsoil	5"						
Very Stiff, Gray-Brown, Weathered GLACIAL SILTY CLAY TILL (Possible Fill)							
	3	SS	12	2.3	2.1	117	14
	6	SS	11	2.5	2.3	-	14
Medium-Density, Brown, Medium- To Coarse- Grained SAND And Fine-Grained GRAVEL With Considerable Silty Clay							
		SS	11	-	-	-	10
638+ 9	9						
Very Stiff, Gray-Brown, Weathered GLACIAL SILTY CLAY TILL							
		SS	20	3.5	3.2	120	13
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL	12						
		SS	20	2.7	2.3	-	13
	15						
		SS	14	3.6	3.3	120	12
EXPLORATORY BORING DISCONTINUED							
	18						

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
FALLING 30 INCHES
SS - SPLIT SPOON SAMPLE
ST - SHELBY TUBE SAMPLE

Qp - CALIBRATED PENETROMETER READING - T.S.F.
Qu - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
Dd - NATURAL DRY DENSITY - P.C.F.
Mc - NATURAL MOISTURE CONTENT - %

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BORING NO. B-02DATE 11-28-06W. & A. FILE NO. 3891SHEET 2 OF 14**WHITNEY & ASSOCIATES**

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PEORIA, ILLINOIS 61604**BORING LOG**

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS LOCATION Washington, Illinois
 BORING LOCATION See Plot Plan Sheet DRILLED BY Fehl
 BORING TYPE Hollow Stem Auger WEATHER CONDITIONS Partly Cloudy & Mild
 SOIL CLASSIFICATION SYSTEM U.S.B.S.C. SEEPAGE WATER ENCOUNTERED AT ELEVATION None
 GROUND SURFACE ELEVATION 646.1 GROUND WATER ELEVATION AT 24+ HRS. 639.6
 BORING DISCONTINUED AT ELEVATION 615.1 GROUND WATER ELEVATION AT COMPLETION None

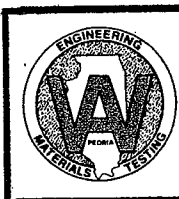
DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
Brown SANDY CLAY Organic Topsoil	6"						
Very Stiff, Brown SANDY CLAY LOAM With Trace Of Fine-Grained Gravel		SS	30	3.3	---	-	7
Medium-Density, Brown, Fine- To Coarse-Grained SAND And Coarse-Grained GRAVEL With Possible Cobbles 639+	5	SS	25	-	-	-	3
Very Stiff, Brown, Weathered GLACIAL SILTY CLAY TILL		SS	13	4.0	3.8	-	13
Hard, Gray, Unweathered GLACIAL SILTY CLAY TILL	10	SS	15	4.5+	4.4	124	12
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	20	4.1	3.7	-	13
	15	SS	17	4.0	3.6	122	13
	20	SS	15	3.6	3.4	-	12
	25	SS	23	3.9	3.6	123	13
Dense, Gray, Fine- To Medium-Grained SAND And Fine-Grained GRAVEL	30	SS	48	-	-	-	5
EXPLORATORY BORING DISCONTINUED							

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
 FALLING 30 INCHES
 SS - SPLIT SPOON SAMPLE
 ST - SHELBY TUBE SAMPLE

Q_p - CALIBRATED PENETROMETER READING - T.S.F.
 Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
 D_d - NATURAL DRY DENSITY - P.C.F.
 M_c - NATURAL MOISTURE CONTENT - %

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BORING NO. B-03
DATE 11-28-06
W. & A. FILE NO. 3891
SHEET 3 OF 14



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 PEORIA, ILLINOIS 61604

BORING LOG

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS **LOCATION** Washington, Illinois
BORING LOCATION See Plot Plan Sheet **DRILLED BY** FehI
BORING TYPE Hollow Stem Auger **WEATHER CONDITIONS** Partly Cloudy & Mild
SOIL CLASSIFICATION SYSTEM U.S.B.S.C. **SEEPAGE WATER ENCOUNTERED AT ELEVATION** None
GROUND SURFACE ELEVATION 646.0 **GROUND WATER ELEVATION AT** 24+ HRS. 638.2
BORING DISCONTINUED AT ELEVATION 615.0 **GROUND WATER ELEVATION AT COMPLETION** None

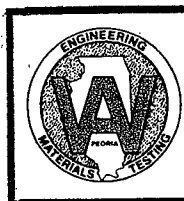
DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Qp	Qu	Dd	Mc
Brown SANDY CLAY Organic Topsoil	6"						
Stiff, Brown SANDY LOAM With Considerable Fine-Grained Gravel (Fill)		SS	21	2.0	-	-	7
Very Stiff, Brown SANDY CLAY With Considerable Fine-Grained Gravel	5	SS	17	3.5	3.2	107	10
	639+						
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	16	3.6	3.2	120	13
	10	SS	17	2.7	2.4	118	14
		SS	14	2.7	2.5	-	13
	15	SS	16	2.5	2.1	117	14
	20	SS	17	3.5	3.2	-	12
Hard, Gray, Unweathered GLACIAL SILTY CLAY TILL	25	SS	19	4.5+	4.1	123	11
	30	SS	20	4.5+	4.3	124	11
EXPLORATORY BORING DISCONTINUED							

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
 FALLING 30 INCHES
 SS - SPLIT SPOON SAMPLE
 ST - SHELBY TUBE SAMPLE

Qp - CALIBRATED PENETROMETER READING - T.S.F.
 Qu - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
 Dd - NATURAL DRY DENSITY - P.C.F.
 Mc - NATURAL MOISTURE CONTENT - %

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BORING NO. B-04
DATE 11-28-06
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SHEET 4 **OF** 14



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BORING LOG

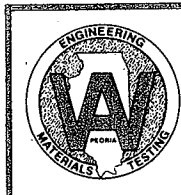
PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS **LOCATION** Washington, Illinois
BORING LOCATION See Plot Plan Sheet **DRILLED BY** FehI
BORING TYPE Hollow Stem Auger **WEATHER CONDITIONS** Partly Cloudy & Mild
SOIL CLASSIFICATION SYSTEM U.S.B.S.C. **SEEPAGE WATER ENCOUNTERED AT ELEVATION** 636.8
GROUND SURFACE ELEVATION 645.3 **GROUND WATER ELEVATION AT** 24+ **HRS.** 638.5
BORING DISCONTINUED AT ELEVATION 614.3 **GROUND WATER ELEVATION AT COMPLETION** 637.1

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Qp	Qu	Dd	Mc
Brown SANDY CLAY Organic Topsoil	6"						
Hard, Brown SANDY CLAY LOAM With Some Fine-Grained Gravel		SS	18	4.5+	-	-	10
Stiff, Brown SANDY CLAY With Considerable Fine-Grained Gravel	5	SS	10	2.0	1.7	102	14
Medium-Density, Brown, Medium- To Coarse- Grained SAND And Fine-Grained GRAVEL With Considerable Silty Clay 636+		SS	10	-	-	-	15
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL	10	SS	15	3.0	2.7	120	13
Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	15	1.8	1.6	-	14
	15	SS	16	1.6	1.5	117	15
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL							
	20	SS	18	2.6	2.3	-	13
Hard, Gray, Unweathered GLACIAL SILTY CLAY TILL							
	25	SS	33	4.5+	4.8	124	11
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL							
	30	SS	24	3.0	2.7	122	13
EXPLORATORY BORING DISCONTINUED							

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
 FALLING 30 INCHES
 SS - SPLIT SPOON SAMPLE
 ST - SHELBY TUBE SAMPLE

Qp - CALIBRATED PENETROMETER READING - T.S.F.
 Qu - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
 Dd - NATURAL DRY DENSITY - P.C.F.
 Mc - NATURAL MOISTURE CONTENT - %

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BORING LOG

BORING NO. B-05

DATE 11-28-06

W. & A. FILE NO. 3891

SHEET 5 OF 14

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS LOCATION Washington, Illinois

BORING LOCATION See Plot Plan Sheet DRILLED BY Fehl

BORING TYPE Hollow Stem Auger WEATHER CONDITIONS Partly Cloudy & Mild

SOIL CLASSIFICATION SYSTEM U.S.C.S. SEEPAGE WATER ENCOUNTERED AT ELEVATION 617.6

GROUND SURFACE ELEVATION 647.1 GROUND WATER ELEVATION AT 24+ HRS. 636.9

BORING DISCONTINUED AT ELEVATION 614.1 GROUND WATER ELEVATION AT COMPLETION 619.3

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
Brown SANDY LOAM Organic Topsoil	7"						
Very Stiff, Brown SANDY CLAY With Some Fine-Grained Sand							
		SS	22	3.0	2.7	-	10
	4						
Very Stiff, Brown SILTY CLAY							
		SS	10	3.5	3.2	105	14
Medium, Brown SANDY CLAY With Some Coarse-Grained Gravel							
	8	SS	9	1.1	-	-	15
Very Stiff, Brown, Weathered GLACIAL SILTY CLAY TILL							
		SS	14	2.3	2.2	118	14
	12						
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL							
		SS	18	2.5	2.2	-	14
	16	SS	16	3.8	3.7	122	12
	20	SS	17	3.5	3.2	-	13
	24						
		SS	40	4.3	3.9	123	12

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES

SS - SPLIT SPOON SAMPLE

ST - SHELBY TUBE SAMPLE

Q_p - CALIBRATED PENETROMETER READING - T.S.F.

Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.

D_d - NATURAL DRY DENSITY - P.C.F.

M_c - NATURAL MOISTURE CONTENT - %

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BORING LOG

BORING NO. B-05

(CONTINUATION)

DATE 11-28-06

PROJECT Washington Sewage Treatment Plant #2 Improvements

SHEET 6 OF 14

LOCATION Washington, Illinois

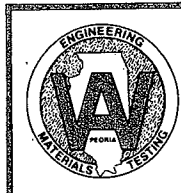
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DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
See Sheet 5 of 14							
Medium-Density, Gray, Medium- To Coarse- Grained SAND With Trace Of Fine-Grained Gravel	30	SS	18	-	-	-	14
EXPLORATORY BORING DISCONTINUED	34						
	38						
	42						
	46						
	50						
	54						

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
FALLING 30 INCHES
SS - SPLIT SPOON SAMPLE
ST - SHELBY TUBE SAMPLE

Q_p - CALIBRATED PENETROMETER READING - T.S.F.
Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
D_d - NATURAL DRY DENSITY - P.C.F.
M_c - NATURAL MOISTURE CONTENT - %

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BORING LOG

BORING NO. B-06

DATE 11-28-06

W. & A. FILE NO. 3891

SHEET 7 OF 14

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS LOCATION Washington, Illinois

BORING LOCATION See Plot Plan Sheet DRILLED BY Fehl

BORING TYPE Hollow Stem Auger WEATHER CONDITIONS Partly Cloudy & Mild

SOIL CLASSIFICATION SYSTEM U.S.C.S. SEEPAGE WATER ENCOUNTERED AT ELEVATION 635.3

GROUND SURFACE ELEVATION 646.8 GROUND WATER ELEVATION AT 24+ HRS. 636.2 CAVE-IN

BORING DISCONTINUED AT ELEVATION 613.8 GROUND WATER ELEVATION AT COMPLETION 621.6

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
Brown SANDY LOAM Organic Topsoil	4"						
Very Stiff, Brown SANDY CLAY LOAM With Some Fine-Grained Gravel							
		SS	19	3.0	2.8	109	7
	4						
Dense, Gray-Brown, Coarse-Grained GRAVEL And COBBLES		SS	48	-	-	-	4
Medium-Density, Brown, Coarse-Grained GRAVEL And Medium- To Coarse-Grained SAND With Some Silty Clay	8	SS	27	-	-	-	9
		SS	25	-	-	-	12
Stiff, Brown, Weathered GLACIAL SILTY CLAY TILL	12						
		SS	10	1.7	1.6	-	15
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	12	2.6	2.4	118	14
	16						
	20	SS	18	4.5	4.0	-	12
	24						
		SS	15	3.9	3.6	120	13

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
FALLING 30 INCHES

SS - SPLIT SPOON SAMPLE

ST - SHELBY TUBE SAMPLE

Q_p - CALIBRATED PENETROMETER READING - T.S.F.

Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.

D_d - NATURAL DRY DENSITY - P.C.F.

M_c - NATURAL MOISTURE CONTENT - %

WHITNEY & ASSOCIATES
PEORIA, ILLINOIS

BORING LOG

BORING NO. B-06

(CONTINUATION)

DATE 11-28-06

PROJECT Washington Sewage Treatment Plant #2 Improvements

SHEET 8 OF 14

LOCATION Washington, Illinois

W. & A. FILE NO. 3891

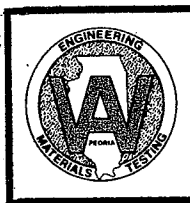
DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
See Sheet 7 of 14	30	SS	25	4.0	3.8	121	13
EXPLORATORY BORING DISCONTINUED	34						
	38						
	42						
	46						
	50						
	54						

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
FALLING 30 INCHES
SS - SPLIT SPOON SAMPLE
ST - SHELBY TUBE SAMPLE

Q_p - CALIBRATED PENETROMETER READING - T.S.F.
Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
D_d - NATURAL DRY DENSITY - P.C.F.
M_c - NATURAL MOISTURE CONTENT - %

WHITNEY & ASSOCIATES
PEORIA, ILLINOIS

BORING NO. B-07
DATE 11-27-06
W. & A. FILE NO. 3891
SHEET 9 **OF** 14



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INCORPORATED

2406 West Nebraska Avenue
PEORIA, ILLINOIS 61604

BORING LOG

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS **LOCATION** Washington, Illinois
BORING LOCATION See Plot Plan Sheet **DRILLED BY** Fehl
BORING TYPE Hollow Stem Auger **WEATHER CONDITIONS** Partly Cloudy & Mild
SOIL CLASSIFICATION SYSTEM U.S.B.S.C. **SEEPAGE WATER ENCOUNTERED AT ELEVATION** None
GROUND SURFACE ELEVATION 644.6 **GROUND WATER ELEVATION AT** 24+ **HRS.** 631.9
BORING DISCONTINUED AT ELEVATION 613.6 **GROUND WATER ELEVATION AT COMPLETION** None

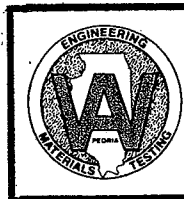
DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
Brown SANDY CLAY Organic Topsoil	6"						
Very Stiff, Brown SANDY CLAY		SS	10	3.5	3.2	105	10
Medium, Brown SANDY CLAY With Occasional Coarse-Grained Gravel	5	SS	12	1.0	0.8	-	16
Very Stiff, Brown, Weathered GLACIAL SILTY CLAY TILL	637±	SS	16	3.3	3.0	122	13
Hard, Gray-Brown, Weathered GLACIAL SILTY CLAY TILL	10	SS	15	4.5+	4.6	124	12
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	12	2.6	-	-	14
	15	SS	18	3.1	2.8	122	13
Hard, Gray, Unweathered GLACIAL SILTY CLAY TILL	20	SS	19	4.5+	4.5	-	11
	25	SS	20	4.5	4.1	123	12
	30	SS	24	4.5+	4.6	-	11
EXPLORATORY BORING DISCONTINUED							

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
 FALLING 30 INCHES
 SS - SPLIT SPOON SAMPLE
 ST - SHELBY TUBE SAMPLE

Q_p - CALIBRATED PENETROMETER READING - T.S.F.
 Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
 D_d - NATURAL DRY DENSITY - P.C.F.
 M_c - NATURAL MOISTURE CONTENT - %

WHITNEY & ASSOCIATES
 PEORIA, ILLINOIS

BORING NO. B-08
DATE 11-27-06
W. & A. FILE NO. 3891
SHEET 10 OF 14



WHITNEY & ASSOCIATES INCORPORATED

2406 West Nebraska Avenue
 PEORIA, ILLINOIS 61604

BORING LOG

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS **LOCATION** Washington, Illinois
BORING LOCATION See Plot Plan Sheet **DRILLED BY** FehI
BORING TYPE Hollow Stem Auger **WEATHER CONDITIONS** Partly Cloudy & Mild
SOIL CLASSIFICATION SYSTEM U.S.B.S.C. **SEEPAGE WATER ENCOUNTERED AT ELEVATION** None
GROUND SURFACE ELEVATION 641.1 **GROUND WATER ELEVATION AT** 24+ HRS. 628.9
BORING DISCONTINUED AT ELEVATION 610.1 **GROUND WATER ELEVATION AT COMPLETION** None

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Qp	Qu	Dd	Mc
Brown And Dark Brown SANDY LOAM Organic Topsoil	5"						
Medium-Density, Brown, Medium- To Coarse-Grained SAND, Coarse-Grained GRAVEL And SILTY CLAY (Fill) 637+		SS	19	-	-	-	13
Very Stiff, Brown, Weathered GLACIAL SILTY CLAY TILL	5	SS	16	3.5	3.2	119	15
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	18	2.7	-	-	14
	10	SS	22	3.7	3.4	122	12
		SS	16	3.4	3.1	-	13
Hard, Gray, Unweathered GLACIAL SILTY CLAY TILL	15	SS	23	4.5+	4.7	123	12
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL	20	SS	34	3.5	3.2	-	13
Stiff To Very Stiff, Gray SILT	25	SS	23	2.1	1.9	114	17
	30	SS	18	2.5	2.3	115	16
EXPLORATORY BORING DISCONTINUED							

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES
 SS - SPLIT SPOON SAMPLE
 ST - SHELBY TUBE SAMPLE

Qp - CALIBRATED PENETROMETER READING - T.S.F.
 Qu - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
 Dd - NATURAL DRY DENSITY - P.C.F.
 Mc - NATURAL MOISTURE CONTENT - %

WHITNEY & ASSOCIATES
 PEORIA, ILLINOIS



WHITNEY & ASSOCIATES

INCORPORATED

2406 West Nebraska Avenue
PEORIA, ILLINOIS 61604

BORING LOG

BORING NO. B-09

DATE 11-27-06

W. & A. FILE NO. 3891

SHEET 11 OF 14

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS LOCATION Washington, Illinois

BORING LOCATION See Plot Plan Sheet

DRILLED BY FehI

BORING TYPE Hollow Stem Auger

WEATHER CONDITIONS Partly Cloudy & Mild

SOIL CLASSIFICATION SYSTEM U.S.B.S.C.

