INVITATION FOR BID

BID DOCUMENTS AND SPECIFICATIONS

BID NUMBER # 21121
Des Plaines River Water Reclamation Facility Dewatering Phase 1 Improvements

PW# 2019.162

FOR
LAKE COUNTY PUBLIC WORKS DEPARTMENT

LakeCounty
Department of Public Works

BID INFORMATION BY
LAKE COUNTY
PURCHASING DIVISION
18 NORTH COUNTY STREET, NINTH FLOOR
WAUKEGAN, ILLINOIS 60085-4350
(847) 377-2929

PROJECT MANUAL

PROJECT NAME: Des Plaines River – WRF Dewatering Phase 1 Improvements
PROJECT NUMBER: PW# 2019.162

LAKE COUNTY PUBLIC WORKS DEPARTMENT
LAKE COUNTY, ILLINOIS

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Lake County, Illinois

INVITATION TO BID
BID NUMBER 21121

Date: September 15, 2021

Project Name: Des Plaines River-WRF Dewatering Phase 1 Improvements

Project Description: Provide site civil, process, structural, electrical, mechanical and I&C upgrades necessary to provide a new polymer system for current and future dewatering equipment as well as installing a new buried alum line to provide a new alum dosing point to the secondary effluent upstream of the tertiary filters. Additionally, implement the gas monitoring and odor control improvements in the Dryer Building.

GENERAL REQUIREMENTS: Contractors are to submit sealed bids.

SITE VISITS **Monday, September 27**, 2021(To Be Scheduled)
Due to COVID-19 time slots shall be reserved in advance
See "Plan to Mitigate Covid-19 Risk", last page of this Invite

PRE-BID CONFERENCE: **Thursday, September 30**, 2021 1:00 PM
Due to COVID-19 will be conducted via a Zoom Meeting
Go to Purchasing Portal for call in information.

BID LOCATION: Lake County Purchasing Department
18 N. County Street- 9th Floor
Waukegan, Illinois
Electronic Bid Submission Only
See Page INV-3 for instructions

DUE DATE: **Thursday, October 14,** 2021 11:00 AM
See attached instructions due to COVID-19 restrictions.

LAKE COUNTY - INVITATION FOR BIDS: TERMS AND CONDITIONS

1. **AUTHORITY.** This Invitation for Bids is issued pursuant to applicable provisions of the Lake County Purchasing Ordinance.
2. **BID OPENING.** Sealed bids will be received at the Lake County Purchasing Department until the date and time specified at which time they shall be opened via Zoom meeting. Late bids shall be rejected and unopened. Lake County is only accepting electronic bid submission via the Lake County Purchasing Portal.
3. **BID PREPARATION.** Bids must be submitted on this form and all information and certifications called for must be furnished. Bids submitted in any other manner, or which fail to furnish all information or certificates required, may be summarily rejected. Bids may be modified or withdrawn prior to the time specified for the opening of bids. Bids shall be filled out legibly by the person signing the bid. The bid shall include the legal name of the bidder, the complete mailing address, and be signed by a person or persons legally authorized to bind the bidder to a contract. Name of person signing should be typed or printed below the signature.
4. **ERRORS IN BIDS.** Bidders are cautioned to verify their bids before submission. Negligence on the part of the bidder in preparing the bid confers no right for withdrawal or modification of the bid after it has been opened. In case of error in the extension of prices in the bid, the unit prices will govern.
5. **RESERVED RIGHTS.** The County of Lake reserves the right at any time and for any reason to cancel this Invitation for Bids, accept or reject any or all bids or any portion thereof, or to accept an alternate bid. The County reserves the right to waive any immaterial defect in any bid. Unless otherwise specified by the bidder or the County, the County has ninety (90) days to accept. The County may seek clarification from any bidder at any time and failure to respond promptly is cause for rejection.
6. **INCURRED COSTS.** The County will not be liable for any costs incurred by bidders in replying to this Invitation for Bids.
7. **AWARD.** It is the intent of the County to award a contract to the lowest responsive responsible bidder meeting specifications. The County reserves the right to determine the lowest responsible bidder on the basis of an individual item, groups of items, or in any way determined to be in the best interests of the County. Award will be based on the following factors (where applicable): (a) adherence to all conditions and requirements of the bid specifications; (b) price; (c) qualifications of the bidder, including past performance, financial responsibility, general reputation, experience, service capabilities, and facilities; (d) delivery or completion date; (e) product appearance, workmanship, finish, taste, feel, overall quality, and results of product testing; (f) maintenance costs and warranty provisions; and (g) repurchase or residual value.
8. **PRICING.** The price quoted for each item is the full purchase price, including delivery to destination, and includes all transportation and handling charges, premiums on bonds, material or service costs, patent royalties and all other overhead charges of every kind and nature. Unless otherwise specified, prices shall remain firm for the contract period.
9. **DISCOUNTS.** Prices quoted must be net after deducting all trade and quantity discounts. Where cash discounts for prompt payment are offered, the discount period shall begin with the date of receipt of a correct invoice or receipt or final acceptance of goods, whichever is later.
10. **TAXES.** Lake County is not subject to Federal Excise Tax. Per Illinois Compiled Statutes, 35 ILCS 120/2-5, Lake County is exempt from state and local taxes.
11. **SPECIFICATIONS.** Reference to brand names and numbers is descriptive, but not restrictive, unless otherwise specified. Bids on equivalent items will be considered, provided the bidder clearly states exactly what is proposed to be furnished, including complete specifications. Unless the bidder specified otherwise, it is understood the bidder is offering a referenced brand item as specified or is bidding as specified when no brand is referenced, and does not propose to furnish an "equal." The County reserves the right to determine whether a substitute offer is equivalent to and meets the standard of quality indicated by the brand name and number.
12. **SAMPLES.** Samples of items, when called for, must be furnished free of expense and, if not destroyed in the evaluation process, will, upon request, be returned at the bidder's expense. Request for the return of samples must accompany the sample and include UPS Pickup Slip, postage or other acceptable mode of return. Individual samples must be labeled with bidder's name, invitation number, item reference, manufacturer's brand name and number.
13. **INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS.** Bidders shall promptly notify the County of any ambiguity, inconsistency or error which they may discover upon examination of the bidding documents. Interpretations, corrections and changes will be made by addendum. Each bidder shall ascertain prior to submitting a bid that all addenda have been received and acknowledged in the bid.
14. **INDEMNIFICATION.** The Seller shall indemnify and hold harmless the County, its agents, officials, and employees from and against all injuries, losses, claims, suits, costs and expenses which may accrue against the County as a consequence of granting the Contract.
15. **DEFAULT.** Time is of the essence of this contract and if delivery of acceptable items or rendering of services is not completed by the time promised, the County reserves the right, without liability, in addition to its other rights and remedies, to terminate the contract by notice effective when received by Seller, as to stated items not yet shipped or services not yet rendered and to purchase substitute items or services elsewhere and charge the Seller with any or all losses incurred. The County shall be entitled to recover its attorney's fees and expenses in any successful action by the County to enforce this contract.
16. **INSPECTION.** Materials or equipment purchased are subject to inspection and approval at the County's destination. The County reserves the right to reject and refuse acceptance of items which are not in accordance with the instructions, specifications, drawings or data of Seller's warranty (express or implied). Rejected materials or equipment shall be removed by, or at the expense of, the Seller promptly after rejection.
17. **WARRANTY.** Seller warrants that all goods and services furnished hereunder will conform in all respects to the terms of this solicitation, including any drawings, specifications or standards incorporated herein, and that they will be free from latent and patent defects in materials, workmanship and title, and will be free from such defects in design. In addition, Seller warrants that said goods and services are suitable for, and will perform in accordance with, the purposes for which they are purchased, fabricated, manufactured and designed or for such other purposes as are expressly specified in this solicitation. The County may return any nonconforming or defective items to the Seller or require correction or replacement of the item at the time the defect is discovered, all at the Seller's risk and expense. Acceptance shall not relieve the Seller of its responsibility.
18. **REGULATORY COMPLIANCE.** Seller represents and warrants that the goods or services furnished hereunder (including all labels, packages and container for said goods) comply with all applicable standards, rules and regulations in effect under the requirements of all Federal, State and local laws, rules and regulations as applicable, including the Occupational Safety and Health Act as amended, with respect to design, construction, manufacture or use for their intended purpose of said goods or services. Seller shall furnish "Material Safety Data Sheets" in compliance with the Illinois Toxic Substances Disclosure to Employees Act.
19. **EQUAL EMPLOYMENT OPPORTUNITY.** Contractor shall comply with the Illinois Human Rights Act, 775 ILCS 5/1-101 et seq., as amended and any rules and regulations promulgated in accordance therewith, including, but not limited to the Equal Employment Opportunity Clause, Illinois Administrative Code, Title 44, Part 750 (Appendix A), which is incorporated herein by reference. Furthermore, the Contractor shall comply with the Public Works Employment Discrimination Act, 775 ILCS 10/0.01 et seq., as amended.
20. **ROYALTIES AND PATENTS.** Seller shall pay all royalties and license fees. Seller shall defend all suits or claims for infringement of any patent, copyright or trademark rights and shall hold the County harmless from loss on account thereof.
21. **LAW GOVERNING.** This contract shall be governed by and construed according to the laws of the State of Illinois. Jurisdiction and venue shall be found exclusively in the 19th Judicial Circuit Court, State of Illinois.