SEEPAGE WATER ENCOUNTERED AT ELEVATION None

GROUND SURFACE ELEVATION 642.2

GROUND WATER ELEVATION AT 24+ HRS. 632.6

BORING DISCONTINUED AT ELEVATION 611.2

GROUND WATER ELEVATION AT COMPLETION None

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
Brown SANDY CLAY Organic Topsoil	5"						
Medium, Brown SANDY CLAY With Some Fine-Grained Gravel		SS	7	0.9	0.6	101	20
638+							
Very Stiff, Gray-Brown, Weathered GLACIAL SILTY CLAY TILL	5	SS	16	3.6	3.4	120	13
Very Stiff, Gray-Brown, Weathered GLACIAL SANDY CLAY TILL		SS	23	2.8	2.5	-	11
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL	10	SS	17	2.5	2.2	120	13
Hard, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	18	4.0	3.5	-	12
	15	SS	32	4.5+	4.6	124	11
	20	SS	25	4.5+	4.8	-	11
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL							
	25	SS	22	4.2	3.8	123	12
Dense, Gray, Fine-Grained SAND							
	30	SS	33	-	-	-	5
EXPLORATORY BORING DISCONTINUED							

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER

FALLING 30 INCHES

SS - SPLIT SPOON SAMPLE

ST - SHELBY TUBE SAMPLE

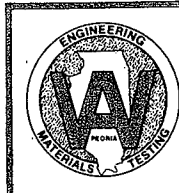
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Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.

D_d - NATURAL DRY DENSITY - P.C.F.

M_c - NATURAL MOISTURE CONTENT - %

WHITNEY & ASSOCIATES
PEORIA, ILLINOIS



WHITNEY & ASSOCIATES

INCORPORATED

2406 West Nebraska Avenue
PEORIA, ILLINOIS 61604

BORING LOG

BORING NO. B-10

DATE 11-27-06

W. & A. FILE NO. 3891

SHEET 12 OF 14

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS LOCATION Washington, Illinois

BORING LOCATION See Plot Plan Sheet

DRILLED BY FehI

BORING TYPE Hollow Stem Auger

WEATHER CONDITIONS Partly Cloudy & Mild

SOIL CLASSIFICATION SYSTEM U.S.C.S.

SEEPAGE WATER ENCOUNTERED AT ELEVATION 631.4

GROUND SURFACE ELEVATION 639.9

GROUND WATER ELEVATION AT 24+ HRS. 632.5

BORING DISCONTINUED AT ELEVATION 616.9

GROUND WATER ELEVATION AT COMPLETION 627.8

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
Brown SANDY CLAY Organic Topsoil	7"						
Medium, Brown SILTY CLAY LOAM							
		SS	8	1.0	0.8	98	16
	4						
Stiff, Brown SILTY CLAY LOAM With Occasional Coarse-Grained Sand		SS	12	1.6	-	-	4
Very Loose, Brown, Medium- To Coarse-Grained SAND, Fine-Grained GRAVEL And SILTY CLAY	8	SS	3	-	-	-	9
630±							
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	15	3.4	3.2	122	13
	12						
		SS	19	3.8	3.5	-	13
		SS	22	4.2	3.9	124	12
	16						
	20	SS	24	4.0	3.6	123	13
EXPLORATORY BORING DISCONTINUED	24						

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
FALLING 30 INCHES

SS - SPLIT SPOON SAMPLE

ST - SHELBY TUBE SAMPLE

Q_p - CALIBRATED PENETROMETER READING - T.S.F.
Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.
D_d - NATURAL DRY DENSITY - P.C.F.
M_c - NATURAL MOISTURE CONTENT - %

WHITNEY & ASSOCIATES
PEORIA, ILLINOIS



WHITNEY & ASSOCIATES

INCORPORATED

2406 West Nebraska Avenue
PEORIA, ILLINOIS 61604

BORING LOG

BORING NO. B-11

DATE 11-28-06

W. & A. FILE NO. 3891

SHEET 13 OF 14

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS LOCATION Washington, Illinois

BORING LOCATION See Plot Plan Sheet DRILLED BY Fehl

BORING TYPE Hollow Stem Auger WEATHER CONDITIONS Partly Cloudy & Mild

SOIL CLASSIFICATION SYSTEM U.S.B.S.C. SEEPAGE WATER ENCOUNTERED AT ELEVATION 634.8

GROUND SURFACE ELEVATION 643.7 GROUND WATER ELEVATION AT 24+ HRS. 635.4

BORING DISCONTINUED AT ELEVATION 627.7 GROUND WATER ELEVATION AT COMPLETION 634.5 CAVE-IN

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Qp	Qu	Dd	Mc
Brown SANDY CLAY Organic Topsoil	6"						
Loose, Gray-Brown, Medium-Grained SAND With Some Silty Clay And Occasional Fine-Grained Gravel	3	SS	9	-	-	-	6
Medium, Dark Brown SILTY CLAY LOAM	6	SS	5	0.8	0.7	96	24
Very Loose, Brown, Medium- To Coarse-Grained SAND With Some Silty Clay And Fine-Grained Gravel	9	SS	3	-	-	-	11
Loose, Brown, Medium- To Coarse-Grained SAND With Some Fine-Grained Gravel	12	SS	5	-	-	-	10
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL	15	SS	16	2.4	2.2	-	15
	18	SS	18	2.8	2.5	121	14
EXPLORATORY BORING DISCONTINUED	18						

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER
FALLING 30 INCHES

SS - SPLIT SPOON SAMPLE

ST - SHELBY TUBE SAMPLE

Qp - CALIBRATED PENETROMETER READING - T.S.F.

Qu - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.

Dd - NATURAL DRY DENSITY - P.C.F.

Mc - NATURAL MOISTURE CONTENT - %

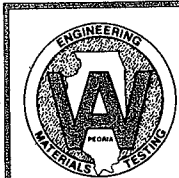
WHITNEY & ASSOCIATES
PEORIA, ILLINOIS

BORING NO. B-12

DATE 11-27-06

W. & A. FILE NO. 3891

SHEET 14 OF 14



WHITNEY & ASSOCIATES

INCORPORATED

2406 West Nebraska Avenue
PEORIA, ILLINOIS 61604

BORING LOG

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS LOCATION Washington, Illinois

BORING LOCATION See Plot Plan Sheet

DRILLED BY Fehl

BORING TYPE Hollow Stem Auger

WEATHER CONDITIONS Partly Cloudy & Mild

SOIL CLASSIFICATION SYSTEM U.S.B.S.C.

SEEPAGE WATER ENCOUNTERED AT ELEVATION 632.9

GROUND SURFACE ELEVATION 640.7

GROUND WATER ELEVATION AT 24+ HRS. 633.8

BORING DISCONTINUED AT ELEVATION 624.7

GROUND WATER ELEVATION AT COMPLETION 630.1

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
Dark Brown SANDY CLAY LOAM Organic Topsoil	10"						
Stiff, Gray-Brown SANDY LOAM (Fill)							
	3	SS	9	2.0	1.7	104	12
Medium, Gray-Brown SANDY CLAY LOAM With Some Coarse-Grained Gravel And Organic Matter (Fill)	6	SS	6	1.0	0.6	100	21
WOOD DEBRIS With Gravel (Fill)							
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	10	2.6	-	-	13
	9						
		SS	12	2.3	2.1	121	14
	12						
		SS	18	2.7	-	-	13
	15						
		SS	22	2.6	2.2	122	13
EXPLORATORY BORING DISCONTINUED							
	18						

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER

FALLING 30 INCHES

SS - SPLIT SPOON SAMPLE

ST - SHELBY TUBE SAMPLE

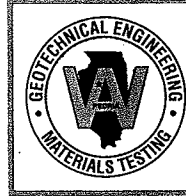
Q_p - CALIBRATED PENETROMETER READING - T.S.F.Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.D_d - NATURAL DRY DENSITY - P.C.F.M_c - NATURAL MOISTURE CONTENT - %WHITNEY & ASSOCIATES
PEORIA, ILLINOIS

TELEPHONE

309-673-2131

TESTS * INVESTIGATIONS
 ANALYSIS * DESIGN * EVALUATIONS
 CONSULTATION * REPORTS * INSPECTIONS
 ARBITRATION * EXPERT WITNESS TESTIMONY
 * * * * *

SOILS * PORTLAND CEMENT CONCRETE
 BITUMINOUS CONCRETE * STEEL
 ASPHALT * AGGREGATES * EMULSIONS
 POZOLANIC MATERIALS * LIME

**WHITNEY & ASSOCIATES****INCORPORATED**

2406 West Nebraska Avenue

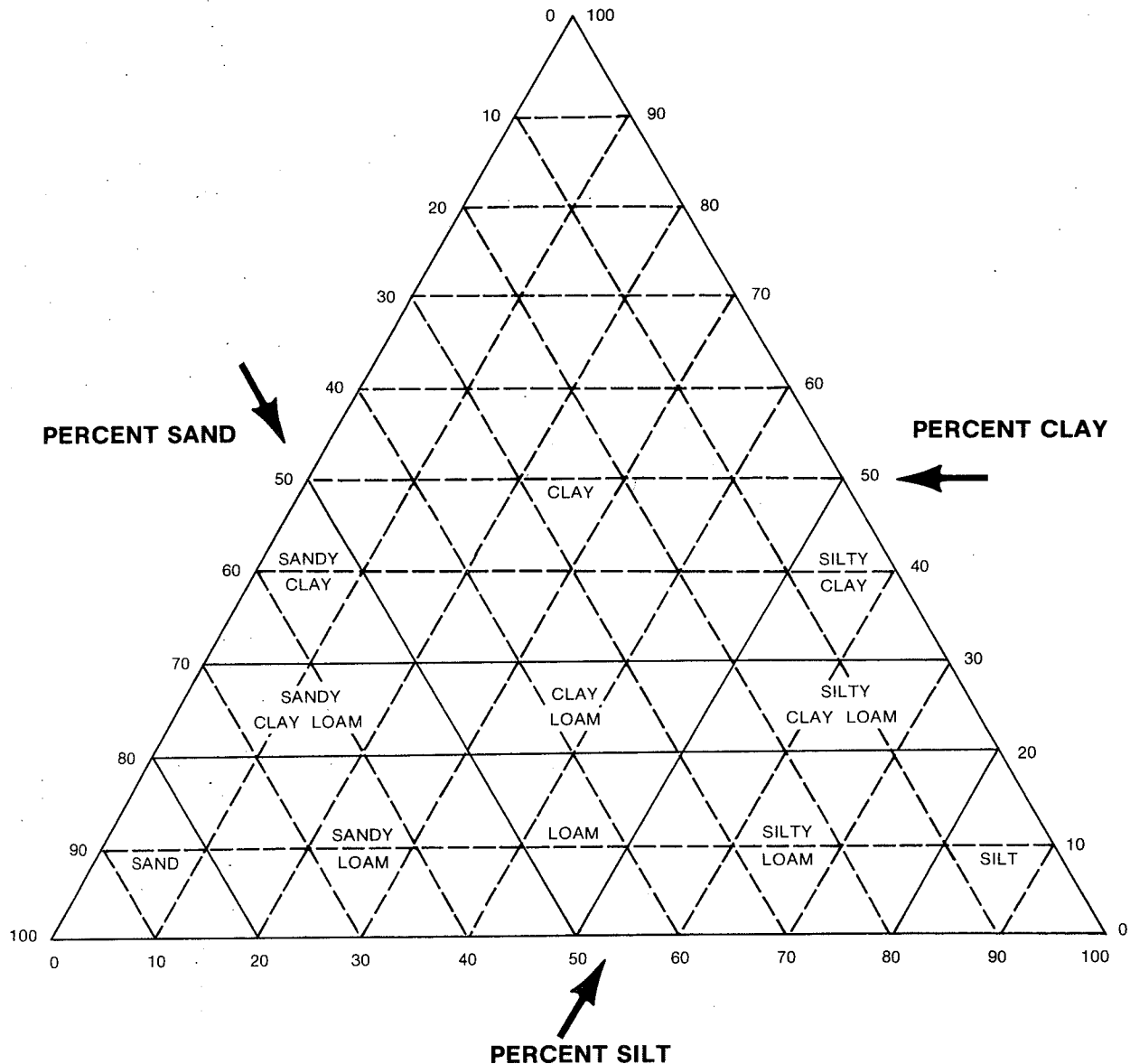
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309-673-3050

GEOTECHNICAL ENGINEERING
 CONSTRUCTION QUALITY CONTROL
 SUBSURFACE EXPLORATIONS
 ENVIRONMENTAL INVESTIGATIONS
 * * * * *

MONITORING WELL INSTALLATIONS
 BUILT-UP ROOF INVESTIGATIONS
 WELDER CERTIFICATIONS
 INSURANCE INVESTIGATIONS

**TRIANGULAR TEXTURAL CLASSIFICATION CHART**

DEVELOPED BY

UNITED STATES BUREAU OF SOILS AND CHEMISTRY
 (U.S.B.S.C.)

WHITNEY & ASSOCIATES

PEORIA, ILLINOIS

TELEPHONE

309-673-2131

TESTS * INVESTIGATIONS
 ANALYSIS * DESIGN * EVALUATIONS
 CONSULTATION * REPORTS * INSPECTIONS
 ARBITRATION * EXPERT WITNESS TESTIMONY
 * * * * *

SOILS * PORTLAND CEMENT CONCRETE
 BITUMINOUS CONCRETE * STEEL
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**WHITNEY & ASSOCIATES****INCORPORATED**

2406 West Nebraska Avenue
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GEOTECHNICAL ENGINEERING
 CONSTRUCTION QUALITY CONTROL
 SUBSURFACE EXPLORATIONS
 ENVIRONMENTAL INVESTIGATIONS
 * * * * *

MONITORING WELL INSTALLATIONS
 BUILT-UP ROOF INVESTIGATIONS
 WELDER CERTIFICATIONS
 INSURANCE INVESTIGATIONS

SOIL MECHANICS CLASSIFICATION SYSTEMS**TEXTURAL CLASSIFICATION**

DESCRIPTION	SIZE
BOULDERS	LARGER THAN 3.0 IN.
COARSE GRAVEL	0.75 IN. — 3.0 IN.
FINE GRAVEL	NO. 4 SIEVE — 0.75 IN.
COARSE SAND	NO. 10 SIEVE — NO. 4 SIEVE
MEDIUM SAND	NO. 40 SIEVE — NO. 10 SIEVE
FINE SAND	NO. 200 SIEVE — NO. 40 SIEVE
SILT	LESS THAN NO. 200 SIEVE — NONPLASTIC
CLAY	LESS THAN NO. 200 SIEVE — PLASTIC

QUANTITY CLASSIFICATION

DESCRIPTION	PERCENT
TRACE	0 - 5
SMALL AMOUNT	5 - 10
SOME	10 - 15
CONSIDERABLE	15 - 20
SUBORDINATE TEXTURAL CLASSIFICATION	OVER 20

RELATIVE DENSITY CLASSIFICATION — COHESIONLESS SOILS

N. BLOWS / FT.	RELATIVE DENSITY
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM
30 - 50	DENSE
OVER 50	VERY DENSE

*** CONSISTENCY CLASSIFICATION — COHESIVE SOILS**

N. BLOWS / FT.	CONSISTENCY	Q _u , TONS / SQ. FT.
0 - 2	VERY SOFT	0.00 - 0.25
2 - 4	SOFT	0.25 - 0.50
4 - 8	MEDIUM	0.50 - 1.00
8 - 15	STIFF	1.00 - 2.00
15 - 30	VERY STIFF	2.00 - 4.00
OVER 30	HARD	OVER - 4.00

*** NOTE:**

THIS CLASSIFICATION SYSTEM IS TO BE USED SOLELY AS A GUIDE AND IS NOT ADEQUATE FOR PURPOSES OF DESIGN.

WHITNEY & ASSOCIATES GENERAL CONDITIONS (GEOTECHNICAL AND CONSTRUCTION SERVICES)

THESE STANDARD TERMS AND CONDITIONS SHALL CONTINUE IN FORCE AND EFFECT DURING AND AFTER THE COMPLETION OF WHITNEY & ASSOCIATES EMPLOYMENT AND SHALL CONTROL ANY CONFLICTING TERM OR CONDITION UNLESS WHITNEY & ASSOCIATES AGREES OTHERWISE IN WRITING.

1. PARTIES AND SCOPE OF WORK: This Agreement consists of Whitney & Associates (W&A) proposal, W&A's Schedule of Fees and Services, client's written acceptance thereof, if accepted by W&A, and these General Conditions. The terms contained in these General Conditions are intended to prevail over any conflicting terms in this Agreement. "Client" refers to the person or entity ordering the work to be done or professional services to be rendered by Whitney & Associates (except where distinction is necessary, either work or professional services are referred to as "services" herein). If client is ordering the services on behalf of another, client represents and warrants that client is the duly authorized agent of said party for the purpose of ordering and directing said services, and in such case the term "client" shall also include the principal for whom the services are being performed. Prices quoted and charged by W&A for its services are predicated on the conditions and the allocations of risks and obligations expressed in these General Conditions. Unless otherwise stated in writing, client assumes sole responsibility for determining whether the quantity and the nature of the services ordered by client are adequate and sufficient for client's intended purpose. Client shall communicate these General Conditions to each and every third party to whom the client transmits any report prepared by W&A. Unless otherwise expressly assigned in writing, W&A shall have no duty to any third party, and in no event shall W&A have any duty or obligation other than those duties and obligations expressly set forth in this Agreement. Ordering services from W&A shall constitute acceptance of W&A's proposal and these General Conditions. In addition, Client's acceptance of W&A's proposal and these General Conditions may be indicated by Client signing the proposal, and a facsimile copy or an electronic signature by Client shall be considered as an original signature by Client.

2. SCHEDULING OF SERVICES: The services set forth in this Agreement will be accomplished in a timely and workmanlike manner. If W&A is required to delay any part of its services to accommodate the requests or requirements of client, regulatory agencies, or other parties, or due to any cause beyond its reasonable control, client agrees to pay such additional charges, if any, as may be applicable.

3. ACCESS TO SITE: Client will arrange and provide such access to the site as is necessary for W&A to perform its services. W&A shall take reasonable measures and precautions to minimize damage to the site and any improvements located thereon as a result of its services or the use of its equipment; however, W&A has not included in its fee the cost of restoration of damage which may occur. If client desires or requires W&A to restore the site to its former condition, W&A will, upon written request, perform such additional work as is necessary to do so and client agrees to pay to W&A the cost thereof plus W&A's normal markup for overhead and profit.

4. CLIENT'S DUTY TO NOTIFY ENGINEER: Client represents and warrants that client has advised W&A of any known or suspected hazardous materials, utility lines and underground structures at any site at which W&A is to perform services under this Agreement.

5. DISCOVERY OF POLLUTANTS: W&A services shall not include investigation for hazardous substances, materials or wastes or petroleum products. Hazardous materials, substances or wastes (all cumulatively referred to herein as "hazardous substances") includes, but is not limited to, any substance, waste, pollutant or contaminant, in whatever form, now or hereafter included with such terms under any federal, state or local statute, ordinance, code, rule or regulation now existing or hereinafter enacted or amended. W&A shall not be liable for any contamination as a result of hazardous substances which may be encountered. In the event that hazardous substances are suspected by W&A, W&A's sole duty shall be to notify client and W&A has no duty to identify or attempt to identify within the project area.

6. MONITORING: If this Agreement includes testing construction materials or observing any aspect of construction of improvements, W&A will report its test results and observations as more specifically set forth elsewhere in this Agreement. Client shall cause all tests and inspections of the site, materials and work to be timely and properly performed in accordance with the plans, specifications, contract documents, and W&A recommendations. No claims for loss, damage or injury shall be brought against W&A unless all tests and inspections have been so performed and unless W&A recommendations have been followed.

W&A services shall not include determining or implementing the means, methods, techniques or procedures of work done by the contractor(s) being monitored or whose work is being tested. W&A services shall not include the authority to accept or reject work or to in any manner supervise the work of any contractor. W&A services or failure to perform same shall not in any way operate or excuse any contractor from the performance of its work in accordance with its contract. W&A services shall not include any responsibility or liability for the owner and/or contractor's site safety and/or operations of construction, including surface water management practices. "Contractor" as used herein shall include the general contractor, subcontractors, suppliers, architects, engineers and construction managers.

7. LIMITATIONS OF PROCEDURES, EQUIPMENT AND TESTS: Information obtained from borings, observations and analyses of sample materials shall be reported in formats considered appropriate by W&A unless directed otherwise by Client. Such information is considered evidence, but any inference or conclusion based thereon is, necessarily, an opinion also based on engineering judgment and shall not be construed as a representation of fact. The test report documents shall not be considered certification or guarantee that certain conditions have been met. Subsurface conditions may not be uniform throughout an entire site and ground water levels may fluctuate due to climatic and other variations. Construction materials may vary from the samples taken. W&A shall not be liable for diminution of value wherein the results of the investigation and evaluation may result in decreased value of a property or project. Unless otherwise agreed in writing, the procedures employed by W&A are not designed to detect intentional concealment or misrepresentation of fact by others. W&A services are being performed solely for client's benefit and no contractor, subcontractor, supplier, fabricator, manufacturer, tenant, occupant, consultant, or other third party shall have any claim against W&A as a result of its services.

8. SAMPLE DISPOSAL: Unless otherwise agreed in writing, test specimens or samples will be disposed immediately upon completion of the test. All drilling samples or specimens will be disposed sixty (60) days after submission of W&A report.

9. TERMINATION: This Agreement may be terminated by either party upon seven days prior written notice. In the event of termination, W&A shall be compensated by client for all services performed up to and including the termination date, including reimbursable expenses.

10. PAYMENT: The firm or individual engaging W&A is responsible for payment of charges unless W&A is notified in writing, prior to the time that the charges are incurred, that the engagement is on behalf of another party. Client shall be invoiced periodically for services performed. Client agrees to pay each invoice within thirty (30) days of its receipt. Client further agrees to pay interest on all amounts invoiced and not paid or objected to in writing for valid cause within thirty (30) days at the rate of eighteen (18%) per annum (or the maximum interest rate permitted by applicable law, whichever is the lesser) until paid and W&A costs of collection of such accounts, including court costs and reasonable attorney's fees.

11. STANDARD OF CARE: W&A professional services will be performed, its findings obtained and its reports prepared in accordance with this Agreement and with generally accepted principles and practices. In performing its professional services, W&A will use that degree of care and skill ordinarily exercised under similar circumstances by members of its profession. W&A may rely upon information supplied by the client engaging W&A, or the contractors or consultants involved, or information available from generally accepted reputable sources, without independent verification. In performing physical work in pursuit of its professional services, W&A will use that degree of care and skill ordinarily used under similar circumstances. This statement is in lieu of all other warranties or representations, either express or implied. Statements made in W&A reports are opinions based upon engineering judgment and are not to be construed as representations of fact.

12. LIMITATION OF LIABILITY: Should W&A or any of its employees be found to have been negligent in performing professional services or to have made and breached any express or implied warranty, representation or contract, client, all parties claiming through client and all parties claiming to have in any way relied upon W&A services or work agree that the maximum aggregate amount of damages for which W&A, its officers, employees and agents shall be liable is limited to \$10,000 or the total amount of the fee paid to W&A for its services performed with respect to the project whichever amount is greater.

In the event client is unwilling or unable to limit the damages for which W&A may be liable in accordance with the provisions set forth in the preceding paragraph, upon written request of client received within five (5) days of client's acceptance of W&A's proposal together with payment of an additional fee in the amount of 5% of W&A's estimated cost for its services (to be adjusted to 5% of the amount actually billed by W&A for its services on the project at time of completion), the limit damages shall be increased to \$50,000 or the amount of W&A's fee whichever is the greater. This charge is not to be construed as being a charge for insurance of any type, but is increased consideration for the exposure to an award of greater damages.

13. INDEMNITY: Subject to the provisions set forth herein, W&A and client hereby agree to indemnify and hold harmless each other and their respective shareholders, directors, officers, partners, employees, agents, subsidiaries and division (and each of their heirs, successors, and assigns) from any and all claims, demands, liabilities, suits, causes of action, judgments, costs and expenses, including reasonable attorney's fees arising, or allegedly arising, from personal injury, including death, property damage, including loss of use thereof, due in any manner to the negligence of either of them or their agents or employees. In the event both are negligent or at fault, then any liability shall be apportioned between them pursuant to their pro rata share of negligence or fault. W&A and client further agree that their liability to any third party shall, to the extent permitted by law, be several and not joint. The indemnities provided hereunder shall not terminate upon the termination or expiration of this Agreement.

14. SUBPOENAS: W&A employees shall not be retained as expert witnesses except by separate written agreement. Client agrees to pay W&A pursuant to W&A's then current Fee Schedule for any W&A employee(s) subpoenaed by any party as an occurrence witness as a result of W&A's services.

15. OTHER AGREEMENTS: W&A shall not be bound by any provision or agreement requiring or providing for arbitration of disputes or controversies arising out of this Agreement or any provision wherein W&A waives any rights to a mechanics lien, or any provision that conditions W&A's right to receive payment for its services upon payment to client by any third party. These General Conditions are notice, where required, that W&A shall file a lien whenever necessary to collect past due amounts. This Agreement contains the entire understanding between the parties. Client acknowledges that no representations, warranties, undertakings or promises have been made other than and except those expressly contained herein. All understandings and agreements heretofore had among the parties respecting this transaction, are merged in this Agreement. Unless expressly accepted by W&A in writing prior to delivery of W&A's services, client shall not add any conditions other than those contained in this Agreement. W&A's offer to provide services is conditioned on client's acceptance of all the terms and conditions set forth in these General Conditions without alteration or modification of any kind. The unenforceability or invalidity of any provision or provisions shall not render any other provision or provisions unenforceable or invalid. This Agreement shall be construed and enforced in accordance with the laws of the State of Illinois. The parties hereto consent to jurisdiction and venue in an appropriate Illinois State Court in and for the County of Peoria, Peoria, Illinois, or the Federal District Court for The Mid-Central District of Illinois. Paragraph headings are for convenience only and shall not be construed as limiting the meaning of the provisions contained in these General Conditions.

**SUPPLEMENTAL
GEOTECHNICAL ENGINEERING REPORT
OF
SITE INVESTIGATION
WASHINGTON SEWAGE TREATMENT
PLANT #2 IMPROVEMENTS
WASHINGTON, ILLINOIS
BY
WHITNEY & ASSOCIATES
PEORIA, ILLINOIS**

**PREPARED
FOR**

Mr. Ken Newman, P.E.
City of Washington
115 West Jefferson Street
Washington, Illinois 61571

DATE

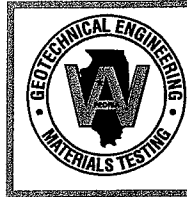
July 9, 2007

TELEPHONE

309-673-2131

TESTS * INVESTIGATIONS
ANALYSIS * DESIGN * EVALUATIONS
CONSULTATION * REPORTS * INSPECTIONS
ARBITRATION * EXPERT WITNESS TESTIMONY

SOILS * PORTLAND CEMENT CONCRETE
BITUMINOUS CONCRETE * STEEL
ASPHALT * AGGREGATES * EMULSIONS
POZZOLANIC MATERIALS * LIME

**WHITNEY & ASSOCIATES****INCORPORATED****2406 West Nebraska Avenue
PEORIA, ILLINOIS 61604-3193****TELEFAX**

309-673-3050

GEOTECHNICAL ENGINEERING
CONSTRUCTION QUALITY CONTROL
SUBSURFACE EXPLORATIONS
ENVIRONMENTAL INVESTIGATIONS

MONITORING WELL INSTALLATIONS
BUILT-UP ROOF INVESTIGATIONS
WELDER CERTIFICATIONS
INSURANCE INVESTIGATIONS

July 9, 2007

Mr. Ken Newman, P. E.
City of Washington
115 West Jefferson Street
Washington, Illinois 61571

Re: Supplemental Geotechnical
Engineering Report of
Site Investigation
Washington Sewage Treatment
Plant #2 Improvement
Washington, Illinois

Dear Mr. Newman:

Pursuant to your request, our geotechnical engineering firm has performed a supplemental subsurface soils and ground water investigation at the above referenced project site. Included in this report are the results of our field and laboratory tests as well as a summary of the data which was obtained during this investigation.

This supplemental site investigation included the drilling of two (2) exploratory test borings (Borings B-13 and B-14) for the relocated Clarifier Number 1 on June 14, 2007, which extended to a depth of thirty-one (31) feet below the existing surface grades. The locations of the exploratory soil test borings with respect to the site were established by personnel from the City of Washington and have been depicted on the enclosed Plot Plan sheet. The ground surface elevations of the borings as indicated on the Soil Boring Logs have been referenced to the U.S.G.S. data from existing benchmark elevations at the treatment plant. The results of this

investigation have been summarized on the enclosed Soil Boring Logs which have been analyzed by our geotechnical engineer and which form the basis for the following observations and recommendations.

At the present time, the site for the proposed Clarifier Number 1 exists as a lawn area located south of the RAS pumping building which is blanketed with approximately six (6) inches of brown, silty clay loam organic topsoil. Beneath the existing surface cover, fine- to medium-grained sand with some fine-grained gravel was noted to a depth of approximately four (4) feet below the existing surface grades in the area of Boring B-14 within the southwest quadrant of the proposed clarifier. Preconsolidated glacial till soils were encountered beneath these granular soils as well as near the existing surface grades in the area of Boring B-13 and typically extended in depth until the exploratory borings were discontinued by our drill crew personnel. A relatively thin seam of medium- to coarse-grained sand and fine-grained gravel with considerable silty clay was however penetrated between the approximate depths of twenty-four (24) to twenty-seven (27) feet in Boring B-14.

The consistency of the preconsolidated glacial till soils ranged from stiff to very stiff whereas the relative density of the limited cohesionless soils encountered was classified as medium-density. Standard penetration tests, designated as "N" values, ranged from 9 to 29 blows per foot within the soils encountered during this subsurface investigation.

The description of the various soils encountered as indicated on the Soil Boring Logs represent the soil conditions at the actual boring locations and variations may occur throughout the proposed site. The lines of demarcation

represent the approximate boundary between the soil types although the transition may be gradual.

It may also be observed from an inspection of the Soil Boring Logs that ground water was encountered at the proposed site. The ground water levels in the bore holes were checked after the completion of the drilling operations and after a brief time lapse. These readings and site observations indicate that ground water levels appear to exist at a depth of approximately twelve (12) to fifteen (15) feet below the existing surface grades. Some variation in the ground water levels may be anticipated however due to typical seasonal fluctuations.

Only a few minor excavation and/or construction problems are anticipated at the proposed site due to the fact that the ground water levels appear to exist near the limits of the proposed clarifier construction. Pumping of seepage and ground water accumulations may be anticipated from those excavations which extend beyond a depth of approximately twelve (12) feet below the existing surface grades and are allowed to remain open for an extended period of time.

It is our understanding that the bases of the proposed clarifiers are to be established at an elevation of approximately 629 or approximately twelve (12) feet below the existing surface grades in this location. Based on the results of this supplemental site investigation, it is our professional opinion that similar subsurface conditions exist to those which were encountered previously and the recommended net allowable soil bearing pressure of 4500 pounds per square foot may be utilized for the design of this relocated structure. The estimated soil design parameters as indicated in our previous geotechnical engineering report and subsequent correspondence may also be utilized for design of the Number 1 Clarifier.

July 9, 2007

In summary, a supplemental site investigation of the subsurface soils and ground water conditions has been conducted at the site for the relocated Number 1 Clarifier at the Washington Sewage Treatment Plant #2 Improvements in Washington, Illinois. A summary of the existing site conditions has been presented and construction recommendations have been discussed in some detail.

Should deviations from the noted subsurface conditions be encountered during construction, it is mandatory that they be brought to the attention of our personnel for further evaluation. On-site observation and testing by personnel from our geotechnical engineering firm is also considered essential to verify the recommendations presented in this report.

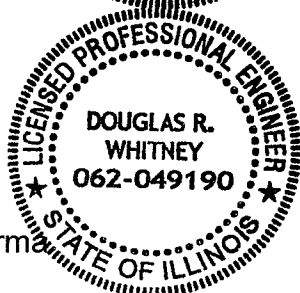
Should you have any questions or comments whatsoever in regard to this supplemental geotechnical engineering report, or if any additional information is desired, do not hesitate to contact us at your convenience.

Respectfully submitted,

WHITNEY & ASSOCIATES



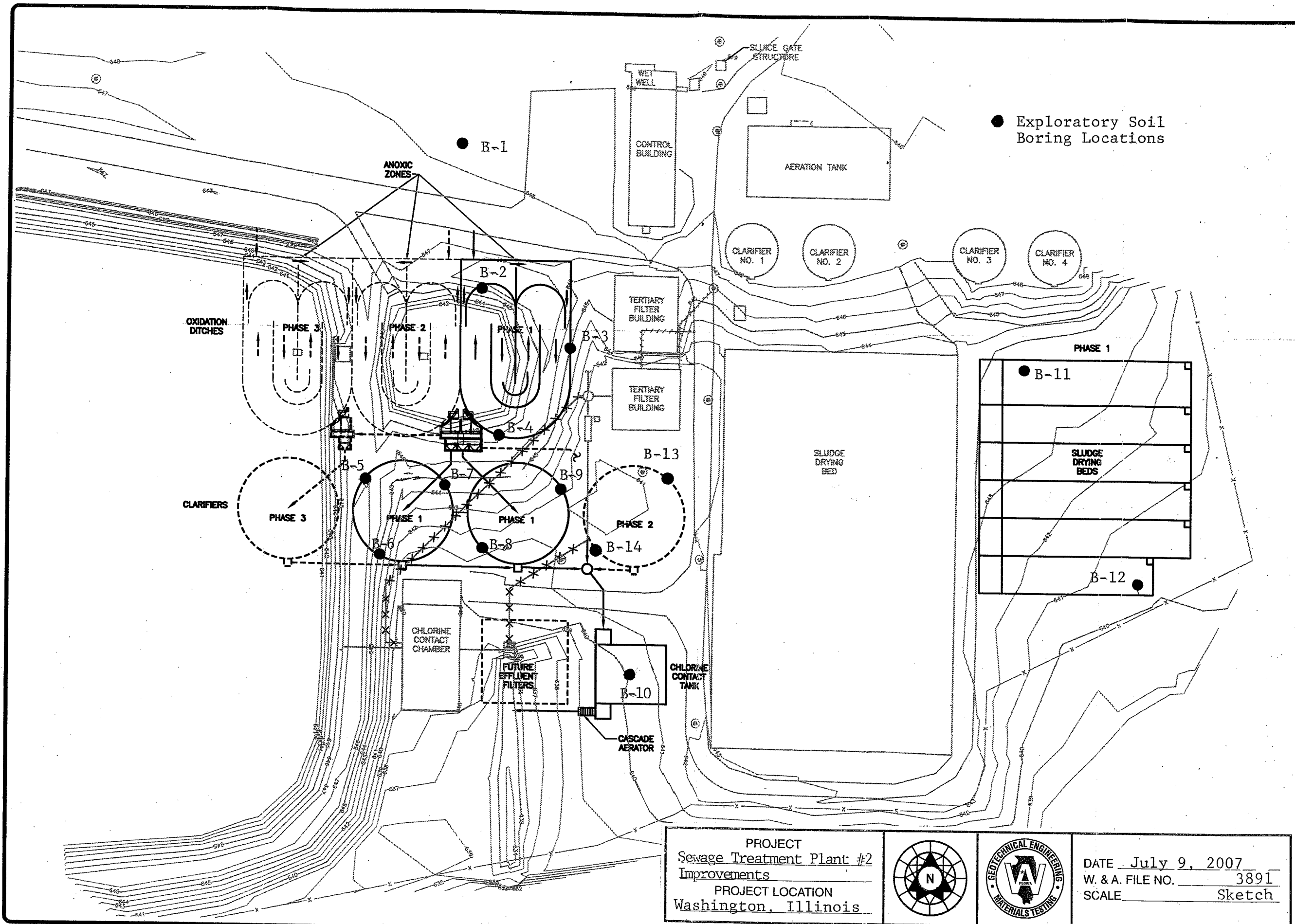
(By) *James R. Krusemark*
James R. Krusemark, P.E.