LakeCounty

Purchasing Division

http://doingbusiness.lakecountyil.gov/

Lake County will be accepting **only** electronic bid submissions for Invitation for Bid #21121 / Des Plaines River – WRF Dewatering Phase 1 Improvements

Please follow the steps below to upload your electronic Bid Submission:

1. Go to www.lakecountypurchasingportal.com
2. Click on the Bid Number: 21121
3. Click on register for this bid
4. Enter your username and password
5. Under the Submittals section you will be able to upload your bid submittal
    a. Click on the browse button
    b. Navigate your computer and select the appropriate file
        i. Multiple files can be uploaded, each file can be no more than 20 MB
        ii. Files can also be uploaded as a .zip file
    c. Click on save submittals
    d. Close the browser

***Please note: Responses are due at 11:00 a.m. local time on Thursday, October 14, 2021. Please allow sufficient time for any technical issues you may have and upload your bid early. Please email Purchasing at purchasing@lakecountyil.gov to receive confirmation that we have successfully received your submissions.**

Please follow the following steps to attend the Public Bid Opening:

1. Go to www.lakecountypurchasingportal.com
2. Click on the "Under Review" tab
3. Click on the Bid Number: 21121
4. Click on the "Events" tab
5. Join the Zoom Meeting by clicking on the meeting link
    a. Please plan on joining the meeting at least 5 minutes early and mute your microphone.

ALL SUBMITTALS SHOULD BE LABELED ACCORDINGLY. PLEASE USE BELOW LABEL FOR YOUR CONVENIENCE.

<table>
<tr><td>Bid No. 21121</td><td rowspan="2">Vendor Name:</td></tr>
<tr><td>Buyer: Yvette Albarran</td></tr>
<tr><td>Bid Description:</td><td rowspan="2">Deliver to:
Lake County
ATTN: PURCHASING DIVISION
18 N. County Street – 9th Floor
Waukegan, IL 60085</td></tr>
<tr><td>Bid Due Date:</td></tr>
</table>

Plan to Mitigate COVID-19 Risk
During Site Visits

Project: Des Plaines River - Dewatering Phase 1 Improvements
Project #: PW2019.162
Bid #: 21121
Site Visits: Monday, September 27, 2021

1. Each prospective bidder is limited to a maximum of two representatives.

2. Masks are required at all times when outside of a vehicle.

3. All people on site shall maintain a 6-foot distance from each other.

4. Each prospective bidder will have a scheduled time of 1 hour to visit the site as assigned by LCPW. Please contact Joel Sensenig at 847-377-7124 a minimum of 2 days prior to the scheduled Site Visit meeting date to schedule a time slot.

5. A COVID-19 questionnaire will be e-mailed to each prospective bidder when they call in to reserve their time slot. The completed questionnaire is to be e-mailed to Joel Sensenig (jsensenig@lakecountyil.gov) by 7:00 am the day of the site visit and a paper copy shall be brought to the site that morning.

6. There shall be no entry into the structures.

7. LCPW personnel shall be located at each of the structures were observations will be facilitated for each Contractor.

8. LCPW personnel will remove manhole lids for contractors to view inside of structure(s) at each location if necessary. CPW personnel will remain near the structure(s) as an open structure(s) are required to be monitored.

9. LCPW personnel cannot answer any questions from the contractor or provide any information related to the project.

10. Contractor can ask questions at the Pre-bid Meeting or can submit questions to Lake County Purchasing as noted in Article 7 of the Instructions to Bidders.

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ARTICLE 1 – DEFINED TERMS

1.01 Terms used in these Instructions to Bidders will have the meanings indicated in the General Conditions and 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. Bidder—The individual or entity who submits a Bid directly to OWNER.

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

C. Successful Bidder—The lowest responsible Bidder submitting a responsive Bid to whom OWNER (on the basis of OWNER's evaluation as hereinafter provided) makes an award.

D. Owner – Lake County Public Works Department

E. Agency—Illinois Environmental Protection Agency

ARTICLE 2 - COPIES OF BIDDING DOCUMENTS

2.01 Bid documents including plans and specifications for this project are available to be downloaded at the following website: http://lakecountypurchasingportal.com. Click on the appropriate bid number to register. After registering, bidders have access to all bid documents including specifications, plans and related files.

2.02 Complete sets of Bidding Documents must be used in preparing Bids; neither OWNER nor ENGINEER assumes 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 the 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 such other data as may be called for below.

A. The number of years engaged in the contracting business under the present firm name, and the name of the state where incorporated.
B. A list of the property and equipment available to the Bidder to evaluate if the Bidder can complete the Work in accordance with the Bidding Documents.
C. A financial statement of the Bidder showing that the Bidder has the financial resources to meet all obligations incidental to the Work.
D. The Bidder's performance record giving the description, location and telephone numbers of similar projects constructed in a satisfactory manner by the Bidder.
E. A list of projects presently under contract, the approximate contract amount, and the percentage of completion for each.

F. A list of contracts which resulted in lawsuits.
G. A list of contracts defaulted.
H. A statement of the Bidder indicating whether or not the Bidder has ever filed bankruptcy while performing Work of like nature or magnitude.
I. A list of officers of the firm who, while in the employ of the firm or the employ of previous firms, were associated with contracts which resulted in lawsuits, contracts defaulted or filed for bankruptcy.
J. The technical experience of personnel guaranteed to be employed in the responsible charge of the Work stating whether the personnel have or have not performed satisfactorily on other contracts of like nature and magnitude or comparable difficulty at similar rate of progress.
K. Such additional information as will assist OWNER in determining whether the Bidder is adequately prepared to fulfill the contract.

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

4.01 Subsurface and Physical Conditions

A. 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 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 5.03.A will be made available by OWNER to any Bidder on request. Those reports and drawings are not part of the Contract Document, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in paragraph 5.03.B of the General Conditions has been identified and established in paragraph 5.03 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 is 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 those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that ENGINEER has used in preparing the Bidding Documents.

B. Copies of reports and drawings referenced in paragraph 5.03.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 5.03.B of the General Conditions has been identified and established in paragraph 5.03 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 5.03 and 5.04 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 5.06 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.

4.06 Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work, if any, that is to be performed at the Site by OWNER or others (such as utilities and other prime contractors) that related to the Work for which a Bid is to be submitted. 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;
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, or performance of the Work;
D. Carefully study 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 5.03.A of the General Conditions, and carefully study all reports and drawings if a Hazardous Environmental Condition, if any, at the Site which have been identified in the Supplementary Conditions as provided in paragraph 5.06 of the General Conditions.
E. Obtain and carefully study (or assume responsibility for doing so) all additional or supplemental 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 any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Document, and safety precautions and programs incident thereto;
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 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 resolutions thereof by ENGINEER are 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 – PRE-BID CONFERENCE

5.01 A pre-bid conference will be held as noted in the Invitation to Bid at the Des Plaines River, Water Reclamation Facility, 800 Krause Dr, Buffalo Grove, IL unless subsequent notice is given to plan-holders.

ARTICLE 6 – SITE AND OTHER AREAS

6.01 The Site is identified in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by CONTRACTOR. 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.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.01 Should the bidder require additional information about this bid, please submit questions on our website at http://lakecountypurchasingportal.com by selecting the bid number and addendum link. Questions may also be submitted via email to purchasing@lakecountyil.gov. All questions shall be submitted no less than seven (7) days prior to the bid opening date.

7.02 ANY and ALL changes to these specifications are valid only if included in an addendum issued by Lake County Purchasing. No interpretation of the meaning of the plans, specifications or other contract documents will be made orally. Failure of any bidder to receive any such addendum or interpretation shall not relieve the bidder from obligation under this bid as submitted. All addenda as issued shall become part of the bid documents. Failure to request an interpretation constitutes a waiver to later claim that ambiguities or misunderstandings caused a bidder to improperly submit a bid.

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

ARTICLE 8 – BID SECURITY

8.01 A bid must be accompanied by a Bid security in the amount of 10% of Bidder's maximum bid price and in the form of a certified or bank check or a Bid Bond [on the form attached] issued by a surety meeting the requirements of paragraphs 6.01 and 6.02 of the General Conditions.

8.02 The Bid security shall guarantee the Successful Bidder will execute the Agreement, furnish the required contract security, and meet the other conditions of the Notice of Award. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within 10 days after the Notice of Award, OWNER may annul the Notice of Award and the Bid security of that Bidder will be forfeited.

ARTICLE 9 – CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be (a) Substantially Completed and (b) also completed and ready for final payment are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

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

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

11.01 Materials and equipment described in the Contract Documents by using the name of a proprietary item or name of a particular supplier is intended to establish type, function, 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, a substitute or "or-equal" item of material or equipment may be furnished or used by CONTRACTOR if acceptable to ENGINEER. Application for acceptance of substitutes and "or-equal" items will not be considered by ENGINEER until after the Effective Date of Agreement. The procedure for submission of any such application by CONTRACTOR and consideration by ENGINEER is set forth in Paragraph 7.04 and 7.05 of the General Conditions and may be supplemented in the Supplementary Conditions or General Requirements.