(By) *Douglas R. Whitney*
Douglas R. Whitney, P.E.

JRK/DRW:rm

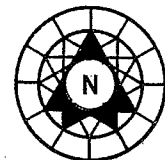
Enclosures



● Exploratory Soil Boring Locations

PRELIMINARY SITE PLAN
SEWAGE TREATMENT PLANT NO. 2
CITY OF WASHINGTON
TAZEWELL COUNTY, ILLINOIS

PROJECT
 Sewage Treatment Plant #2
 Improvements
 PROJECT LOCATION
 Washington, Illinois



DATE July 9, 2007
 W. & A. FILE NO. 3891
 SCALE Sketch



FIGURE 1

BORING NO. B-13

DATE 06-14-07

W. & A. FILE NO. 3891

SHEET 1 OF 2

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS

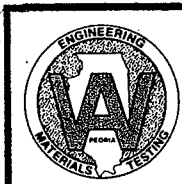
BORING LOCATION See Plot Plan Sheet

BORING TYPE Hollow Stem Auger

SOIL CLASSIFICATION SYSTEM U.S.B.S.C.

GROUND SURFACE ELEVATION 641.1

BORING DISCONTINUED AT ELEVATION 610.1



WHITNEY & ASSOCIATES

INCORPORATED

 2406 West Nebraska Avenue
 PEORIA, ILLINOIS 61604

BORING LOG

LOCATION Washington, Illinois

DRILLED BY Fehl

WEATHER CONDITIONS Partly Cloudy & Mild

SEEPAGE WATER ENCOUNTERED AT ELEVATION (-)29.5 Ft.

GROUND WATER ELEVATION AT 2 HRS. (-)20.2 Ft.

GROUND WATER ELEVATION AT COMPLETION None

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
Brown SILTY CLAY LOAM Organic Topsoil	6"						
Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	10	1.7	1.5	-	14
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL	5	SS	11	2.5	2.3	118	13
		SS	13	3.3	3.1	-	12
	10	SS	14	4.0	3.7	120	12
		SS	9	2.8	2.5	-	13
	15	SS	15	3.5	3.4	120	12
	20	SS	16	3.3	3.1	-	12
	25	SS	20	4.0	3.9	122	11
	30	SS	15	2.8	2.6	-	13
EXPLORATORY BORING DISCONTINUED							

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER FALLING 30 INCHES

SS - SPLIT SPOON SAMPLE

ST - SHELBY TUBE SAMPLE

Q_p - CALIBRATED PENETROMETER READING - T.S.F.Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.D_d - NATURAL DRY DENSITY - P.C.F.M_c - NATURAL MOISTURE CONTENT - %
 WHITNEY & ASSOCIATES
 PEORIA, ILLINOIS

BORING NO. B-14

DATE 06-14-07

W. & A. FILE NO. 3891

SHEET 2 OF 2

PROJECT WASHINGTON SEWAGE TREATMENT PLANT #2 IMPROVEMENTS

See Plot Plan Sheet

LOCATION Washington, Illinois

BORING LOCATION Hollow Stem Auger

DRILLED BY FehI

BORING TYPE U.S.B.S.C.

WEATHER CONDITIONS Partly Cloudy & Mild (-)29.0 Ft.

SOIL CLASSIFICATION SYSTEM

SEEPAGE WATER ENCOUNTERED AT ELEVATION

GROUND SURFACE ELEVATION 641.6

GROUND WATER ELEVATION AT HRS.

BORING DISCONTINUED AT ELEVATION 610.6

GROUND WATER ELEVATION AT COMPLETION None

DESCRIPTION	DEPTH IN FEET	SAMPLE TYPE	N	Q _p	Q _u	D _d	M _c
Brown SILTY CLAY LOAM Organic Topsoil	6"						
Medium-Density, Brown, Fine- To Medium-Grained SAND With Some Fine-Grained Gravel		SS	10	-	-	-	8
Very Stiff, Gray And Brown, Weathered GLACIAL SILTY CLAY TILL	5	SS	15	3.8	3.6	120	12
Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL		SS	10	1.8	1.6	-	13
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL	10	SS	15	3.8	3.7	120	12
		SS	11	3.0	2.8	-	12
	15	SS	17	3.3	3.2	121	12
	20	SS	15	3.5	3.4	-	11
Medium-Density, Gray, Medium- To Coarse-Grained SAND And Fine-Grained GRAVEL With Considerable Silty Clay	25	SS	29	-	-	-	9
Very Stiff, Gray, Unweathered GLACIAL SILTY CLAY TILL							
	30	SS	21	4.0	3.6	122	12
EXPLORATORY BORING DISCONTINUED							

N - BLOWS DELIVERED PER FOOT BY A 140 LB. HAMMER

FALLING 30 INCHES

SS - SPLIT SPOON SAMPLE

ST - SHELBY TUBE SAMPLE

Q_p - CALIBRATED PENETROMETER READING - T.S.F.Q_u - UNCONFINED COMPRESSIVE STRENGTH - T.S.F.D_d - NATURAL DRY DENSITY - P.C.F.M_c - NATURAL MOISTURE CONTENT - %WHITNEY & ASSOCIATES
PEORIA, ILLINOIS

WHITNEY & ASSOCIATES

INCORPORATED

2406 West Nebraska Avenue
PEORIA, ILLINOIS 61604

BORING LOG

TELEPHONE

309-673-2131

TESTS * INVESTIGATIONS
 ANALYSIS * DESIGN * EVALUATIONS
 CONSULTATION * REPORTS * INSPECTIONS
 ARBITRATION * EXPERT WITNESS TESTIMONY
 * * * * *

SOILS * PORTLAND CEMENT CONCRETE
 BITUMINOUS CONCRETE * STEEL
 ASPHALT * AGGREGATES * EMULSIONS
 POZOLANIC MATERIALS * LIME

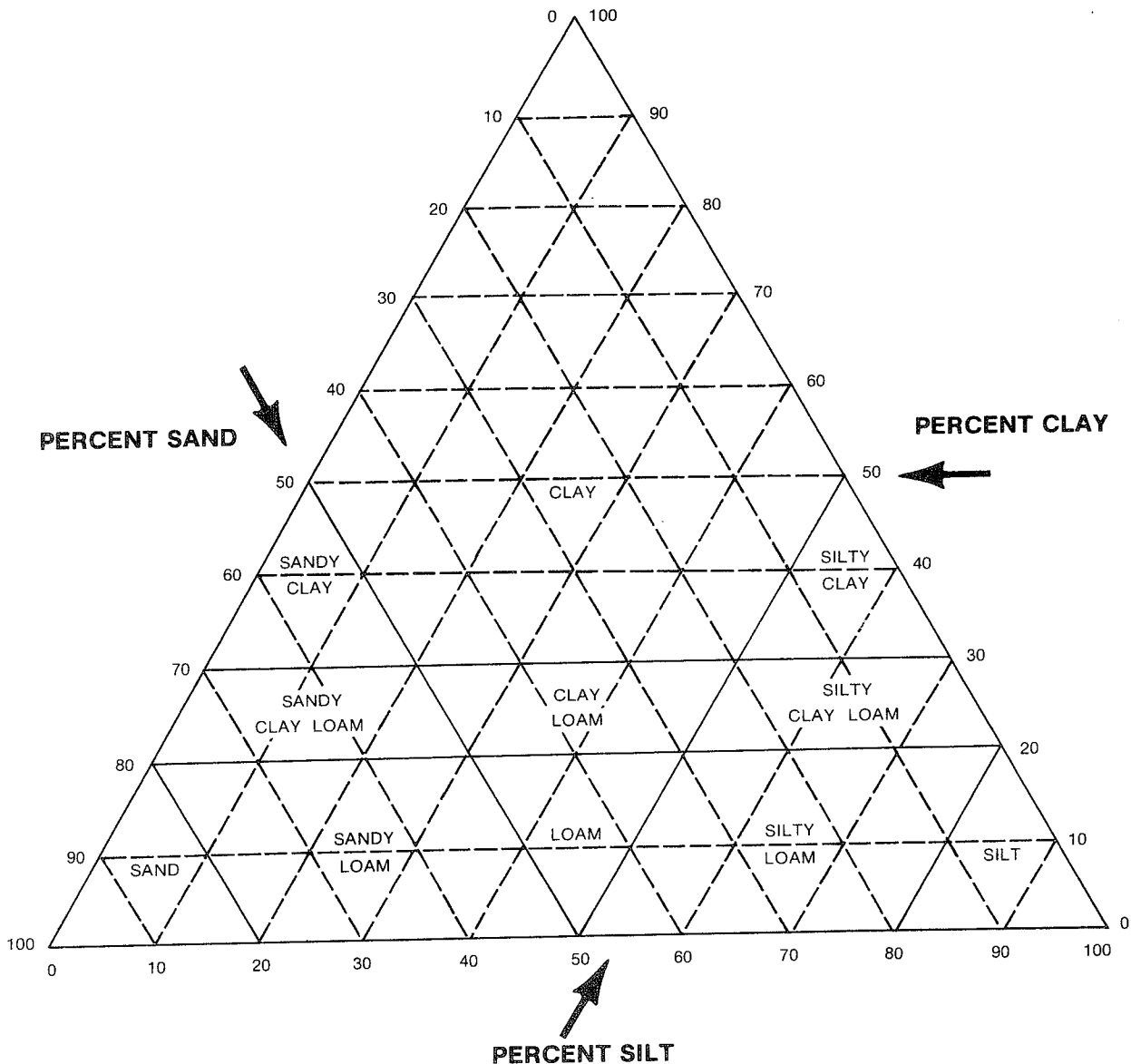


WHITNEY & ASSOCIATES
INCORPORATED
 2406 West Nebraska Avenue
 PEORIA, ILLINOIS 61604-3193

TELEFAX

309-673-3050

GEOTECHNICAL ENGINEERING
 CONSTRUCTION QUALITY CONTROL
 SUBSURFACE EXPLORATIONS
 ENVIRONMENTAL INVESTIGATIONS
 * * * * *
 MONITORING WELL INSTALLATIONS
 BUILT-UP ROOF INVESTIGATIONS
 WELDER CERTIFICATIONS
 INSURANCE INVESTIGATIONS

**TRIANGULAR TEXTURAL CLASSIFICATION CHART**

DEVELOPED BY
 UNITED STATES BUREAU OF SOILS AND CHEMISTRY
 (U.S.B.S.C.)

WHITNEY & ASSOCIATES
 PEORIA, ILLINOIS

TELEPHONE

309-673-2131

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SOIL MECHANICS CLASSIFICATION SYSTEMS**TEXTURAL CLASSIFICATION**

DESCRIPTION	SIZE
BOULDERS	LARGER THAN 3.0 IN.
COARSE GRAVEL	0.75 IN. — 3.0 IN.
FINE GRAVEL	NO. 4 SIEVE — 0.75 IN.
COARSE SAND	NO. 10 SIEVE — NO. 4 SIEVE
MEDIUM SAND	NO. 40 SIEVE — NO. 10 SIEVE
FINE SAND	NO. 200 SIEVE — NO. 40 SIEVE
SILT	LESS THAN NO. 200 SIEVE — NONPLASTIC
CLAY	LESS THAN NO. 200 SIEVE — PLASTIC

QUANTITY CLASSIFICATION

DESCRIPTION	PERCENT
TRACE	0 - 5
SMALL AMOUNT	5 - 10
SOME	10 - 15
CONSIDERABLE	15 - 20
SUBORDINATE TEXTURAL CLASSIFICATION	OVER 20

RELATIVE DENSITY CLASSIFICATION — COHESIONLESS SOILS

N. BLOWS / FT.	RELATIVE DENSITY
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM
30 - 50	DENSE
OVER 50	VERY DENSE

*** CONSISTENCY CLASSIFICATION — COHESIVE SOILS**

N. BLOWS / FT.	CONSISTENCY	Q _u , TONS / SQ. FT.
0 - 2	VERY SOFT	0.00 - 0.25
2 - 4	SOFT	0.25 - 0.50
4 - 8	MEDIUM	0.50 - 1.00
8 - 15	STIFF	1.00 - 2.00
15 - 30	VERY STIFF	2.00 - 4.00
OVER 30	HARD	OVER 4.00

*** NOTE:**

THIS CLASSIFICATION SYSTEM IS TO BE USED SOLELY AS A GUIDE AND IS NOT ADEQUATE FOR PURPOSES OF DESIGN.

WHITNEY & ASSOCIATES GENERAL CONDITIONS (GEOTECHNICAL AND CONSTRUCTION SERVICES)

THESE STANDARD TERMS AND CONDITIONS SHALL CONTINUE IN FORCE AND EFFECT DURING AND AFTER THE COMPLETION OF WHITNEY & ASSOCIATES EMPLOYMENT AND SHALL CONTROL ANY CONFLICTING TERM OR CONDITION UNLESS WHITNEY & ASSOCIATES AGREES OTHERWISE IN WRITING.

1. PARTIES AND SCOPE OF WORK. "This Agreement" consists of Whitney & Associates (W&A) proposal, W&A's Schedule of Fees and Services, client's written acceptance thereof, if accepted by W&A, and these General Conditions. The terms contained in these General Conditions are intended to prevail over any conflicting terms in this Agreement. "Client" refers to the person or entity ordering the work to be done or professional services to be rendered by Whitney & Associates (except where distinction is necessary, either work or professional services are referred to as "services" herein). If client is ordering the services on behalf of another, client represents and warrants that client is the duly authorized agent of said party for the purpose of ordering and directing said services, and in such case the term "client" shall also include the principal for whom the services are being performed. Prices quoted and charged by W&A for its services are predicated on the conditions and the allocations of risks and obligations expressed in these General Conditions. Unless otherwise stated in writing, client assumes sole responsibility for determining whether the quantity and the nature of the services ordered by client are adequate and sufficient for client's intended purpose. Client shall communicate these General Conditions to each and every third party to whom the client transmits any report prepared by W&A. Unless otherwise expressly assigned in writing, W&A shall have no duty to any third party, and in no event shall W&A have any duty or obligation other than those duties and obligations expressly set forth in this Agreement. Ordering services from W&A shall constitute acceptance of W&A's proposal and these General Conditions. In addition, Client's acceptance of W&A's proposal and these General Conditions may be indicated by Client signing the proposal, and a facsimile copy or an electronic signature by Client shall be considered as an original signature by Client.

2. SCHEDULING OF SERVICES: The services set forth in this Agreement will be accomplished in a timely and workmanlike manner. If W&A is required to delay any part of its services to accommodate the requests or requirements of client, regulatory agencies, or other parties, or due to any cause beyond its reasonable control, client agrees to pay such additional charges, if any, as may be applicable.

3. ACCESS TO SITE: Client will arrange and provide such access to the site as is necessary for W&A to perform its services. W&A shall take reasonable measures and precautions to minimize damage to the site and any improvements located thereon as a result of its services or the use of its equipment; however, W&A has not included in its fee the cost of restoration of damage which may occur. If client desires or requires W&A to restore the site to its former condition, W&A will, upon written request, perform such additional work as is necessary to do so and client agrees to pay to W&A the cost thereof plus W&A's normal markup for overhead and profit.

4. CLIENT'S DUTY TO NOTIFY ENGINEER: Client represents and warrants that client has advised W&A of any known or suspected hazardous materials, utility lines and underground structures at any site at which W&A is to perform services under this Agreement.

5. DISCOVERY OF POLLUTANTS: W&A services shall not include investigation for hazardous substances, materials or wastes or petroleum products. Hazardous materials, substances or wastes (all cumulatively referred to herein as "hazardous substances") includes, but is not limited to, any substance, waste, pollutant or contaminant, in whatever form, now or hereafter included with such terms under any federal, state or local statute, ordinance, code, rule or regulation now existing or hereinafter enacted or amended. W&A shall not be liable for any contamination as a result of hazardous substances which may be encountered. In the event that hazardous substances are suspected by W&A, W&A's sole duty shall be to notify client and W&A has no duty to identify or attempt to identify within the project area.

6. MONITORING: If this Agreement includes testing construction materials or observing any aspect of construction of improvements, W&A will report its test results and observations as more specifically set forth elsewhere in this Agreement. Client shall cause all tests and inspections of the site, materials and work to be timely and properly performed in accordance with the plans, specifications, contract documents, and W&A recommendations. No claims for loss, damage or injury shall be brought against W&A unless all tests and inspections have been so performed and unless W&A recommendations have been followed.

W&A services shall not include determining or implementing the means, methods, techniques or procedures of work done by the contractor(s) being monitored or whose work is being tested. W&A services shall not include the authority to accept or reject work or to in any manner supervise the work of any contractor. W&A services or failure to perform same shall not in any way operate or excuse any contractor from the performance of its work in accordance with its contract. W&A services shall not include any responsibility or liability for the owner and/or contractor's site safety and/or operations of construction, including surface water management practices. "Contractor" as used herein shall include the general contractor, subcontractors, suppliers, architects, engineers and construction managers.

7. LIMITATIONS OF PROCEDURES, EQUIPMENT AND TESTS: Information obtained from borings, observations and analyses of sample materials shall be reported in formats considered appropriate by W&A unless directed otherwise by Client. Such information is considered evidence, but any inference or conclusion based thereon is, necessarily, an opinion also based on engineering judgment and shall not be construed as a representation of fact. The test report documents shall not be considered certification or guarantee that certain conditions have been met. Subsurface conditions may not be uniform throughout an entire site and ground water levels may fluctuate due to climatic and other variations. Construction materials may vary from the samples taken. W&A shall not be liable for diminution of value wherein the results of the investigation and evaluation may result in decreased value of a property or project. Unless otherwise agreed in writing, the procedures employed by W&A are not designed to detect intentional concealment or misrepresentation of fact by others. W&A services are being performed solely for client's benefit and no contractor, subcontractor, supplier, fabricator, manufacturer, tenant, occupant, consultant, or other third party shall have any claim against W&A as a result of its services.

8. SAMPLE DISPOSAL: Unless otherwise agreed in writing, test specimens or samples will be disposed immediately upon completion of the test. All drilling samples or specimens will be disposed sixty (60) days after submission of W&A report.

9. TERMINATION: This Agreement may be terminated by either party upon seven days prior written notice. In the event of termination, W&A shall be compensated by client for all services performed up to and including the termination date, including reimbursable expenses.

10. PAYMENT: The firm or individual engaging W&A is responsible for payment of charges unless W&A is notified in writing, prior to the time that the charges are incurred, that the engagement is on behalf of another party. Client shall be invoiced periodically for services performed. Client agrees to pay each invoice within thirty (30) days of its receipt. Client further agrees to pay interest on all amounts invoiced and not paid or objected to in writing for valid cause within thirty (30) days at the rate of eighteen (18%) per annum (or the maximum interest rate permitted by applicable law, whichever is the lesser) until paid and W&A costs of collection of such accounts, including court costs and reasonable attorney's fees.

11. STANDARD OF CARE: W&A professional services will be performed, its findings obtained and its reports prepared in accordance with this Agreement and with generally accepted principles and practices. In performing its professional services, W&A will use that degree of care and skill ordinarily exercised under similar circumstances by members of its profession. W&A may rely upon information supplied by the client engaging W&A, or the contractors or consultants involved, or information available from generally accepted reputable sources, without independent verification. In performing physical work in pursuit of its professional services, W&A will use that degree of care and skill ordinarily used under similar circumstances. This statement is in lieu of all other warranties or representations, either express or implied. Statements made in W&A reports are opinions based upon engineering judgment and are not to be construed as representations of fact.

12. LIMITATION OF LIABILITY: Should W&A or any of its employees be found to have been negligent in performing professional services or to have made and breached any express or implied warranty, representation or contract, client, all parties claiming through client and all parties claiming to have in any way relied upon W&A services or work agree that the maximum aggregate amount of damages for which W&A, its officers, employees and agents shall be liable is limited to \$10,000 or the total amount of the fee paid to W&A for its services performed with respect to the project whichever amount is greater.

In the event client is unwilling or unable to limit the damages for which W&A may be liable in accordance with the provisions set forth in the preceding paragraph, upon written request of client received within five (5) days of client's acceptance of W&A's proposal together with payment of an additional fee in the amount of 5% of W&A's estimated cost for its services (to be adjusted to 5% of the amount actually billed by W&A for its services on the project at time of completion), the limit damages shall be increased to \$50,000 or the amount of W&A's fee whichever is the greater. This charge is not to be construed as being a charge for insurance of any type, but is increased consideration for the exposure to an award of greater damages.

13. INDEMNITY: Subject to the provisions set forth herein, W&A and client hereby agree to indemnify and hold harmless each other and their respective shareholders, directors, officers, partners, employees, agents, subsidiaries and division (and each of their heirs, successors, and assigns) from any and all claims, demands, liabilities, suits, causes of action, judgments, costs and expenses, including reasonable attorney's fees arising, or allegedly arising, from personal injury, including death, property damage, including loss of use thereof, due in any manner to the negligence of either of them or their agents or employees. In the event both are negligent or at fault, then any liability shall be apportioned between them pursuant to their pro rata share of negligence or fault. W&A and client further agree that their liability to any third party shall, to the extent permitted by law, be several and not joint. The indemnities provided hereunder shall not terminate upon the termination or expiration of this Agreement.

14. SUBPOENAS: W&A employees shall not be retained as expert witnesses except by separate written agreement. Client agrees to pay W&A pursuant to W&A's then current Fee Schedule for any W&A employee(s) subpoenaed by any party as an occurrence witness as a result of W&A's services.

15. OTHER AGREEMENTS: W&A shall not be bound by any provision or agreement requiring or providing for arbitration of disputes or controversies arising out of this Agreement or any provision wherein W&A waives any rights to a mechanics lien, or any provision that conditions W&A's right to receive payment for its services upon payment to client by any third party. These General Conditions are notice, where required, that W&A shall file a lien whenever necessary to collect past due amounts. This Agreement contains the entire understanding between the parties. Client acknowledges that no representations, warranties, undertakings or promises have been made other than and except those expressly contained herein. All understandings and agreements heretofore had among the parties respecting this transaction, are merged in this Agreement. Unless expressly accepted by W&A in writing prior to delivery of W&A's services, client shall not add any conditions other than those contained in this Agreement. W&A's offer to provide services is conditioned on client's acceptance of all the terms and conditions set forth in these General Conditions without alteration or modification of any kind. The unenforceability or invalidity of any provision or provisions shall not render any other provision or provisions unenforceable or invalid. This Agreement shall be construed and enforced in accordance with the laws of the State of Illinois. The parties hereto consent to jurisdiction and venue in an appropriate Illinois State Court and in the County of Peoria, Peoria, Illinois, or the Federal District Court for the Mid-Central District of Illinois. Paragraph headings are for convenience only and shall not be construed as limiting the meaning of the provisions contained in these General Conditions.

SECTION 16941 SAMPLE DRAWINGS

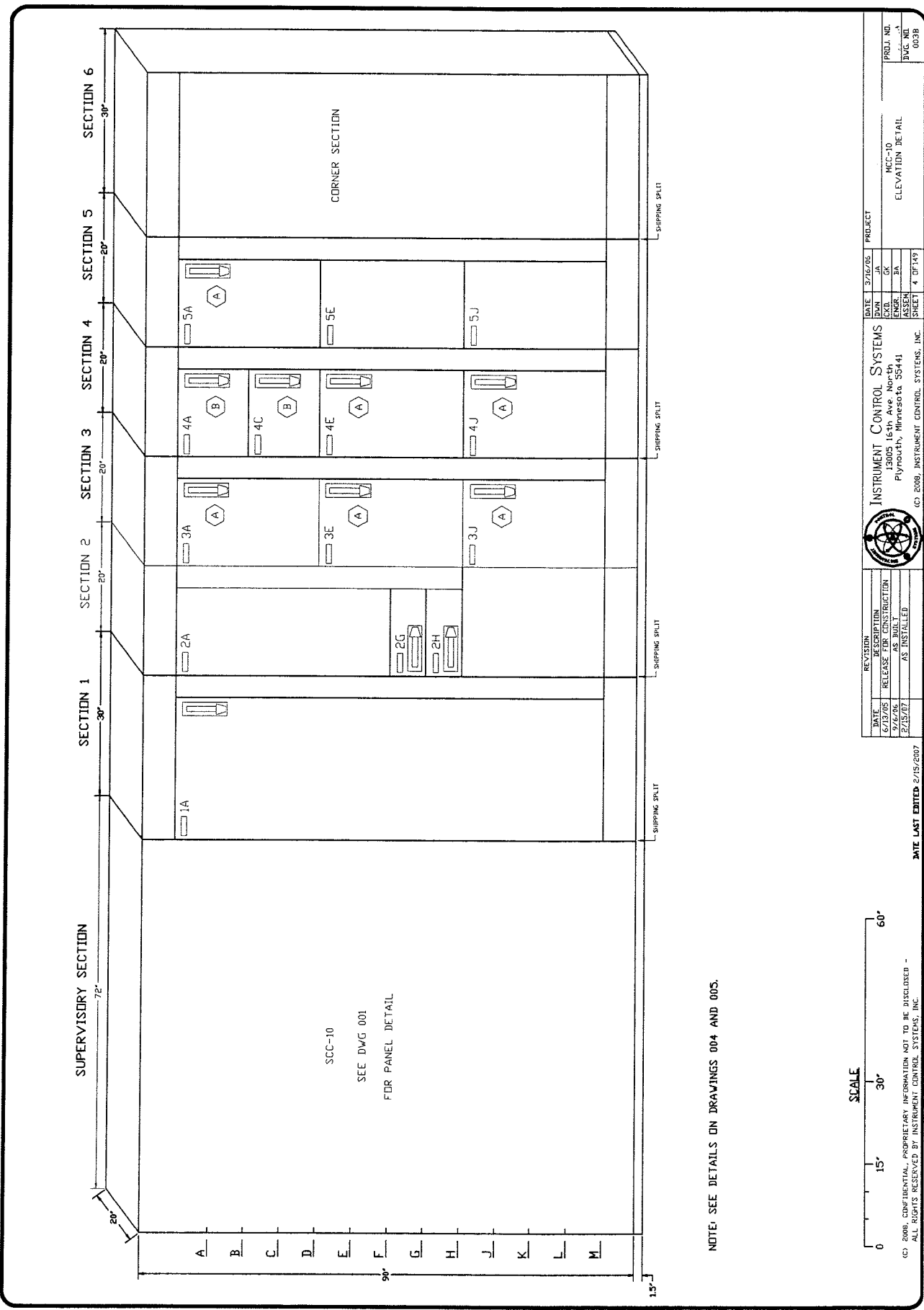
CONDUCTORS		SWITCHES		PROCESS SWITCHES		INPUT/OUTPUT DEVICES		MISCELLANEOUS	
CONDUCTOR CONDUCTORS NOT CONNECTED CONDUCTORS CONNECTED CONDUCTOR SHIELD FIELD CONDUCTOR EARTH GROUND CHASSIS GROUND SHIELD GROUND (ISOLATED IF REQUIRED BY SPEC.)		DESCRIPTION TEXT (EXAMPLE: LAMP TEST) NORMALLY OPEN PUSHBUTTON NORMALLY CLOSED PUSHBUTTON NORMALLY CLOSED MUSHROOM HEAD E-STOP MECHANICAL CONNECTION TWO POSITION SELECTOR SWITCH SHOWN IN 'POS1' CONTACT MADE IN 'POS2' THREE POSITION SELECTOR SWITCH SHOWN IN 'POS1' POSITION ARROW INDICATES SPRING RETURN FROM 'POS3' CONTACT MADE IN 'POS3' FOUR POSITION SELECTOR SWITCH SHOWN IN 'POS1' POSITION CONTACT MADE IN 'POS3' LIMIT SWITCHES NORMALLY OPEN NORMALLY CLOSED NORMALLY OPEN HELD CLOSED NORMALLY CLOSED HELD OPEN		TORQUE SWITCH NORMALLY OPEN CLOSE ON INCREASE TORQUE TORQUE SWITCH NORMALLY CLOSED OPEN ON INCREASE TORQUE LIQUID LEVEL SWITCH NORMALLY OPEN CLOSE ON RISE LIQUID LEVEL SWITCH NORMALLY CLOSED OPEN ON RISE FLOW SWITCH NORMALLY OPEN CLOSE ON INCREASE FLOW FLOW SWITCH NORMALLY CLOSED OPEN ON INCREASE FLOW PRESSURE SWITCH NORMALLY OPEN CLOSE ON RISE PRESSURE SWITCH NORMALLY CLOSED OPEN ON RISE TEMPERATURE SWITCH NORMALLY OPEN CLOSE ON RISE TEMPERATURE SWITCH NORMALLY CLOSED OPEN ON RISE		DIGITAL INPUT ADDRESS RACK/SLOT/POINT DIGITAL OUTPUT ADDRESS RACK/SLOT/POINT ANALOG INPUT ADDRESS RACK/SLOT/POINT ANALOG OUTPUT ADDRESS RACK/SLOT/POINT		CIRCUIT BREAKER WITH AMPERAGE FUSE WITH AMPERAGE AUDIBLE DEVICE ELAPSED TIME METER RESISTOR 250 OHM RECTIFIER, DIODE CAPACITOR, ELECT. TRANSFORMER SECONDARY VOLTAGE AND RATING INDICATED AS APPLICABLE	
TERMINALS		RELAY COILS		PILOT LIGHTS		COIL CONTACTS		INSTRUMENTATION DEVICES	
TERMINAL BLOCK FOR FIELD TERMINATION TERMINAL BLOCK FOR INTERNAL USE ONLY TERMINATION DEVICE TERMINATION POINT FUSED TERMINAL BLOCK FOR DEVICES LOCATED INTERNALLY		CR1 MI TD SET R XXSEC SOL1 DL1		PL1 PL2		CR1 CR2 TR1 TR2 TR3 TR4		FD LI FI	
DEVICE ID / DRAWING CROSS REFERENCE		WIRE COLOR STANDARDS		WIRE COLOR STANDARDS		WIRE COLOR STANDARDS		WIRE COLOR STANDARDS	
SEQUENCE 00-99		BLACK, INCLUDING POWER AC		BLACK, INCLUDING POWER AC		BLACK, INCLUDING POWER AC		BLACK, INCLUDING POWER AC	
DRAWING CROSS REFERENCE 1-99		WHITE, NEUTRAL AC		WHITE, NEUTRAL AC		WHITE, NEUTRAL AC		WHITE, NEUTRAL AC	
FAMILY CODE ABBREVIATION		GREEN, GROUND		GREEN, GROUND		GREEN, GROUND		GREEN, GROUND	
EXAMPLE: CR201		RED, CONTROL POWER AC		RED, CONTROL POWER AC		RED, CONTROL POWER AC		RED, CONTROL POWER AC	
		BLUE, CONTROL POWER DC		BLUE, CONTROL POWER DC		BLUE, CONTROL POWER DC		BLUE, CONTROL POWER DC	
		BLUE WITH STRIP, CONTROL POWER COMMON DC		BLUE WITH STRIP, CONTROL POWER COMMON DC		BLUE WITH STRIP, CONTROL POWER COMMON DC		BLUE WITH STRIP, CONTROL POWER COMMON DC	
		SHLD		SHLD		SHLD		SHLD	
		SHIELDED 2 CONDUCTOR BLACK(++)		SHIELDED 2 CONDUCTOR BLACK(++)		SHIELDED 2 CONDUCTOR BLACK(++)		SHIELDED 2 CONDUCTOR BLACK(++)	
		YEL		YEL		YEL		YEL	
		YELLOW, SEPARATE EXTERNAL CONTROL POWER SOURCE		YELLOW, SEPARATE EXTERNAL CONTROL POWER SOURCE		YELLOW, SEPARATE EXTERNAL CONTROL POWER SOURCE		YELLOW, SEPARATE EXTERNAL CONTROL POWER SOURCE	