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 the 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 entity if requested by OWNER. If OWNER or ENGINEER, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, OWNER may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute, without an increase in the Bid.

ARTICLE 13 – PREPARATION OF BID

13.01 Only the Bid form included with the Bidding Documents shall be used to submit a Bid. Additional copies may be obtained from the issuing office.

13.02 All blanks on the Bid form shall be completed by printing in ink or by typewriter and the Bid signed. A Bid price shall be indicated for each Bid Item listed therein, or the words "No Bid," "No Change," or "Not Applicable" entered.

13.03 A Bid by a corporation shall be executed in the corporate name by the president or a 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 must 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 must be shown below the signature.

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

13.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall 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 of Illinois 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 Bids which are signed by an attorney-in-fact for individuals, firms, partnerships or joint ventures shall have attached thereto a power-of-attorney evidencing authority to sign the Bid.

13.13 It is the responsibility of the Bidder to submit a neat, accurate, and complete Bid.

13.14 The Bid shall contain a Contractor Qualification Form which provides experience information that meets the following criteria. Failure to meet these experience requirements or failure to provide the required information at bid time will result in bid rejection. Failure to provide crews or Quality Control Inspectors with the requisite experience will result in termination of the services of the Contractor for cause by the Owner in accordance with Section 14.06 of the General Conditions.

13.15 Any and all changes to the specifications and terms and conditions of this Bid are valid only if they are included by addendum issued by Lake County Purchasing. Bidders shall acknowledge addenda by signing the enclosed Addendum Acknowledgement form. It is the vendor's responsibility to check for addendums, posted on the website at http://lakecountypurchasingportal.com prior to the submittal due date. No notification will be sent when addendums are posted unless there is an addendum issued within three business days of the submittal due date.

ARTICLE 14 – SUBMITTAL OF BID

14.01 Each prospective Bidder is furnished one copy of the Bidding Documents with one copy each of the Bid form, and, if required, the Bid Bond.

14.02 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 a 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:

PURCHASING AGENT
LAKE COUNTY PUBLIC WORKS
650 W. WINCHESTER ROAD
LIBERTYVILLE, IL 60048

ARTICLE 15 – MODIFICATION AND WITHDRAWAL OF BID

15.01 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 for the opening of Bids.

15.02 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with OWNER and promptly thereafter demonstrates to the reasonable satisfaction of OWNER that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its bid, and the Bid security will be returned, if written authorization to withdraw the bid is provided by the Lake County Purchasing agent.

ARTICLE 16 – OPENING OF BIDS

16.01 Bids will be opened at the time and place indicated in the advertisement or invitation to Bid and read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 17 – BASIS OF BID; EVALUATION OF BIDS

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

17.02 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.

17.03 Unit Price (**NOT USED**)

A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the Bid schedule

B. The total of all estimated prices will be determined as the sum of the products of the estimated quantity of each item and the unit price Bid for the item. The final quantities and Contract price will be determined in accordance with paragraph 13.03 of the General Conditions.

C. 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. Where words and figures are used in the Bid Form, any discrepancies between words and figures will be resolved in favor of the words.

17.04 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 in paragraph 13.02 of the General Conditions.

17.05 OWNER shall have the right to reject any unit prices for additions to or deductions from the Work as given in the Bid, if the prices are considered excessive or unreasonable, or to accept any unit prices which may be considered fair and reasonable.

17.06 A Bid which does not contain a unit price which is both adequate and reasonable for each item named in the Bid may be considered irregular and subject to rejection.

17.07 OWNER may consider the qualifications and experience of Bidders, and the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. OWNER may also 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.

17.08 OWNER may conduct such investigations as OWNER deems necessary 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.

17.09 OWNER also reserves the right to waive all informalities not involving price, time, or changes in the Work.

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 the right to reject any or all Bids, including without limitation, nonconforming, non-responsive, unbalanced, or conditional Bids. OWNER further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to be non-responsible. OWNER may also 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.

19.02 If the contract is to be awarded, it will be awarded to the lowest responsive, responsible Bidder(s).

19.03 If the contract is to be awarded, OWNER will give Successful Bidder notification within a reasonable time.

ARTICLE 20 – CONTRACT SECURITY AND INSURANCE

20.01 The successful Contractor shall deliver within ten (10) calendar days after the date of the Owner's Notice of Award all performance and payment bonds and insurance along with the signed counterparts of the Agreement. Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth OWNER's requirements as to performance and payment Bonds and insurance. These requirements include but are not necessarily limited to:

- A performance bond satisfactory to the County, executed by a surety company authorized to do business in the State of Illinois, in an amount equal to 100 percent (100%) of the contract price as security for the faithful performance of the contract; and
- A payment bond satisfactory to the County, executed by a surety company authorized to do business in the State of Illinois, for the protection of all persons supplying labor and materials to the Contractor or Subcontractors for the performance of work provided for in the contract, in an amount equal to 100 percent (100%) of the contract price; and
- A Certificate of Insurance with all required endorsements.

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 the other Contract Documents which are identified in the Agreement as attached thereto. Within 10 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to OWNER. Within ten days thereafter, OWNER shall deliver one fully signed counterpart to Successful Bidder with a complete set of Drawings with appropriate identification.

ARTICLE 22 – WAGE RATES

22.01 This project is subject to the Wage of Employees on Public Works (Prevailing Wage) Act (Illinois Revised Statutes, Chapter 48, Section 39s, et. seq.). Not less than the minimum wage rates as established by OWNER or State of Illinois Department of Labor shall be paid.

22.02 The wage rates can be found at: http://www.illinois.gov/idol/Laws-Rules/CONMED/Pages/Rates.aspx .

22.03 The wage rates will be incorporated into and made a part of the Contract Documents when the Contract Documents are prepared for execution.

ARTICLE 23 – TAX

23.01 OWNER is exempt from the Illinois State and municipal or county Retailers Occupation Tax, Service Occupation Tax, Use Tax, Service Use Tax, as described in Illinois Revised Statute Chapter 120. Bid prices shall not include the cost of such taxes.

23.02 Federal excise tax does not apply to materials or services purchased by OWNER. Should the federal excise tax be applicable to this transaction, OWNER will furnish a federal exemption certificate. The Bid prices quoted herein by Bidder shall include all other direct or indirect federal, state, and local taxes which apply.

23.03 Pursuant to 86 Ill. Adm. Code 130.2076, tangible personal property that is purchased by CONTRACTOR for incorporation into the OWNER's real property pursuant to CONTRACTOR's performance of this Contract shall be deemed purchased by the CONTRACTOR for the OWNER and transferred by the CONTRACTOR to the OWNER upon completion of this Contract.

23.04 CONTRACTOR(S) shall forward this information to their Suppliers in order that the sale of such materials and equipment be properly recorded as a tax-exempt sale. Such information shall be accompanied by a copy of the Contract or Purchase Order.

23.05 It shall be the CONTRACTOR's sole responsibility to obtain any necessary approvals from the Illinois Department of Revenue to obtain any exemption from the Retailers' Occupation Tax. If necessary, and upon request of the CONTRACTOR, the OWNER shall supply its tax exemption certificate to the CONTRACTOR, provided that CONTRACTOR shall not alter the tax exemption certificate and shall use it solely for purposes of exempting the above described personal property purchases pursuant to the Contract.

WAGE RATE REQUIREMENTS

1.01 General

A. CONTRACTOR and Subcontractors shall pay wages not less than the prevailing hourly wage rate for each classification of employee engaged on the Work as determined by the State of Illinois Department of Labor. In case of conflict, the wages paid by CONTRACTOR shall be not less than the higher of the prevailing wage determination.

B. CONTRACTOR shall comply with the provisions of Wages of Employees on Public Works (Prevailing Wage) Act (Illinois Revised Statutes, Chapter 48, Section 39S-1 through 39S-12 and 820 ILCS 130/5).

C. The prevailing wage law does not prohibit payment of more than the prevailing rate of wages nor does it limit the hours of Work which may be performed by any employee in any particular period of time.

D. A copy of the wage determination shall be posted by CONTRACTOR in a prominent place at the site of the Work where it can be easily seen by the employees.

E. Statement on Certified Payroll

State of Illinois Prevailing Wage Act (820 ILCS/130/1)
It is the policy of the State of Illinois that a wage of no less than the general prevailing hourly rate as paid for work of a similar character in the locality in which the work is performed, shall be paid to all laborers, workers and mechanics employed by or on behalf of any and all public bodies engaged in public works.

Effective September 1, 2020, the Illinois Department of Labor (IDOL) has activated an electronic database (Payroll Portal) capable of accepting and retaining certified payrolls submitted under the State of Illinois Prevailing Wage Act (820 ILCS/130/1). All contractors and subcontractors completing work for Lake County pursuant to the Act must submit all certified payroll through the IDOL Payroll Portal.