Sample symbol sheet

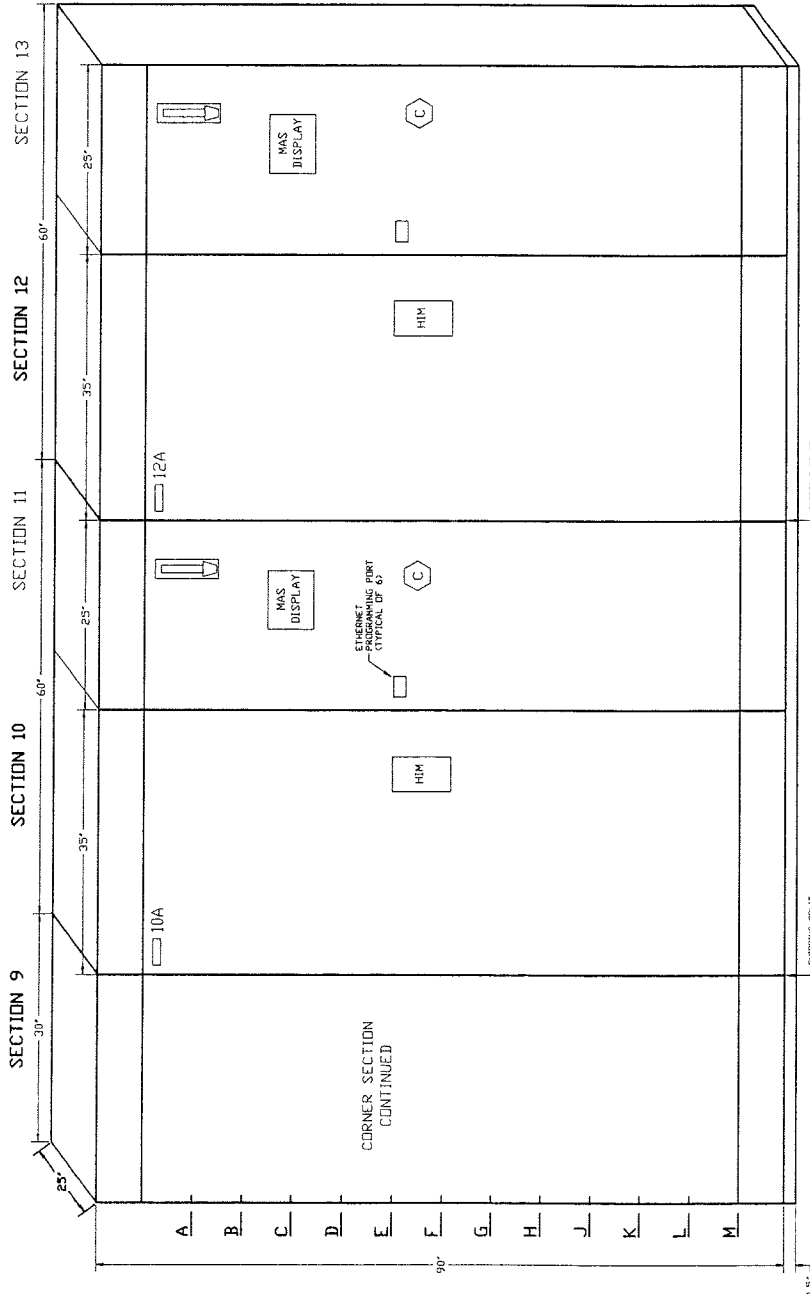
Standard Abbreviations

<u>Abbreviation</u>	<u>Description</u>	<u>Abbreviation</u>	<u>Description</u>
A	Air Compressed	OV	Overvoltage
AC	Air Condition	PB	Pushbutton
AD	Auto Dialer	PC	Pull Cord
AH	Alarm Horn	PC	Personal Computer
AL	Alarm Light	PFC	Power Factor Capacitor
AM	Amp Meter/Ammeter	PL	Pilot Light
ANN	Annunciator	PLC	Programmable Logic Controller
AR	Alternating Relay	PM	Power or Phase Monitor
AWG	American Wire Gauge	PN	Pneumatic
BA	Battery	PR	Pressure Regulator
BLU	Blue	PS	Pressure Switch
BRN	Brown	PS	Power Supply
CA	Cable	PSH	Pressure Switch High
CB	Circuit Breaker	PSL	Pressure Switch Low
CR	Control Relay	REC	Receptacle
CT	Current Transformer	SP	Surge Protector
DB	Distribution Block	SS	Selector Switch
DI	Diode	STP	Shielded Twisted Pair
DS	Disconnect Switch	SV	Solenoid Valve
EC	Electronic Control Device	TD	Time Delay Relay
ETM	Elapsed Time Meter	TG	Toggle Switch
EN	Enclosure	TS	Temperature Switch
FO	Fiber Optic	TSP	Twisted Shielded Pair
FS	Flow Switch	TT	Temperature Transmitter
FU	Fuse	UPS	Uninterruptible Power Supply
GFI	Ground Fault Interrupter	UTP	Unshielded Twisted Pair
GND	Ground	VA	Voltampere
GRN	Green	VFD	Variable
HTR	Heater	VM	Voltmeter
LA	Lightning Arrestor	WHT	White
LP	Lighting Panel	WS	Weight Switch
LR	Latching Relay	WT	Weight Transmitter
LS	Level Switch	XFMR	Transformer
MS	Motor Starter Contactor	SI	Signal Isolator
M	Motor	SS	Speed Switch
NP	Nameplate	ZS	Position Switch
OIT	Operator Interface Terminal		
OL or O/L	Overload		
ORG	Orange		

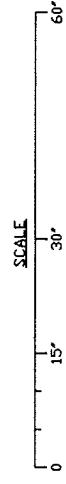
Sample List of
Abbreviations



Sample Exterior
Layout Drawing



NOTE: SEE DETAILS ON DRAWINGS 004 AND 005.
SECTIONS 10 THROUGH 13 ARE MOUNTED BACK-TO-BACK
WITH SECTIONS 14 THROUGH 17.



DATE	REVISION	DESCRIPTION	DATE	PROJECT
6/15/06	RELEASE	AS BUILT	JA	PROJECT
9/16/06	RELEASE	AS BUILT	BA	PROJECT
2/15/07	RELEASE	AS BUILT	BA	PROJECT
			ASSEMB	PROJECT
			SHEET	6 OF 149

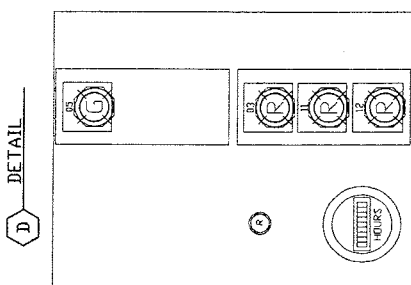
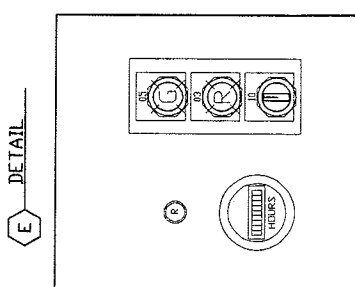
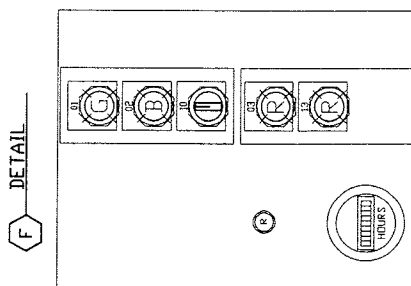
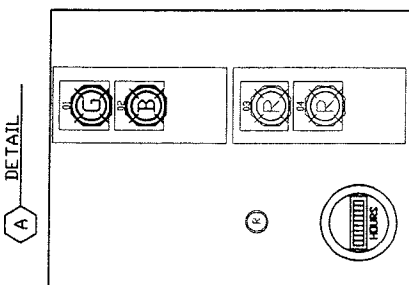
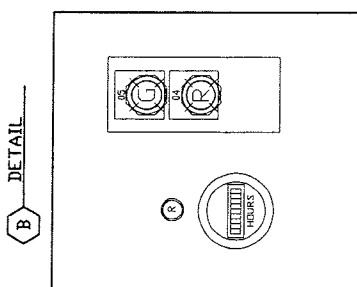
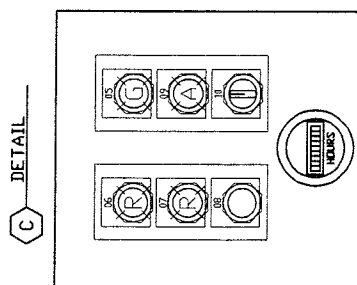
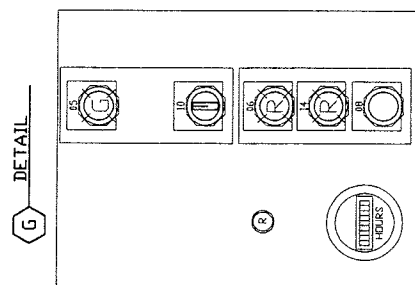
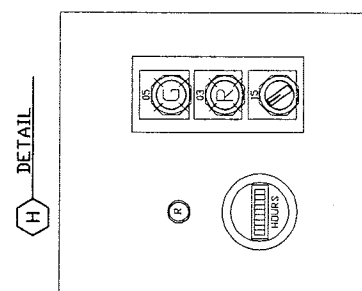


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Plymouth, Minnesota 55441
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DATE LAST EDITED 2/15/2007

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Sample Exterior
Layout Drawing



LEGEND PLATE SCHEDULE					REMARKS
TAG	DESC1	DESC2	DESC3	SIZE	
01	FORWARD			1-13/16" SQ	
02	REVERSE			1-13/16" SQ	
03	OVERLOAD			1-13/16" SQ	
04	OVERCURRENT			1-13/16" SQ	
05	RUN			1-13/16" SQ	
06	VFD FAULT			1-13/16" SQ	
07	MOTOR/BEARING		HIGH TEMP	1-13/16" SQ	
08	RESET			1-13/16" SQ	
09	JIB/MOTOR		MOISTURE	1-13/16" SQ	
10	HAND AUTO		OFF	1-13/16" SQ	
11	ZERO SPEED		ALARM	1-13/16" SQ	
12	STOP		ACTIVATED	1-13/16" SQ	
13	INSPECTION		DOOR OPEN	1-13/16" SQ	
14	MOTOR		OVERTEMP	1-13/16" SQ	
15	ON			1-13/16" SQ	

DATE	REVISION
6/13/05	DESCRIPTION
9/6/06	RELEASE FOR CONSTRUCTION
	AS BUILT
2/15/07	AS INSTALLED

DATE	3/16/06
DWN	JA
CKD	GK
ENGR	BA
ASSEM	
SHEET	11 OF 149

INSTRUMENT CONTROL SYSTEMS
13005 16th Ave. North
Plymouth, Minnesota 55441

REVISION	DATE	DESCRIPTION
	6/13/05	RELEASE FOR CONSTRUCTION
	9/6/06	AS BUILT
	2/15/07	AS INSTALLED

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Sample Exterior
Layout Drawing

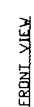
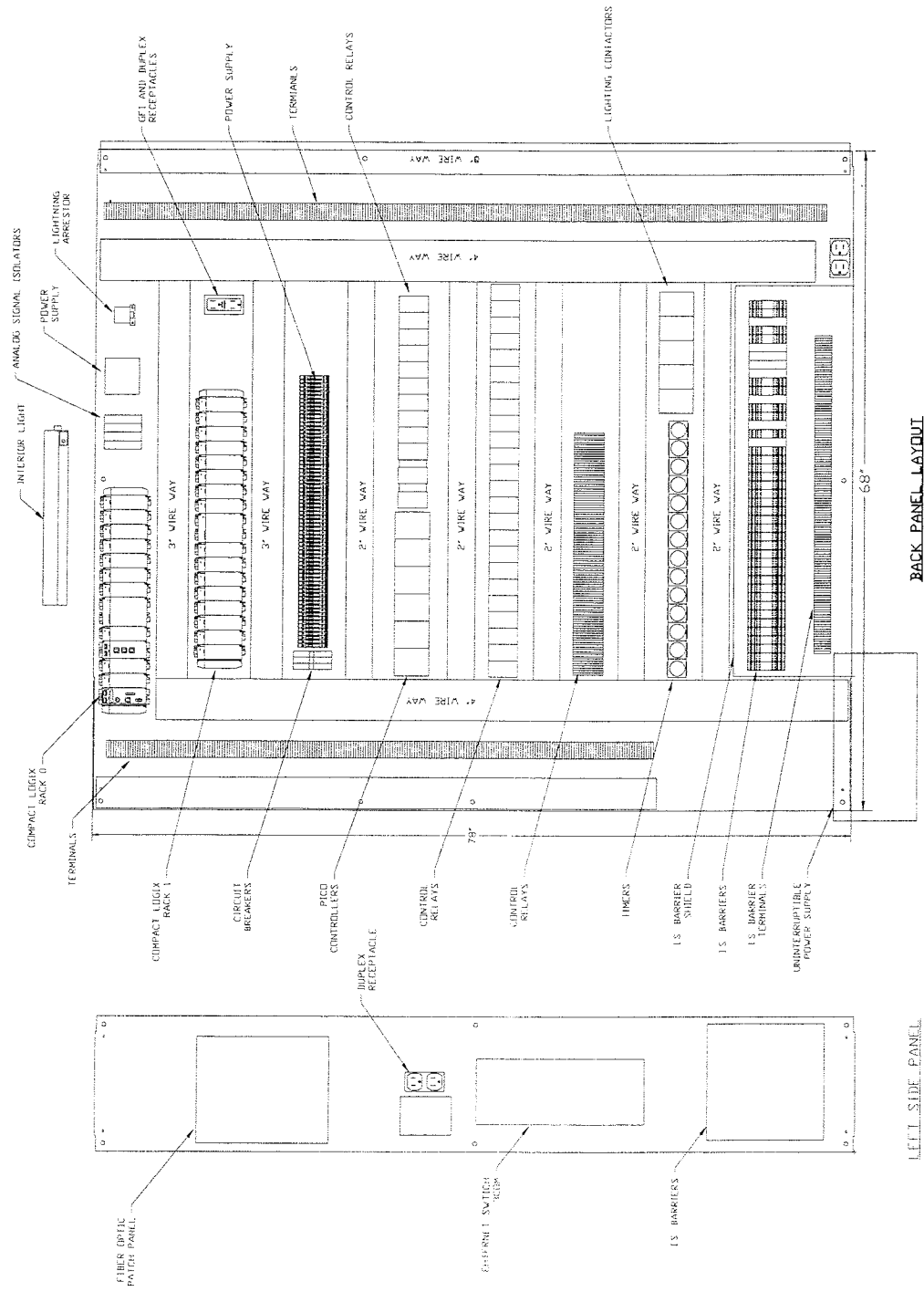


PLATE PLATES ARE BLACK WITH WHITE LETTERS

1 ENCLOSURE IS A NEMA TYPE 12 FREESTANDING HOFFMAN A-9072201 SD
WITH INNER PANEL HOFFMAN A-9072751
2 FINISH IS ANST 61 GRAY
3 UL # BF-3171536

Sample Exterior Layout Drawing



BACK PANEL LAYOUT

LEFT SIDE PANEL



SCALE

DATE	REVISION
2/15/2007	AS BUILT
2/15/2007	AS INSTALLED

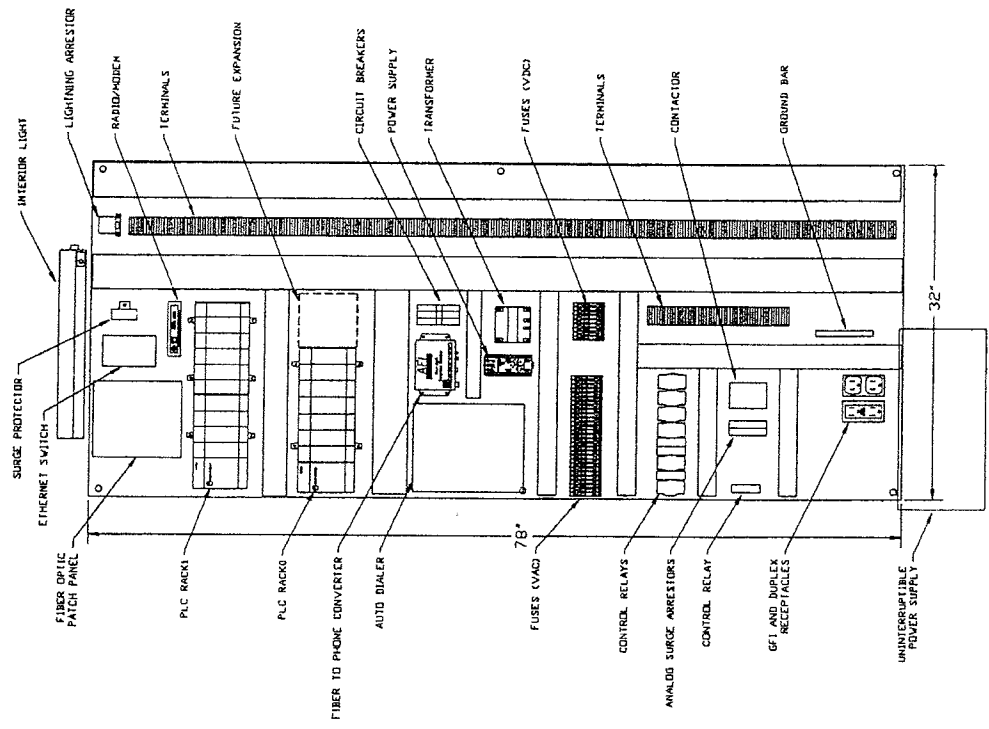
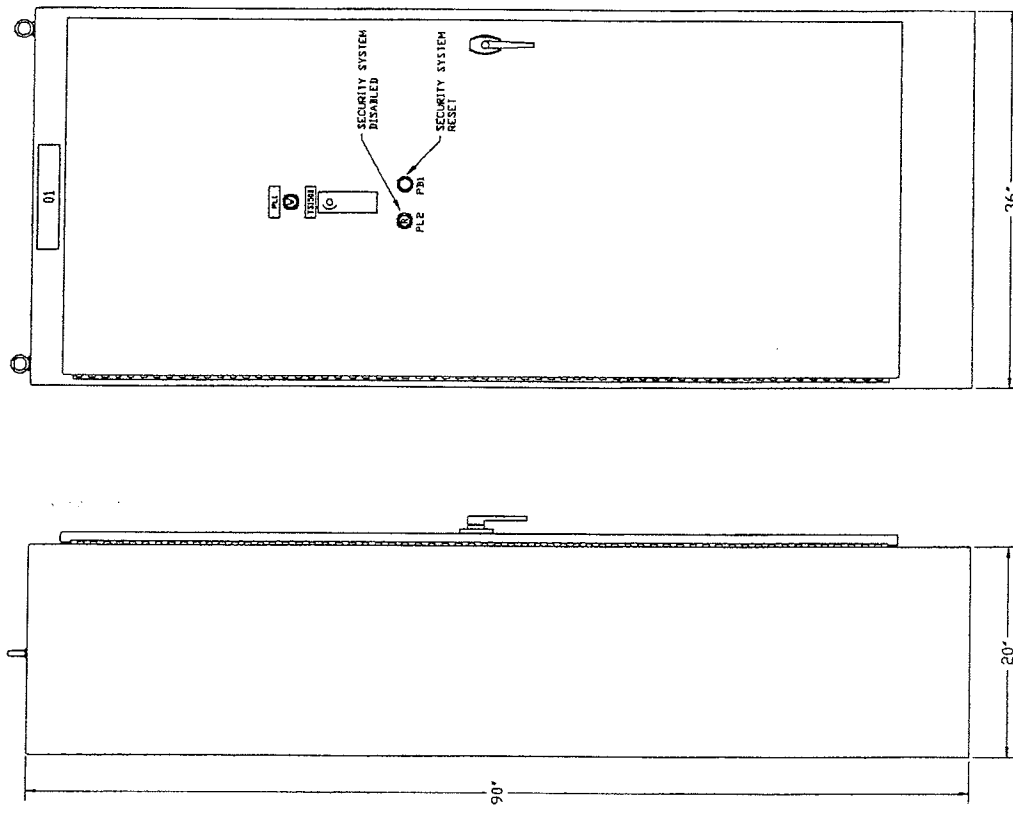
INSTRUMENT CONTROL SYSTEMS
 13805 16th Ave North
 Plymouth, Minnesota 55441
 (612) 208-8888 INSTRUMENT CONTROL SYSTEMS, INC.

DATE	3/16/06	PROJECT
DWN	JA	
CHKD	GR	
ASSEMB	BR	
SHEET	2 OF 149	

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DATE LAST EDITED 2/15/2007

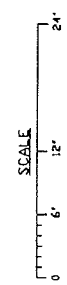
Sample Interior Layout
 Drawing



PANEL LAYOUT

NOTES:

1. ENCLOSURE IS A NEMA TYPE 12 FREESTANDING HOFFMAN A903620F S. WITH INNER PANEL HOFFMAN A90P36FL.
2. FINISH IS ANSI 61 GRAY.
3. UL 508A



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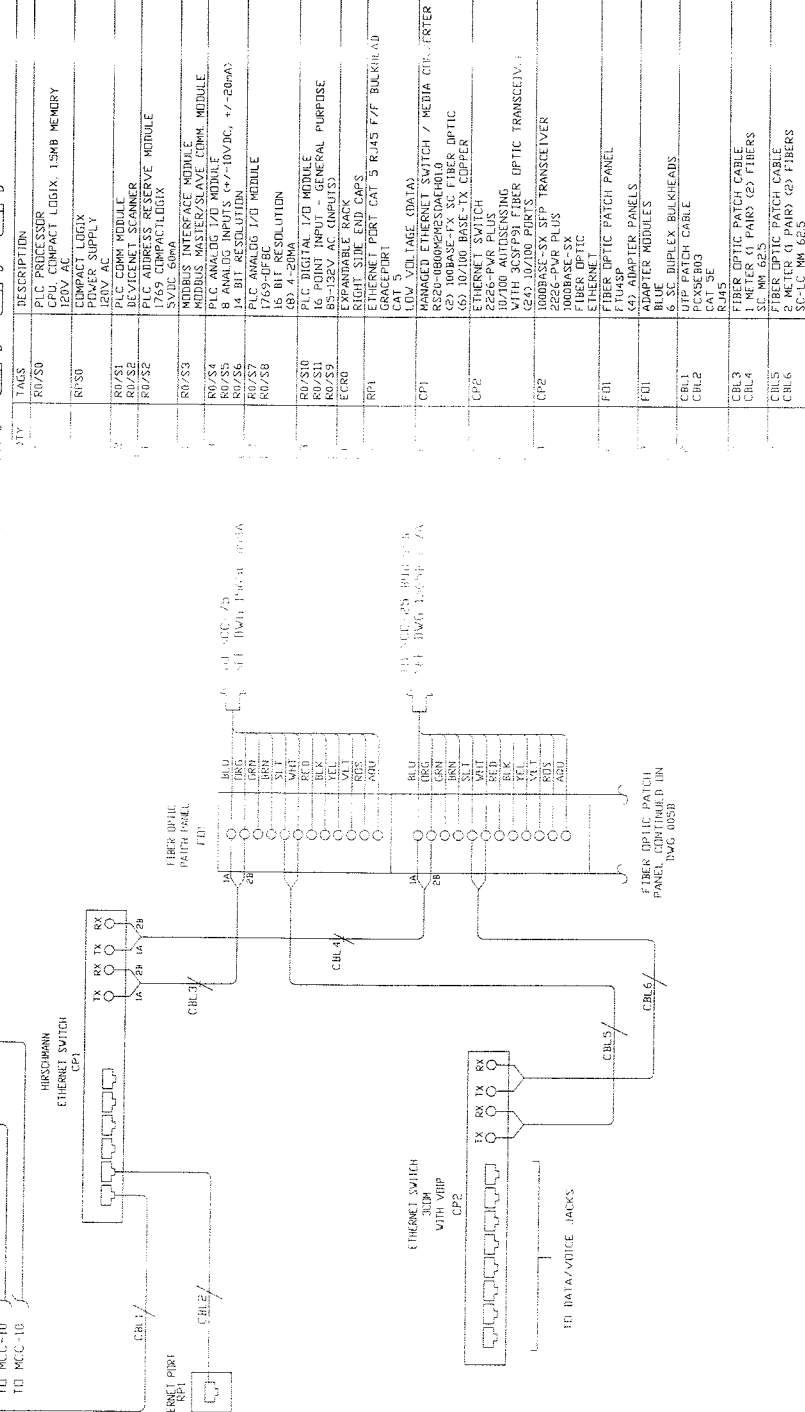
ENCLOSURE DETAIL
SCC-MAIN

PANEL NO.
001

MANUFACTURE SCHEDULE				
TAG	LINE 1	LINE 2	LINE 3	REMARKS
01	SCC-MAIN		2-10	
PL1	POWER ON UPS		1X3	
151560	LOW BUILDING TEMPERATURE		1X3	

MANUFACTURE ARE BLACK WITH WHITE LETTERS

Sample Exterior and Interior Layout Drawing.

[illegible]

DATE LAST EDITED: 11/14/2002

REVISION		DATE	DESCRIPTION
1	RELEASE FOR PRODUCTION	2/1/90	
2	"A"	7/2/90	
3	"B"	7/2/90	
4	"C"	7/2/90	

INSTRUMENT CONTROL SYSTEMS
 13005 15th Ave North
 Plymouth, Minnesota 55441



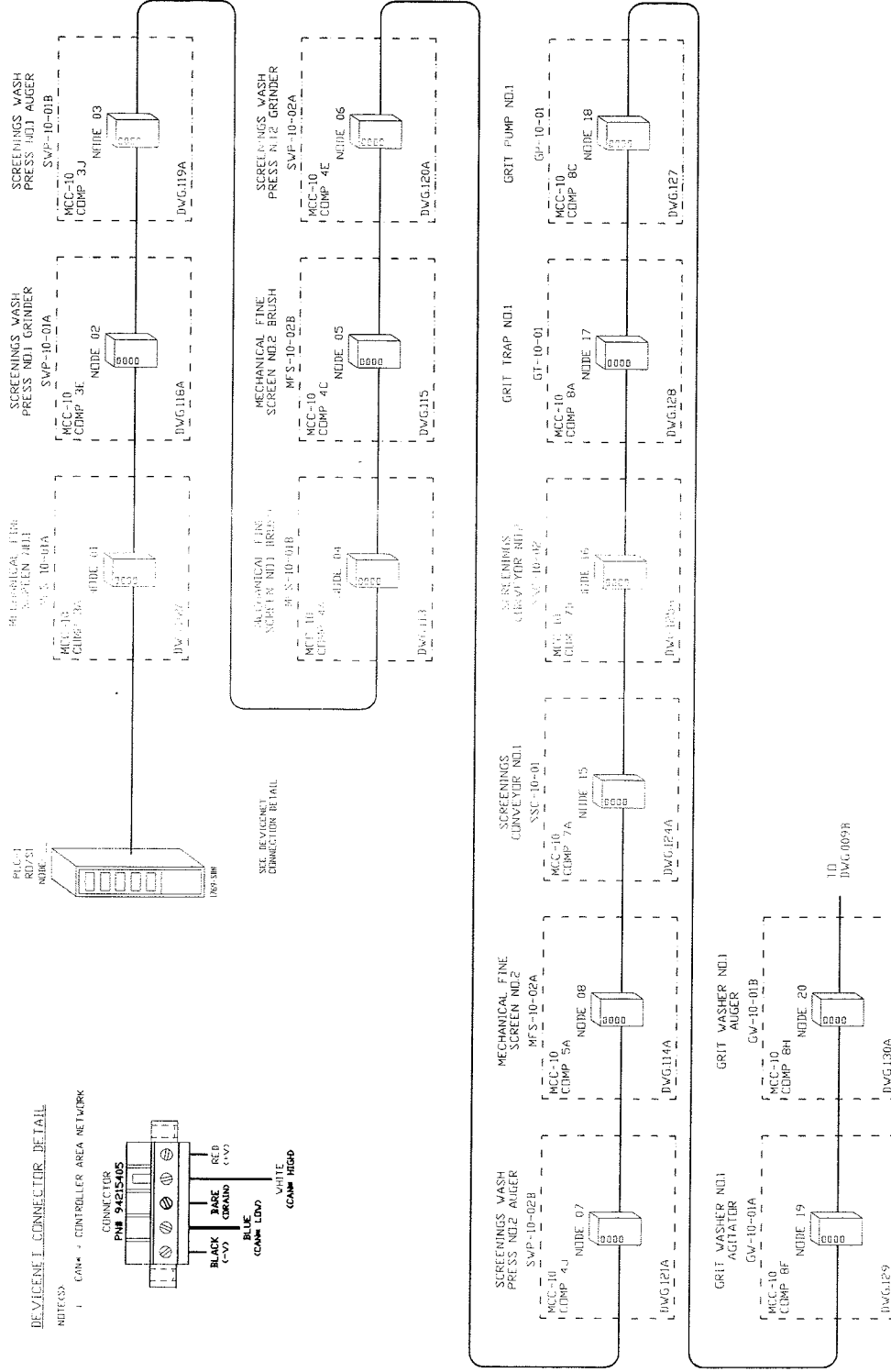
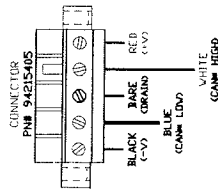
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 SHEET 17 OF 149

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Sample Interconnection Diagram

DEVIEMET I CONNECTOR DETAIL

NOTES:
1. CAN - CONTROLLER AREA NETWORK



* 120 OHM TERMINATING RESISTOR REQUIRED

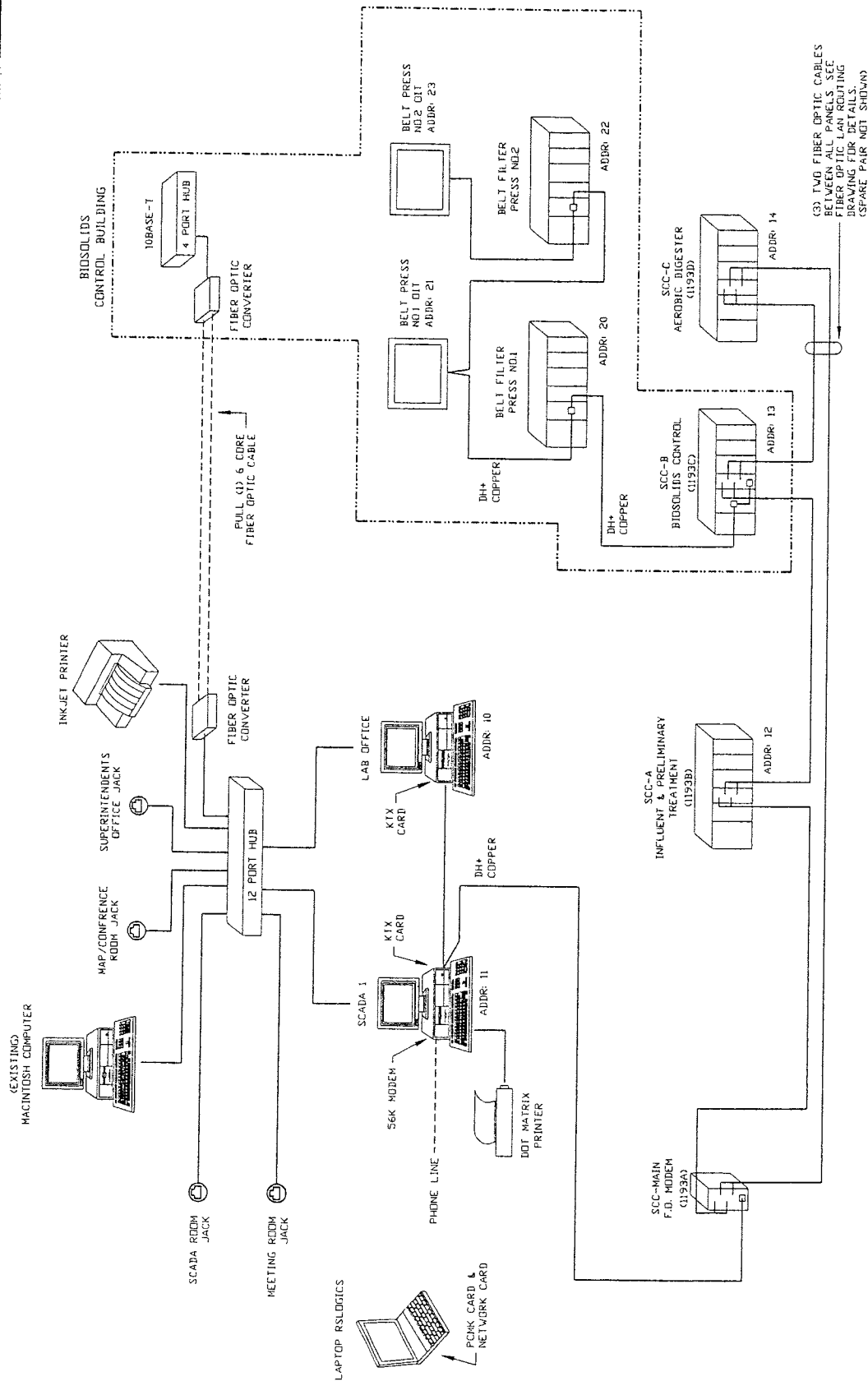
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2/15/05	RELEASE FOR INSTALLATION	DWN	JA	
2/15/05	AS INSTALLED	ECB	OK	
2/15/05	AS INSTALLED	ASSEN	SA	
2/15/05	AS INSTALLED	SHEET	19 OF 149	

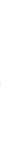
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Sample Network Diagram

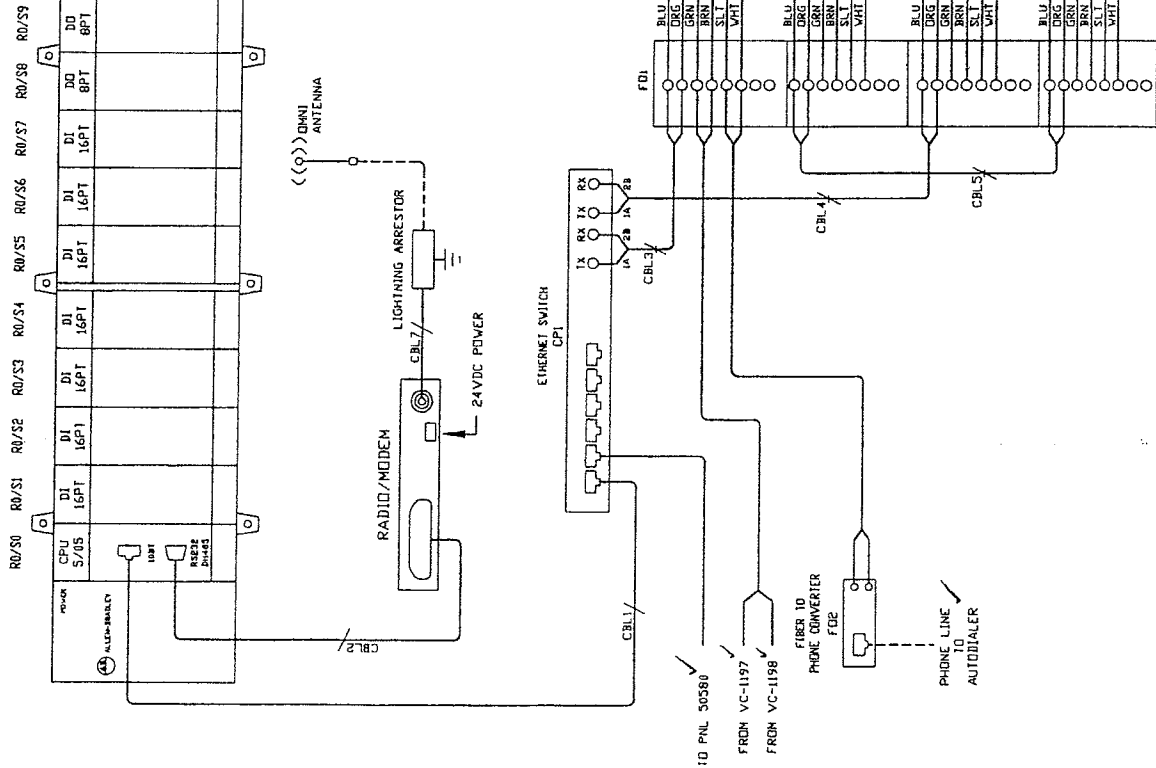


REVISION					PROJECT		
DATE	DESCRIPTION				DATE	BY	CHKD.
INSTRUMENT CONTROL SYSTEMS							
13005 16th Ave. North							
Plymouth, Minnesota 55441							
							
				DATE	3/12/01		
				DRAWN	J/A		
				CHECKED	GK		
				ENGINEER	P/S		
				ASSEMBLED			
				SHEET	OF		
				SCADA SYSTEM LAYOUT			
				JOB NO.			
				POOL NO.			