Any contractor or subcontractor subject to this Act and any officer, employee, or agent of such contractor or subcontractor whose duty as such officer, employee, or agent it is to file such certified payroll who willfully fails to file such a certified payroll on or before the date such certified payroll is required by this paragraph to be filed and any person who willfully files a false certified payroll that is false as to any material fact is in violation of this Act and guilty of a Class A misdemeanor. (820 ILCS 130/5(2)).

Effective September 1, 2020, to receive payment for work conducted for Lake County, contractors must provide the email certification received from their IDOL submittal with each of their pay requests.

A contractor or subcontractor convicted or found guilty under Section 5 or 6 of this Act shall be subject to an automatic and immediate debarment, thereafter prohibited from participating in any public works project for 4 years, with no right to a hearing (820 ILCS 130/11a).

2.01 WAGE DETERMINATIONS

A. The following wage rate schedule(s) are the prevailing rate(s) of hourly wage applicable to this Contract.

B. If the Department of Labor revises the prevailing rate of hourly wages to be paid by the public body, the revised rate as provided by the public body shall apply to this Contract.

Note: Current wage rates can be found at:

http://www.illinois.gov/idol/Laws-Rules/CONMED/Pages/Rates.aspx

LakeCounty

Addendum Acknowledgement

The undersigned acknowledges receipt of the following addendum(s):

ADDENDUM #	SIGNATURE

I have examined and carefully prepared the submittal documentation in detail before submitting my response to Lake County.

Bid Number: _____

Company Name: _____

Authorized Representative: _____
Signature

Authorized Representative: _____
Print

Date: _____

It is the vendor's responsibility to check for addendums, posted on the website at http://lakecountypurchasingportal.com prior to the submittal due date. No notification will be sent when addendums are posted unless there is an addendum within three business days of the submittal due date.

If the submittal has already been received by Lake County, vendors are required to acknowledge receipt of addendum via email to purchasing@lakecountyil.gov prior to the due date.

Submittals that do not acknowledge addendums may be rejected.

All responses are to be submitted in a sealed envelope. Envelopes are to be clearly marked with required submittal information.

BID FORM

BID NUMBER: 21121

PROJECT NAME: Des Plaines River - WRF Dewatering Phase 1 Improvements

Project Number: PW#2019.162

for the Lake County Public Works Department
Lake County, Illinois

THIS BID IS SUBMITTED TO:

Lake County Public Works Department
650 West Winchester Road
Libertyville, IL 60048

(hereinafter called OWNER)

1) The undersigned Bidder proposes and agrees, if this bid is accepted, to enter into an Agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Bid Price and within the Bid Times indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2) Bidder accepts all of the terms and conditions of the Official Notice to Bidders and Instructions to Bidders, including without limitation those dealing with the disposition of the Bid Security. This Bid will remain open for the period of time specified in the Official Notice to Bidders after the day of Bid opening. Bidder will sign and deliver the required number of counterparts of the Agreement with the Bonds, evidence of insurance coverage, and other documents required by the Bidding Requirements within 10 days after the date of OWNER's Notice of Award.

3) In submitting this Bid, Bidder represents, as more fully set forth in the Agreement, that:

   a) Bidder has examined and carefully studied all the Bidding Documents and Addenda, receipt of all which is hereby acknowledged.

   b) Bidder has visited the site and become familiar with and satisfied itself as to the general, local, and site conditions that may affect cost, progress, performance and furnishing of the Work;

   c) Bidder is familiar with and has satisfied itself as to all federal, state, and local laws and regulations that may affect cost, progress, performance, and finishing of the Work.

   d) Bidder acknowledges that OWNER and ENGINEER do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bidding Documents with respect to Underground Facilities at or contiguous to the site. Bidder has

obtained and carefully studied (or assumes responsibility for having done so) all such examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the site or otherwise which may affect cost , progress, performance or furnishing of the Work or which relates to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder and safety precautions and programs incident thereto. Bidder does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the determination of this Bid for performance and furnishing of the Work in accordance with the time, price, and other items and conditions of the Contract Documents.

e) Bidder is aware of the general nature of the Work to be performed by OWNER and others at the site that relates to Work for which the Bid is submitted as indicated in the Contract Documents.

f) Bidder has correlated the information known to Bidder from information and observation 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.

g) Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to Bidder, and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work for which the Bid is submitted.

h) This Bid is genuine and not made in the interest or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, or organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or a corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.

i) Bidder certifies that Bidder is not barred from bidding on this Contract as a result of a conviction for either bid-rigging or bid-rotating under the provisions contained in chapter 38, Paragraphs 33E-3 and 33E-4 of the Illinois Revised Statutes.

4) Bidder will complete the work in accordance with the Contract Documents, including allowances, for the following price:

LUMP SUM CONTRACT PRICE (written)_____

($_____(figures))

5) Bidder agrees that the work will be substantially completed and ready for final payment in accordance with Paragraph 15.06B.1 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6) Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the work within the times specified in the Agreement.

7) The following document is attached and made a condition of this Bid:

Required Bid Security in the form of _____
(Certified Check or Bid Bond)

in the amount of _____
(Dollars or Percent)

8) Communications concerning this Bid shall be addressed to the Bidder as indicated below:

Name: _____

Address: _____

State: _____

Telephone No.: _____

9) The terms used in this Bid are defined in the General Conditions of the Construction Contract or the Instructions to Bidders.

I hereby certify that as Bidder I/we have examined and carefully prepared this Bid from the Bidding Documents and have checked the Bidding Documents in detail before submitting this Bid, and that all statements herein are made on behalf of:

An Individual: By (Written) _____

(Typed) (Individual's Name)

doing business as _____

Business address: _____

_____

_____

Phone No.: _____

A Partnership: By _____ (Firm Name)

By (Written) _____

(Typed) (General Partner)

Business Address: _____

_____

_____

Phone No.: _____

A Corporation: By _____ (Corporation Name)

_____ (State of Incorporation)

By (Written) _____

(Typed) (Name of Person Authorized to Sign)

(Title) _____ (Corporate Seal)

Attest (Written) _____

(Typed) (Secretary)

Business address: _____

_____

_____

Phone No.: _____

A Joint Venture: By (Written) _____

(Typed) (Name)

_____ (Address)

By (Written) _____

(Typed) (Name)

_____ (Address)

Phone number 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).

Sworn and subscribed to before me this

_____ day of _____, 20_____ .

_____

Notary or other officer authorized to administer oaths

My commission expires: _____

Bidders shall not add any conditions or qualifying statements to this Bid as otherwise the Bid may be declared irregular as being not responsive to the advertisement. BIDDERS SHALL USE THIS BID FORM IN SUBMITTING THEIR BIDS.

LakeCounty

Purchasing Division
18 North County Street - 9th Floor
Waukegan, Illinois 60085-4350
Phone 847-377-2929

CONTRACTOR QUALIFICATION FORM

Please return this form with all Bid Documents by the date and time shown on the Invitation to Bid.

If you have submitted one of these forms within the last twelve (12) calendar months, complete Pages 1 and 4 only. Review Pages 2 and 3 and make any changes or corrections from your previous submittal.

Pursuant to applicable sections of the Lake County Purchasing Ordinance, the Lake County Purchasing Division is required to determine whether or not a bidder is responsible. A responsible bidder is defined as "an entity (business) who has the capability in all respects to perform fully the contract requirements, and the tenacity, perseverance, experience, integrity, reliability, capacity, facilities, equipment, and credit which will assure good faith performance." Information furnished by a bidder will be reviewed by the Lake County Purchasing Division, using department, and the project architect /engineer. Said information shall not be otherwise disclosed without prior written consent by the bidder. Failure to submit this form by the date and time specified shall be cause for rejection of your bid.

Contractor Name: _____

Project Name: _____

1. For the current proposed project, list work to be performed by your own forces:

   _____

   _____

2. In accordance with the Responsible Bidders Ordinance, please provide the following information for Proposed Major Subcontractors for this Project:

Trade	Name	Amount ($)	Apprenticeship Program Name	U.S. Dept. of Labor Registration Number

3. Business Organization:

____ Sole Proprietor: An individual. whose signature is a fixed to this bid.

____ Partnership: State full names, titles and addresses of all responsible principals and/or partners:

_____

_____

____ Corporation: State of incorporation: _____

How long in present business: _____

4. Number of personnel in organization: Administrative _____

Engineering _____ Office _____

Shop _____ Field _____

5. Bank Reference: _____

Address: _____

Contact Person: _____

6. Bonding Company: _____

Agency Name: _____

Agency Address: _____

Contact Person: _____

7. Insurance Company: _____

Agency Name: _____

Agency Address: _____

Contact Person: _____

8. Trade References (List Four):

Name: _____ _____

Address: _____ _____

_____ _____

Contact Person: _____ _____

Telephone #: _____ _____

Name: _____ _____

Address: _____ _____

_____ _____

Contact Person: _____ _____

Telephone #: _____ _____

9. A. Have you within the last five years failed to complete a contract?
   ___ Yes ___ No
   B. Are there any judgements, claims or suits pending or outstanding against you? ___ Yes ___ No
   If answer to either question is Yes, submit details on a separate sheet.
   C. List all claims that have been filed by or against your firm due to construction contracts in the last five years, including arbitration:

_____

_____

_____

10. Financial Statement:

Current Assets	$_____	
Fixed Assets (Depreciated)	$_____	
Other Assets	$_____	
Total Assets		$_____
Current Liabilities:	$_____	
Long Term Liabilities	$_____	
Total Liabilities		$_____
Net Worth		$_____

Date of Latest Balance Sheet: _____

Accounting Firm: _____
(Lake County reserves the right to request a copy of financial statement.)

11. Major Contracts Completed During Last Five Years:

Year	Name of Project	Architect/Engineer	Contract Amount

12. Average Annual Billing for Last Five Years: $ _____

13. Total Work in Progress and Under Contract: $_____

14. **List All Major Work** Under Contract:

% Completed	Name of Project	Architect/Engineer	Contract Amount

15. List Minority and Women Owned Sub-Contractor's Participation in this project:

Name of Contractor/Supplier	Work to be Performed	$ Amount	Indicate MBE, WBE, SBE, DBE

16. List the name and construction experience of the proposed superintendent(s) for this project:

_____

_____

_____

The undersigned hereby certifies that answers to the foregoing questions and all statements therein contained are true and correct. Surety, bank, subcontractor, supplier, or any other persons, firms or corporations with whom we have done business, or who have extended any credit to us are hereby authorized to furnish you with any information you may request concerning our organization including, but not limited to, information concerning performance on previous work or credit standing with any of them. We hereby release any and all such parties from any legal responsibility whatsoever of having furnished such information to you.

Name of Organization: _____

By: _____

Title: _____ Date: _____

VENDOR DISCLOSURE STATEMENT

Vendor Name:			
Address:			
Contact Person:		Contact Phone #:	
Bid/RFP/SOI/Contract/Renewal:			

Vendors wishing to contract with Lake County for goods and services in an amount greater than $30,000 shall submit this form in advance of award. This disclosure statement is not required for utility companies regulated by the Illinois Commerce Commission or local units of government. Vendors shall disclose:

- A familial relationship between a Lake County elected official, department director, deputy director and manager and owners, principals, executives, officers, account managers or other similar managerial positions of the vendor's company. Familial relationship is defined as a spouse (including civil partner), child, stepchild, parent, stepparent, grandparent, in-laws (including parent, grandparent, sibling, or child), relatives and non-relatives living in the same residence, and offspring born to any aforementioned person.
- All political campaign contributions made by the vendor or an owner, principal, executive, officer, account manager, or other similar managerial position of the vendor to any county board member, county board chair, or countywide elected official within the last five years.

If there is nothing to report in a section, please state none in the appropriate space.

FAMILIAL RELATIONSHIPS

List names and departments/agencies of Lake County employees or public officials with whom owners, principals, or officers of the vendor's company have a familial relationship and the nature of the relationship. Attach additional pages as necessary. (Provide all names or state none in the space below. Do not leave blank.)

Name and Department/Agency of Lake County Employee/Public Official	Familial Relationship

CAMPAIGN CONTRIBUTIONS

List campaign contributions that have been made within the last five years that exceed $150 annually. Attach additional pages as necessary. (Provide all names or state none in the space below. Do not leave blank.)

Recipient	Donor	Description (e.g., cash, type of item, in-kind service, etc.)	Amount/Value	Date Made

Continuing disclosure is required if information changes. Vendor Disclosure Statements are available at doingbusiness.lakecountyil.gov

The full text of the County's Ethics and Procurement policies and ordinances are available at www.lakecountyil.gov.

I hereby acknowledge that the information above is accurate and complete, that I am an authorized signer on behalf of the vendor, that I have read and understand these disclosure requirements, and that I agree to update this information if there are any related changes by submitting a new Vendor Disclosure Statement.

Authorized Signature:		Title:	
Printed Name:		Date:	

Vendors must insert "x" in the following box indicating exception and provide a brief narrative for exception. ☐

RESPONSIBLE BIDDER AFFIDAVIT

Vendor Name:		Federal Employer Tax Identification #:	
Address:			
Contact Person:		Contact Phone #:	

- That the bidder agrees to and shall comply with the Equal Opportunity Employer provisions of Section 2000e of Chapter 21, Title 42 of the United States Code and Federal Executive Order Number 11246, as amended, by Executive Order 11375, and has and shall comply with the Chapter 33 (Purchasing) of Title III of the Lake County Code of Ordinances, be amended to modify the definition of "Responsible Bidder or Offeror".
- That bidder has Certificates of insurance in accordance with general terms and condition of the invitation for bid.
- That bidder hereby certifies that it shall comply with the provisions of the Illinois Prevailing Wage Act (820 ILCS 130/0.01 *et seq*., as amended). All contractors and sub-contractors are required to turn in certified payrolls as specified in Illinois Public Act 94-0515, and follow all provisions of the Employee Classification Act, 820 ILCS 185/1 et seq.
- That the bidder hereby certifies: [check all that apply]

  _____bidder has not received any notices of violations of the Illinois Prevailing Wage Act (820 ILCS 130/0.01 *et seq.)*; **or**

  _____in the event any such notice has been received by bidder, a copy of any such notice is attached hereto; **or**

  _____in the event that bidder has received such a notice, any documentation demonstrating the resolution of any such notice is attached hereto (attach additional pages to explain how the matter has been resolved)

- All bidders must provide three (3) projects as detailed on the invitation for bid reference form.
- Disclosure of the name and address of each subcontractor from whom the contractor has accepted a bid and/or intends to hire on any part of the project prior to the subcontractor commencing work on the project.
- The bidder and all bidder's sub-contractors must participate in active apprenticeship and training programs approved and registered with the U.S. Department of Labor's Office of Apprenticeship for each of the trades of work contemplated under the awarded contract.

I hereby acknowledge that the information above is accurate and complete, that I am an authorized signer on behalf of the vendor, that I have read and understand these requirements, and that I agree to update this information if there are any related changes by submitting a new Responsible Bidder Affidavit.

Authorized Signature:		Title:	
Printed Name:		Date:	

Vendors must insert "x" in the following box indicating exception and provide a brief narrative for exception. ☐

VENDOR CERTIFICATION FORM

Bid/RFP/SOI Number:			
Vendor Name:			
Address:			
Primary Contact Name:			
Primary Contact Email Address:			
Primary Contact Phone Number:			
Project Manager Name:			
Project Manager Email Address:			
Project Manager Phone Number:			
# Years in Business:		Number of Employees:	
Annual Sales:	$	Dunn & Bradstreet #:	

Vendor Certification Statement: Please identify all of the following that apply to the ownership of this firm. This information is collected for reporting purposes only and not vendor selection. Please include a copy of the certification. (Definitions are included on the second page of Vendor Certification Form).

	Contractor certifies as a Minority – Business Enterprise (MBE)
	Contractor certifies as a Women Business Enterprise (WBE)
	Contractor certifies as a Veteran-Owned (VBE) Business Enterprise
	Contractor certifies as a Persons with Disabilities Owned Business Enterprise (PDBE)
	Contractor certifies as a Service-Disabled Veteran-Owned (SDVBE) Business Enterprise
	Contractor certifies as a Business Enterprise Program (BEP)
	Contractor certifies as a Small Disadvantaged Businesses (SDB)
	Contractor certifies as a Veteran-Owned Small Business (VOSB)
	Local Business
	None
Other (Specify)	
Certification Number:	
Certified by (Agency):	

I certify that this information is accurate to the best of my knowledge and that I am authorized to provide this information on behalf of my company.