DATE LAST EDITED: 02/09/01

Sample Network Diagram

SLCS00 I/O SCHEDULE



QTY	TACS	DESCRIPTION	MFG	CATALOG
1	R0	PLC RACK	ALLEN BRADLEY	1746-A10
1	RPS0	PLC POWER SUPPLY	ALLEN BRADLEY	1746-P2
1	R0/S0	PLC CPU WITH ETHERNET	ALLEN BRADLEY	1747-L552
7	R0/S1 R0/S2 R0/S3 R0/S4 R0/S5 R0/S6 R0/S7	PLC DIGITAL I/O MODULE 16 POINT INPUT - GENERAL PURPOSE 85-15EV AC	ALLEN BRADLEY	1746-IA16
2	R0/S8 R0/S9	PLC DIGITAL I/O MODULE 8 POINT RELAY CONTACT OUTPUT (ISOLATED) 12VDC AC	ALLEN BRADLEY	1746-DA8
1	CPI	ETHERNET HUB 8500BASE-TX HUB 10/100 MBT/S AUTOSENSING (2) SC DUPLEX FIBER OPTIC (6) RJ45 PORTS	HIRSCHMANN	943 434-021
1	F01	FIBER OPTIC PATCH PANEL, BLACK	SIEMON COMPANY	SVIC3-M-01
4	F01	ST BULKHEAD CONNECTOR MODULE SVIC3-M-01	SIEMON COMPANY	RLC-F-SCB-01
1	F02	TELEPHONE LINE EXTENDER 8500BASE-TX HUB 12VAC 500mA	AMERICAN FIBERTEK	MT-86CC
1	CBL1	UTP PATCH CABLE PCXSE CAT 5E	HUBBELL	PCXSEB03
1	CBL2	OPTICAL COMMUNICATIONS CABLE RJ45 3 FEET	CABLE WHOLESAL	10DI-03203
3	CBL3 CBL4 CBL5	DB9F/DB9M STRAIGHT THROUGH FIBER OPTIC PATCH CABLE 1 METER (1 PAIR) (2) FIBERS SC MH 625	HUBBELL	DFPCSCC1MM
1	CBL7	ANTENNA RG142B/U RG142B 30' LENGTH NMALE - 1/4"	TESSCO	448350

DATE	REVISION	DESCRIPTION

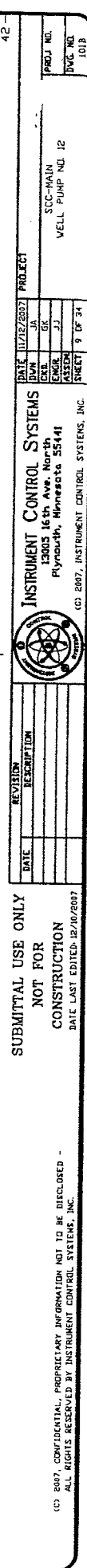
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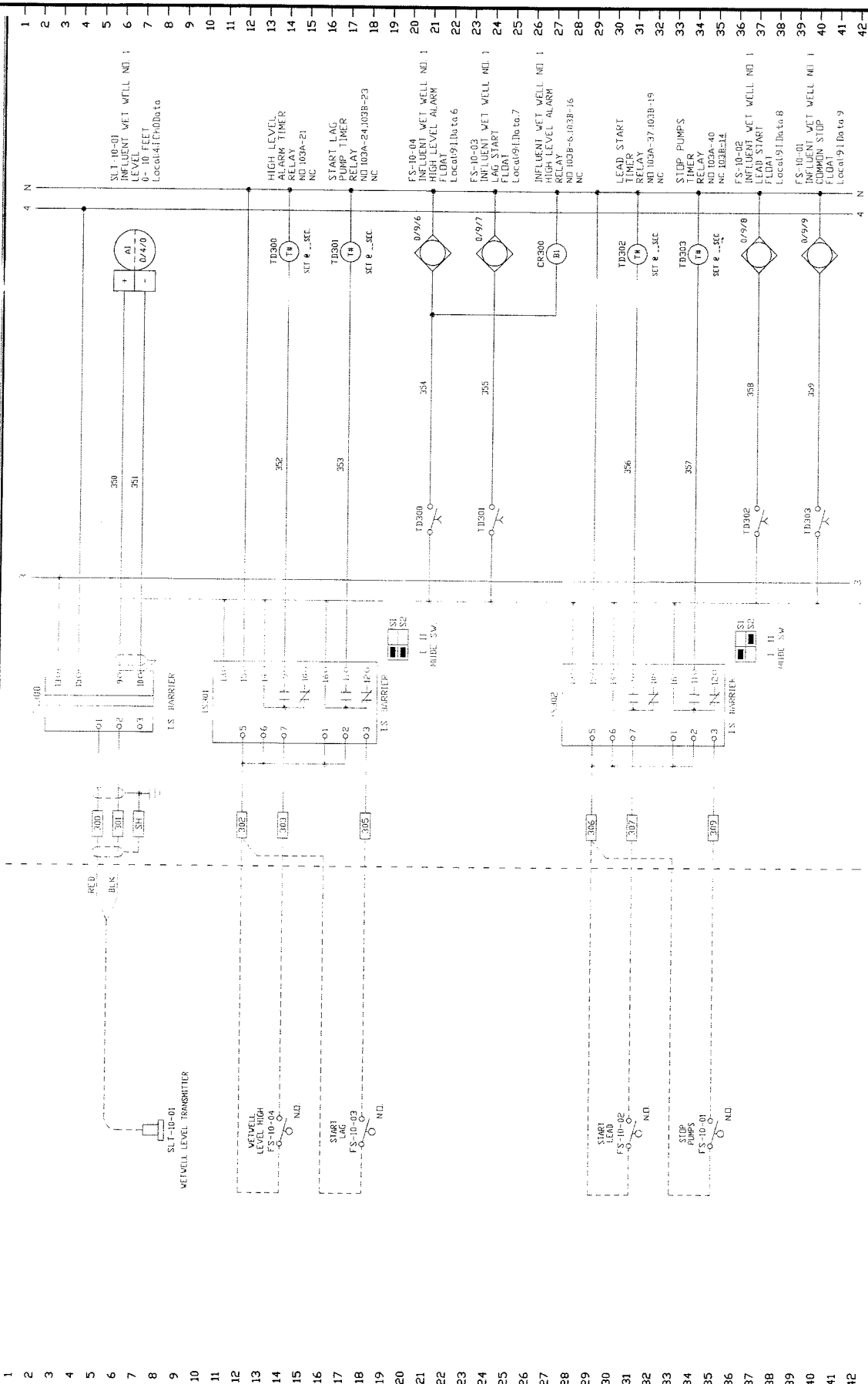
DATE	12/12/2007	PROJECT	PLC I/O SCHEDULE
DWN	JA		
CHK	GR		
APP	JJ		
SHEET	3 OF 24		

Sample Interconnection Diagram



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01-335

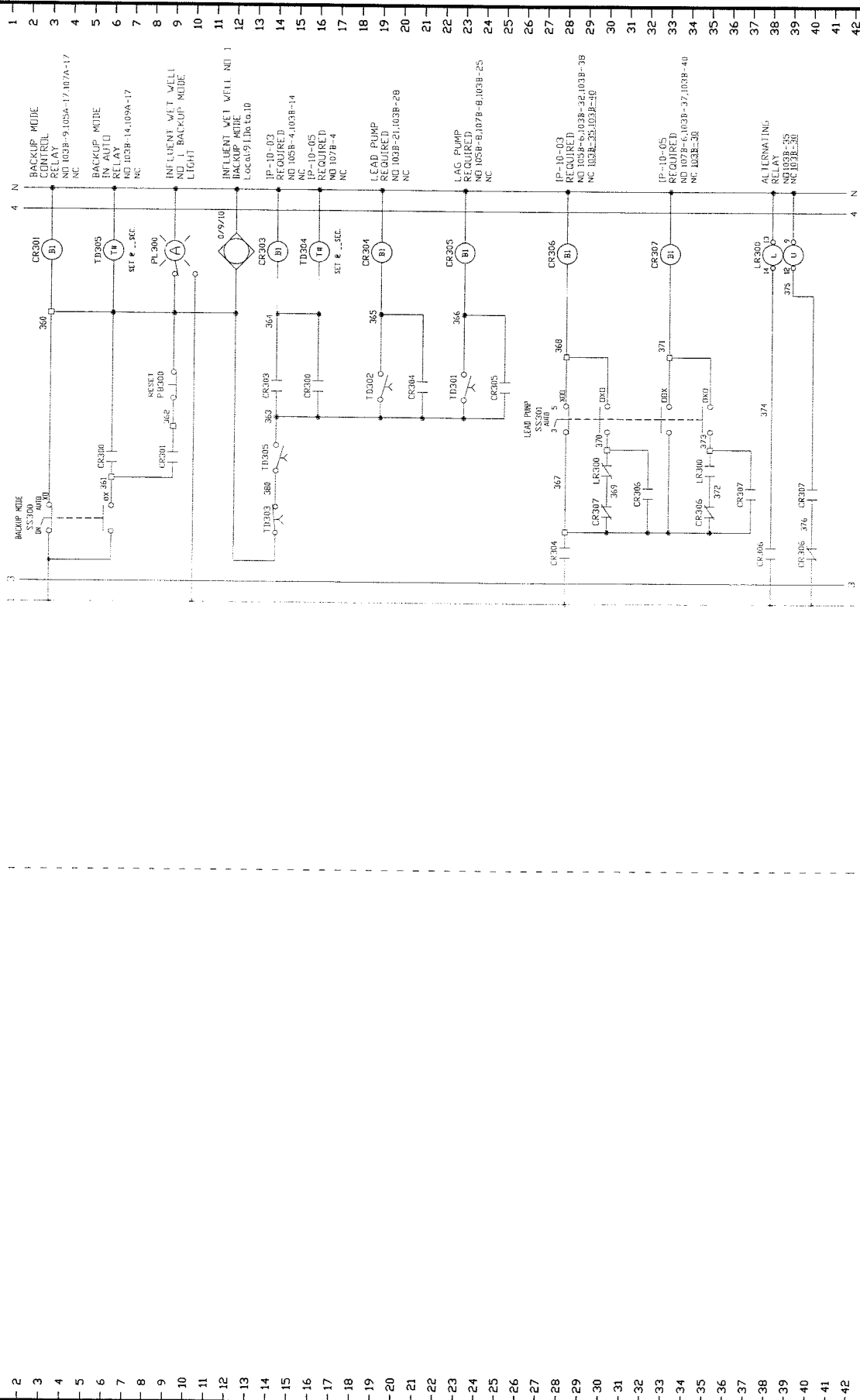


DATE LAST LIMITED 2/15/2007 (C) 2006 CONFIDENTIAL, PROPRIETARY INFORMATION NOT TO BE DISCLOSED - ALL RIGHTS RESERVED BY INSTRUMENT CONTROL SYSTEMS, INC.		DATE 2/17/06 2/17/06 2/17/07		REVISION REVISION RELEASE FOR DISSEMINATION AS BUILT AS INSTALLED		 INSTRUMENT CONTROL SYSTEMS 13005 16th Ave North Plymouth, Minnesota 55441 (612) 208-1000 FAX (612) 208-1001 WWW.ICSYSTEMS.COM		DATE 3/16/06 DRAWN JN CHECKED ENGR. ASSEM. SHEET 149		PROJECT SCC-10 INFLUENT WET WELL, NO.1 BVC, INL 103A	

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Sample Elementary schematic

SCC-10



		INSTRUMENT CONTROL SYSTEMS		PROJECT	
				DATE 2/15/2007	
		13005 16th Ave. North Plymouth, Minnesota 55441		DWN JJA	
		(C) 2008, INSTRUMENT CONTROL SYSTEMS, INC.		EGR LSA	
				ASSET NO	
				SPEC#	
				SCI-10	
				INFLUENT WFT WELL N01	
				PROJ. NO.	
				DWG. NO.	
				HUB#	

DATE LAST EDITED 2/15/2007

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Sample Elementery Schematic

FIELD OR AS NOTED

MCC-10 COMP. 16A/170

SCC-10

DEVICES
NODE 14

60V 20/15 50/15 BUS

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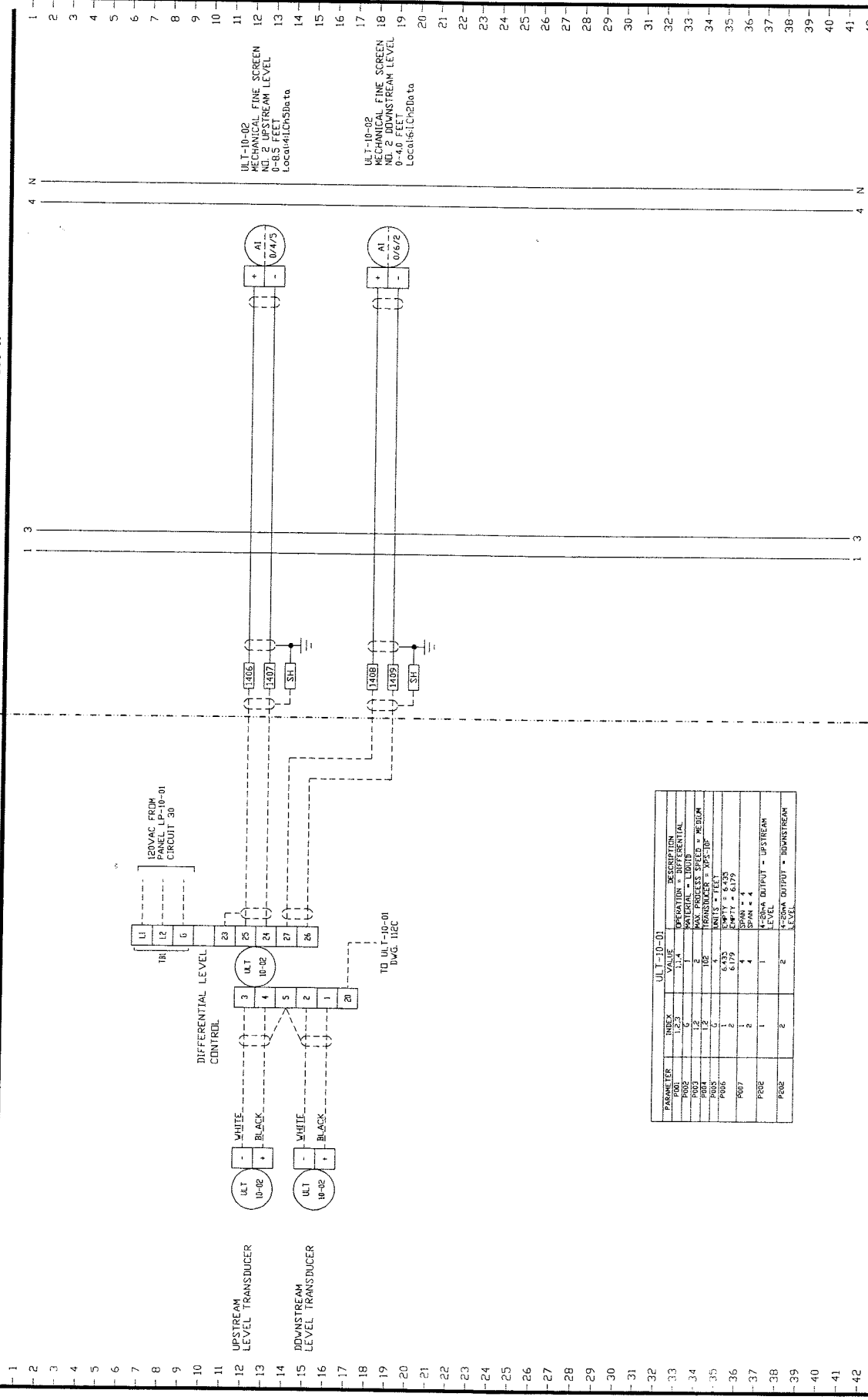
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FIELD OR AS NOTED

SCC-10



PARAMETER	INDEX	UNIT	DESCRIPTION
P001	1, 2, 3	1, 1, 1	OPERATION - DIFFERENTIAL
P002	4	1	MATERIAL - L0000
P003	5	1	MAX PROCESS SPEED - MEDIUM
P004	6	1	MINIMUM - 105-10
P005	7	1	UNITS - FEET
P006	8	1	EMPTY - 5.435
P007	9	1	EMPTY - 6.179
P008	10	1	SPAN - 4
P009	11	1	4-20mA OUTPUT - UPSTREAM
P010	12	1	4-20mA OUTPUT - DOWNSTREAM

DATE	REVISION	DESCRIPTION	DATE	DATE	PROJECT
9/16/06	1	RELEASED AS BUILT	3/16/06	JA	SCC-10
2/15/07	2	AS INSTALLED	EXD	GK	MECHANICAL FINE SCREEN NO.2
			ENC	BA	MFS-10-08A
			SHEET	40 OF 149	DWG NO
					114C

INSTRUMENT CONTROL SYSTEMS
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Sample Elementary
Schematic