_____ _____ _____

Signature, Title **Printed Name, Title** **Date**

Vendor Certification Definitions

- **Minority-owned business (MBE)**
  A business concern which is at least 51% owned by one or more minority persons, or in the case of a corporation, at least 51% of the stock in which is owned by one or more minority persons; and the management and daily business operations of which are controlled by one or more of the minority individuals who own it.
- **Woman-owned business (WBE)**
  A business which is at least 51% owned by one or more women, or, in the case of a corporation, at least 51% of the stock in which is owned by one or more women; and the management and daily business operations of which are controlled by one or more of the women who own it.
- **Veteran-owned Business Enterprise (VBE)**
  A small business (i) that is at least 51 percent owned, controlled and managed by one or more Eligible Veterans or in the case of a corporation, at least 51 percent or more of the stock of which is owned, controlled and managed by one or more Eligible Veterans.
  - Eligible Veteran means a person who (i) has been either a member of the armed forces of the United States or, while a citizen of the United States, was a member of the armed forces of allies of the United States in time of hostilities with a foreign country and (ii) has served under one or more of the following conditions: (a) the veteran served a total of at least 6 months; (b) the veteran served for the duration of hostilities regardless of the length of the engagement; (c) the veteran was discharged on the basis of hardship; or (d) the veteran was released from active duty because of a service connected disability and was discharged under honorable conditions.
  - Armed forces of the United States means the United States Army, Navy, Air Force, Marine Corps, Coast Guard or service in active duty as defined under 38 U.S.C. Section 101. Service in the Merchant Marine that constitutes active duty under Section 401 of federal Public Act 95-202 shall also be considered service in the armed forces for purposes of this Division**.**
- **Persons with Disabilities Owned Business Enterprise (PDBE)**
  A small business (i) that is at least 51 percent owned. controlled and managed by one or more Persons with a Disability; or in the case of a corporation, at least 51 percent or more of the stock of which is owned, controlled, and managed by one or more Persons with a Disability.
  - Disability or Disabled means, with respect to an individual, a physical or mental impairment that substantially limits one or more of the major life activities of the individual, a record of physical or mental impairment that substantially limits one or more of the major life activities of the individual, or being regarded as an individual with a physical or mental impairment that substantially limits one or more of the major life activities of the individual.
- **Service-Disabled Veteran-owned Business Enterprise (SDVBE)**
  A small business (i) that is at least 51 percent owned, controlled, and managed by one or more qualified service disabled veterans or in the case of a corporation, at least 51 percent or more of the stock of which is owned, controlled and managed by one or more Service Disabled Veterans.
  - Service-Disabled Veteran means an Eligible Veteran who has been found to have 10 percent or more service-connected disability by the United States Department of Veterans Affairs or the United States Department of Defense.
  - Service-connected disability means a disability incurred in the line of duty in the active military, naval or air service as described in 38 U.S.C. 101(16).
- **BEP – Business Enterprise Program**
  Business Enterprise Program (BEP) BEP assists businesses owned by minorities, women and people with disabilities gain access to the State of Illinois procurement process. BEP certification with the State of Illinois can also open the door to opportunities with other public and private entities which are looking for diverse suppliers.
- **Small Disadvantaged Businesses (SDB)**
  A Small Disadvantaged Business (SDB) is a small business owned and controlled by socially and economically disadvantaged individuals as defined by Federal Acquisition Regulation (FAR) 19.001
- **Veteran-Owned Small Business (VOSB)**
  A Veteran-Owned Small Business (VOSB) is a small business that is at least 51 percent owned by one or more veterans; or, if a publicly owned business, at least 51 percent of the stock is owned by one or more veterans. Also, one or more veterans control management and daily business operations of the firm.
- **Local business**
  A business that is either owned and operated with a mailing address within the boundaries of Lake County or a corporate business with at least one “brick and mortar” location within the boundaries of Lake County. No additional certification is required; however, address verification for location may be requested.

BID BOND

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

BIDDER *(Name and Address)*:

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

OWNER *(Name and Address)*:

BID

Bid Due Date:

Description *(Project Name— Include Location)*:

BOND

Bond Number:

Date:

Penal sum _____ $ _____

(Words) (Figures)

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

BIDDER	**SURETY**
_____ (Seal)	_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	Attest: _____
Signature	Signature
Title	Title

Note: Addresses are to be used for giving any required notice.
Provide execution by any additional parties, such as joint venturers, if necessary.

EJCDC® C-430, Bid Bond (Penal Sum Form). Published 2013.
Prepared by the Engineers Joint Contract Documents Committee.

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 the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

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 of 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 the 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 the 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. Notices 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 pre-paid, 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 the 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 this Bond conflicts with 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.

AGREEMENT

THIS AGREEMENT is by and between Lake County Public Works Department

(hereinafter called OWNER) and _____
(hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, 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:

Provide site civil, process, structural, electrical, mechanical and I&C upgrades necessary to support a new polymer system for current and future dewatering equipment as well as installing a new buried alum line to provide a new alum dosing point to the secondary effluent upstream of the tertiary filters. Additionally, implement the gas monitoring and odor control improvements in the Dryer Building.

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:

Project Name: Des Plaines River - WRF Dewatering Phase 1 Improvements, Project Number PW# 2019.162

ARTICLE 3 – ENGINEER

3.01 The ENGINEER for this project is Lake County Public Works. The Engineer's Consultant shall be any licensed professional architect or engineer, or working under the supervision of a licensed professional architect or engineer, who has been designated as an Engineer's Consultant.

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 Days to Achieve Substantial Completion and payment.

A. The Work will be substantially completed within 540 (five hundred and forty) days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 600 (six hundred) days after the date when the Contract Times commence to run.

4.03 Liquidated Damages

A. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and the OWNER will suffer financial consequences if the Project is not completed within the time specified in Paragraph 4.02.A. above, plus any extensions thereof allowed in accordance with Article 11 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss (including special, indirect, consequential, incidental and any other losses or damages) suffered by OWNER if the Project is not completed on time. Accordingly, instead of requiring any such proof of losses or damages, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER $1,000.00 (One Thousand Dollars) for each day that expires after the time specified in Paragraph 4.02.A 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 $1,000.00 (One Thousand Dollars) for each day that expires after the time specified above for completion and readiness for final payment.

B. Permitting CONTRACTOR or Surety to continue and finish the Work or any part of the Work after the times specified for completion, or after the date to which the times for completion may have been extended, shall in no way operate as a waiver on the part of OWNER of its rights under the Contract.

ARTICLE 5 – CONTRACT PRICE

5.1 OWNER shall pay CONTRACTOR for the completion of the Work in accordance with the Contract Documents in current funds as shown in the Unit Price Schedule and any Supplementary Price Schedules as completed in the Bid Form, hereto attached as Exhibit "A" as accepted by OWNER, in the amount of $_____.

ARTICLE 6 – PAYMENT PROCEDURES

6.1 CONTRACTOR shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

Progress Payments:

6.2 OWNER will make monthly progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER each month during construction as provided below. All progress payments will be on the basis of the progress of Work measured by the schedule of values established in Paragraph 2.03 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.

Retainage:

6.2.1 After each Application for Payment has been found acceptable by OWNER, OWNER will pay 90% of the estimated value less any previous payments to CONTRACTOR until the Project is 50% complete. At 50% completion, further progress payments will be made in full to CONTRACTOR and no additional amounts will be retained unless ENGINEER determines that the character and progress of the Work is not proceeding satisfactorily. Amounts previously retained shall not be paid to CONTRACTOR. At 50% completion or any time thereafter when the character and progress of the Work is not satisfactory, additional amounts may be retained but in no event shall the total retainage be more than 10% of the value of the work completed.

6.2.2 Upon Substantial Completion of the Work, the amount retained may be reduced. When the Work has been Substantially Completed, except for Work which cannot be completed because of weather conditions, lack of materials or other reasons which, in the judgment of OWNER are valid reasons for non-completion, OWNER may make additional payments, retaining at all times an amount sufficient to cover the estimated cost of the work still to be completed or corrected.

Final Payment:

6.3 Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said Paragraph 15.06.

ARTICLE 7 – PAYMENTS

7.1 Payments shall be made in accordance with the Local Government Prompt Payment Act.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

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

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

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.

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.

CONTRACTOR 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 the Supplementary Conditions as provided in Paragraph 5.03 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 5.06 of the General Conditions.

CONTRACTOR has obtained and carefully studied (or assumes responsibility for having done 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 CONTRACTOR, including applying the specific means, methods, techniques, sequences, and procedures of construction, if any, expressly required by the Contract Documents to be employed by CONTRACTOR, and safety precautions and programs incident thereto.

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.

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

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.

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

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

CONTRACTOR certifies that CONTRACTOR was not barred from bidding on this contract as a result of a conviction for the violation of State laws prohibiting bid-rigging or bid-rotating.

ARTICLE 9 – CONTRACT DOCUMENTS

9.1 The Contract Documents which comprise the entire Agreement between OWNER and CONTRACTOR concerning the Work consist of the following:

1. This Agreement.
2. Performance Bond
3. Payment Bond.
4. General Conditions (Pages 1 to 66, inclusive).
5. Notice to Proceed, not attached hereto.
6. Supplementary Conditions (Pages SC-1 to SC-12, inclusive).
7. Wage Rates
8. Appendix Forms and Drawings
9. Specifications bearing the title "Des Plaines River - WRF Dewatering Phase 1 Improvements", Project Number PW# 2019.162 for the Lake County Public Works Department, Lake County, Illinois.
10. Drawings bearing the following general title: Des Plaines River - WRF Dewatering Phase 1 Improvements, Project Number PW#2019.162 for the Lake County Public Works Department, Lake County, Illinois.
11. All Addendum inclusive.
12. Exhibits to this Agreement (enumerated as follows):

    a. Contractor's Bid

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

    a. Notice to Proceed
    b. Written Amendments
    c. Work Change Directives
    d. Change Orders

9.2 The documents listed in Paragraphs 9.1 et seq. above are attached to this Agreement (except as expressly noted otherwise above.). There are no Contract Documents other than those listed above in this Article 9. The Contract Documents may only be amended, modified or supplemented as provided in Paragraph 11.01 of the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 Terms

Terms used in this Agreement will have the meanings indicated in the General Conditions.

10.02 Assignment of Contract

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, moneys that may become due and moneys 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

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 to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 Severability

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.

10.05 Other Provisions

In the event of CONTRACTOR's and/or vendor's noncompliance with any provision of this Equal Employment Opportunity Clause, the Illinois Fair Employment Practices Act or the Fair Employment Practices Commission's Rules and Regulations for Public Contracts, the CONTRACTOR and/or vendor may be declared nonresponsible and therefore ineligible for future contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, and the Contract may be cancelled or voided in whole or in part, and such other sanctions or penalties may be imposed or remedies invoked as provided by statute or regulation.

During the performance of this Contract, CONTRACTOR and/or vendor agree as follows:

1. That it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin or ancestry; and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such underutilization. The 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 the contract or other legally available remedies.

2. That, if it hires additional employees in order to perform this Contract, or any portion thereof, it will determine the availability (in accordance with the Commission's Rules and Regulations for Public Contracts) of minorities and women in the area(s) from which it may reasonably recruit and it will hire for each job classification for which employees are hired in such a way that minorities and women are not underutilized.

3. That, in all solicitations or advertisements for employees placed by it or on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, sex, national origin, ancestry, age marital status, physical or mental handicap unrelated to ability, or an unfavorable discharge from military service.

4. That it will send to each labor organization or representative of workers with which it has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the CONTRACTOR's obligations under the Illinois Fair Employment Practices Act and the Commission's Rules and Regulations for Public Contracts. If any such labor organization or representative fails or refuses to cooperate with CONTRACTOR in its efforts to comply with such Act and Rules and Regulations, CONTRACTOR will promptly so notify the Illinois Fair Employment Practices Commission and the contracting agency and will recruit employees from other sources when necessary to fulfill its obligations thereunder.

5. That it will submit reports as required by the Illinois Fair Employment Practices Commission's Rules and Regulations for Public Contracts, furnish all relevant information as may from time to time be requested by the Commission or the contracting agency, and in all respects comply with the Illinois Fair Employment Practices Act and the Commission's Rules and Regulations for Public Contracts.

6. That it will permit access to all relevant books, records, accounts and work sites by personnel of the contracting agency and the Illinois Fair Employment Practices Commission for purposes of investigation to ascertain compliance with the Illinois Fair Employment Practices Act and the Commission's Rules and Regulations for Public Contracts.

7. That it will abide by “The Veterans Preference Act, 330 ILCS 55/1” which in part provides: "In the employment and appointment to fill positions in the construction, addition to, or alteration of all public works undertaken or contracted for by the State, or any of its political subdivisions thereof, preference shall be given to persons who have been members of the Armed Forces of the United States...in times of hostilities with a foreign country..." and the Servicemen's Employment Tenure Act, as amended, 330 ILCS 60/2, "safeguarding the employment and the rights and privileges inhering in the employment contract, of servicemen."

8. That it will include verbatim or by reference the provisions of Paragraphs 1 through 8 of this clause in every performance subcontract as defined in Section 2.10(b) of the Commission's Rules and Regulations for Public Contracts so that such provisions will be binding upon every such Subcontractor; and that it will also include the provisions of Paragraphs 1,5,6, and 7 in every supply subcontract as defined in Section 2.10(a) of the Commission's Rules and Regulations for Public Contracts so that such provisions will be binding upon every such subcontractor. In the same manner as with other provisions of this Contract, CONTRACTOR will be liable for such compliance with applicable provisions of this clause by all its subcontractors; and further it will promptly notify the contracting agency and the Illinois Fair Employment Practices Commission in

the event that any Subcontractor fails or refuses to comply therewith. In addition, no CONTRACTOR will utilize any Subcontractor declared by the Commission to be nonresponsible and therefore ineligible for Contracts or subcontracts with the State of Illinois or any of its political subdivision or municipal corporations.

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 Document have been signed, initialed or identified by OWNER and CONTRACTOR or identified by ENGINEER on their behalf.

This Agreement will be effective on _____ , 20 _____ , (which is the effective Date of the Agreement).

Attest:

_____
(CONTRACTOR)

_____
(Signature)

_____
(Signature)

Address for giving notices:

_____
(Typed Name and Title)

_____
_____
_____

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

CONTRACTOR's License No. _____
(If required by state or municipal law)

Attest:

_____

Lake County, IL

(OWNER)

_____
(Signature)

_____
(Signature)

Address for giving notices:

RuthAnne Hall
Purchasing Agent

_____
_____
_____

(If OWNER is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Agreement.)

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PERFORMANCE BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

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**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	**By:** _____
Signature	Signature *(attach power of attorney)*
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	**Attest:** _____
Signature	Signature
_____	_____
Title	Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

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

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction 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 the Owner or its heirs, executors, administrators, successors, and assigns.

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

11. 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 a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the 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 periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

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

14. Definitions

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

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT

Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND

Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

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**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	**By:** _____
Signature	Signature *(attach power of attorney)*
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	**Attest:** _____
Signature	Signature
_____	_____
Title	Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond shall arise after the following:

    5.1 Claimants who do not have a direct contract with the Contractor,

        5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

        5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).

    5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

    7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

    7.2 Pay or arrange for payment of any undisputed amounts.

    7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

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

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, 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 Construction 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.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

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

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. **Definitions**

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the 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.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default**: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

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 Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

EJCDC®
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

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ACEC
AMERICAN COUNCIL OF ENGINEERING COMPANIES

ASCE
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These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. 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, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

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

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document 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, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision

regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Engineer*—The individual or entity named as such in the Agreement.

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

22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

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

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.

26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

27. *Notice to Proceed*—A written notice 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.

28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

29. *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.

30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.

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

34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.

35. *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.

36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and

submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *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, and such other lands furnished by Owner which are designated for the use of Contractor.

38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

39. *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.

40. *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.

41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.

42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

43. *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 a Subcontractor.

44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.

45. *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 but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

46. *Unit Price Work*—Work to be paid for on the basis of unit prices.

47. *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; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 *Terminology*

A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated 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 information in the Contract Documents and with the design concept of the 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 Article 10 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 15.03 or 15.04).

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. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. Unless stated otherwise in the Contract Documents, words or phrases that 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. *Bonds*: 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 Contractor's Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.

C. *Evidence of Owner's Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), 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;

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.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

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 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *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 2.03.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 the component parts of the Work.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, 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.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

A. Standards Specifications, Codes, Laws and Regulations

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, 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, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract 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, reference standard, 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 part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, 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 part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*:

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then 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 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

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 had actual knowledge thereof.

B. *Resolving Discrepancies*:

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

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

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract

Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers 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 its consultants, including electronic media editions, or reuse any 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 adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions 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.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *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 Contract 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 Contract. 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 Contract, whichever date is earlier.

4.02 *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 such date.

4.03 *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.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 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 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.

B. 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, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, 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 Times and Contract Price. 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.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. 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. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. abnormal weather conditions;

3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and

4. acts of war or terrorism.

D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated

with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *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.

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 permanent improvements are to be made 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.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*:

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with

such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all 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 directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent 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 and adjacent areas 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 of 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 structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

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

1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, 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.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site 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 5.03 is materially inaccurate; or

2. is of such a nature as to require a change in the Drawings or Specifications; 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 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, 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 fall within any one or more of the categories described in Paragraph 5.04.A;

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 Paragraph 13.03; and,

c. 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.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a 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 otherwise; or

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

c. Contractor failed to give the written notice as required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent 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 do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; 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 information and data regarding existing Underground Facilities at the Site;

b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;

c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then 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 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

C. *Engineer's Review*: Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

   a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;

   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 Paragraph 13.03;

   c. 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; and

   d. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

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

1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

2. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors 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 removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) 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. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. 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, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.

H. 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, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, 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 (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, 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 failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, 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. 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 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.

B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.

D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then 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 bond and surety requirements above.

E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the

Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, 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.

G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.

H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.

I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.

J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:

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

2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).

3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).

B. *Commercial General Liability—Claims Covered*: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:

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

2. claims for damages insured by reasonably available personal injury liability coverage.

3. 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.

C. *Commercial General Liability—Form and Content*: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage:

a. Such insurance shall be maintained for three years after final payment.

b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.

2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.

3. Broad form property damage coverage.

4. Severability of interest.

5. Underground, explosion, and collapse coverage.

6. Personal injury coverage.

7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.

8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against 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. The automobile liability policy shall be written on an occurrence basis.

E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.

F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, 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 (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.

H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:

1. include at least the specific coverages provided in this Article.

2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.

4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.

5. be appropriate for the Work being performed and provide protection from claims that 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.

J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, 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.

B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable 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 Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."

2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or 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; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available

under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
6. extend to cover damage or loss to insured property while in transit.
7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
8. allow for the waiver of the insurer's subrogation rights, as set forth below.
9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
10. not include a co-insurance clause.
11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
12. include performance/hot testing and start-up.
13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. *Notice of Cancellation or Change*: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.

C. *Deductibles*: The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will

provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.

F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, 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 insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, 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 Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, 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 or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, 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 occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.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, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, 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 builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *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.

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.

7.02 *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, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *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, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work 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.

7.04 *"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 Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item 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 is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.

1. If Engineer in its sole discretion determines that 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, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, 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

4) it is not objectionable to Owner.

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.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. 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:

a. shall certify that the proposed substitute item will:

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

2) be similar in substance to that specified, and

3) be suited to the same use as that specified.

b. will state:

1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,

2) whether 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

3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

c. will identify:

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

2) available engineering, sales, maintenance, repair, and replacement services.

d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

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

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable 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.

E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.

B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. 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 the right of Owner to the completion of the Work in accordance with the Contract Documents.

H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. 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.

J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.

K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

L. 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.

M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

N. Owner 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 the particular Subcontractor or Supplier.

O. 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 create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *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, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors 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 specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, 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.

7.08 *Permits*

A. Unless otherwise provided in the Contract Documents, 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 the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 *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.

7.10 *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 or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, 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 such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

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

7.12 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. 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, other work in progress, 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 Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.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 at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer 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).

F. Contractor's duties and responsibilities for safety and protection 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 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *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.

7.14 *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.

7.15 *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.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements*:

1. Before submitting a Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

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

c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

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

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 of that submittal, and that Contractor approves the 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 set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings*:

a. Contractor shall submit the number of copies required in the Specifications.

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 7.16.D.

2. *Samples*:

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall 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 7.16.D.

3. 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. *Other Submittals*: Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

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 or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample 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 7.16.A.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 will document any such approved variation from the requirements of the Contract Documents in a Field Order.

5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

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.

2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *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 officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on 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;

6. the issuance of a notice of acceptability by Engineer;

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

8. any correction of defective Work by Owner.

D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, 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 officers, directors, members, partners, employees, agents, consultants, or subcontractors 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 7.18.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 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, 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.

7.19 *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 Laws and Regulations.

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, 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, 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 7.16.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. 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 such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, 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.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. an itemization of the specific matters to be covered by such authority and responsibility; and

3. the extent of such authority and responsibilities.

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

8.03 *Legal Relationships*

A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account

information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. 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.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.

C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all 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 damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

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

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *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.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *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.

10.02 *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 10.08. 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.

10.03 *Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. 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.

10.04 *Rejecting Defective Work*

A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.

B. 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, are set forth in Paragraph 7.19.

C. Engineer's authority as to Change Orders is set forth in Article 11.

D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, 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 15.06.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 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. *Change Orders*:

a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.

2. *Work Change Directives*: A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes 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. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-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. Such changes shall be supported by Engineer's recommendation, to the extent the change

involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *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, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.

B. 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, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

C. *Contractor's Fee*: When applicable, 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 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 13.01.B.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 Paragraphs 11.01.C.2.a and

11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

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 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures*: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.

2. *Engineer's Action*: Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole,

approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

3. *Binding Decision*: Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

B. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. 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;

2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety 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), 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.

ARTICLE 12 – CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*:

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction,

the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:

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 on the Work. 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, and 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 13.01.

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, as 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 6.05), 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 communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *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, expediters, 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 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here 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 Paragraph 13.01.B.

D. *Contractor's Fee*: When the Work as a whole 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, Change Proposal, Claim, set-off, or other 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 11.04.C.

E. *Documentation*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, 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.

13.02 *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*: Contractor agrees that:

1. 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

2. 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*: 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.

13.03 *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. Payments to Contractor for Unit Price Work will be based on actual quantities.

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. 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 the following paragraph.

E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price 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;

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that it 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 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

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, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. 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, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then 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, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages 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 pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. 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, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *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, then 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.

14.07 *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, 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, then 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 14.07, 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, 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 incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. 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 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 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 during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *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, a warehouse bond, 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.

C. *Review of Applications*:

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, 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 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, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for

Unit Price Work under Paragraph 13.03, and 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; or

   b. 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 money 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 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

   a. the Work is defective, requiring correction or replacement;

   b. the Contract Price has been reduced by Change Orders;

   c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

   d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

   e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*:

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*:

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

    a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

    b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

    c. Contractor has failed to provide and maintain required bonds or insurance;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

    e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

    f. the Work is defective, requiring correction or replacement;

    g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    h. the Contract Price has been reduced by Change Orders;

    i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;

    j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

    k. 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;

    l. there are other items entitling Owner to a set off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, 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, if Contractor remedies the reasons for such action. The reduction

imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *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 and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

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 preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor

may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

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. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.

2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work 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 15.03 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 6.05 regarding builder's risk or other property insurance.

15.05 *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, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *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, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

   d. a list of all disputes that Contractor believes are unsettled; and

   e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, 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, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

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 have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. 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 15.07. 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. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due*: Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer

(less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *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 Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such other adjacent areas;

2. correct such defective Work;

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 to 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. 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 repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

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, 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 are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *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 written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and 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);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, 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 complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.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 the cost to complete the Work, including all related claims, costs,

losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds 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.

F. 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, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *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; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) 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 16.03.

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 are not intended to preclude Contractor from submitting a Change Proposal 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 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this Article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and

2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this Article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *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, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract 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.

18.03 *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. 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.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SUPPLEMENTARY CONDITIONS

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SUPPLEMENTARY CONDITIONS

GENERAL

The Supplementary Conditions amend or supplement the "Standard General Conditions of the Construction Contract" (EJCDC C-700, 2013 Edition) 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.

ARTICLE 1 – DEFINITIONS

SC 1.01.A.20.
Add the following language at the end of the definition entitled "ENGINEER":

> Whenever the word ARCHITECT is used in the Specifications, it shall have the same meaning as the word ENGINEER.

ARTICLE 2 – PRELIMINARY MATTERS

SC 2.02.A.
Amend the first sentence of Paragraph 2.02.A. of the General Conditions to indicate the number of copies of Contract Documents as follows:

> No printed copies of the Contract Documents shall be furnished.

SC 2.03.A.3.
Amend the first sentence of Paragraph 2.03.A.3 of the General Conditions by inserting the words "Except for Unit Price Work," at the beginning of the sentence.

SC 2.04.
Add new paragraphs immediately after Paragraph 2.04.B of the General Conditions, which are to read as follows:

2.04.C. The conference will be held at a location selected by OWNER. The conference shall be attended by:

1. CONTRACTOR's Office Representative.
2. CONTRACTOR's Resident Superintendent.
3. CONTRACTOR's Safety Representative.
4. Any Subcontractors' or Suppliers' representatives whom CONTRACTOR may desire to invite or ENGINEER may request.
5. OWNER's Representatives.
6. ENGINEER's Representatives and any ENGINEER's Consultants ENGINEER may invite.
7. Local Utilities Representatives.

2.04.D A suggested format would include, but not be limited to, the following subjects:

1. Project safety.

2. Presentation of the preliminary progress schedule.
3. Liquidated damages.
4. Procedures for handling submittals such as Shop Drawings and other submittals.
5. Direction of correspondence, and coordinating responsibility between CONTRACTORS.
6. Project meetings.
7. Equal opportunity requirements.
8. Laboratory testing of material requirements.
9. Procedures for inventory of material and equipment stored on-site or off-site if off-site storage is authorized.
10. Review schedule of values, application for progress payment, and progress payment procedures.
11. Change Order procedures.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

SC 4.01.
Delete the last sentence of Paragraph 4.01.A. of the General Conditions in its entirety and insert the following in its place:

It is anticipated that the Notice to Proceed will be sent at the beginning of December 2021 and work will commence by early January 2022.

SC 4.04
Add a new subparagraph immediately following Paragraph 4.04.B. of the General Conditions:

4.04.C. The Contractor shall submit no later than Thursday a detailed schedule for the following week's Work activities, and notify the ENGINEER immediately of any changes to that schedule**.**

ARTICLE 6 – BONDS AND INSURANCE

SC 6.01.D
Add the following language at the end of Paragraph 6.01.D of the General Conditions:

> In addition, no further progress payments under the Agreement will be made by OWNER until CONTRACTOR complies with the provisions of this paragraph.

Add the following Paragraph 6.01 G after Paragraph 6.01F

SC6.01.G The CONTRACTOR shall supply in addition to other bonds required in the Contract Documents. No other additional bonds required.

SC 6.03. - CONTRACTOR'S INSURANCE

Entirely delete Paragraphs 6.03.A through 6.03.J and substitute the following:

A. The CONTRACTOR shall maintain for the duration of the contract, including warranty period, insurance purchased from a company or companies lawfully authorized to do business in the state of Illinois such insurance as will protect the CONTRACTOR from claims set forth below which may arise out of or result from the CONTRACTOR'S operations under the contract and for which the CONTRACTOR may be legally liable, whether such operations be by the CONTRACTOR or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

1. **Workmen's Compensation Insurance** covering all liability of the CONTRACTOR arising under the Workmen's Compensation Act and Workmen's Occupational Disease Act; limits of liability not less than statutory requirements.
2. **Comprehensive General Liability (CGL)** in a broad form on an occurrence basis, to include but not limited to, coverage for the following where exposure exists; Premises/Operations, Contractual Liability, Products/Completed Operations, Independent Contractor's coverage to respond to claims for damages because of bodily injury, sickness or disease, or death of any person other than the CONTRACTOR'S employees as well as claims for damages insured by usual personal injury liability coverage which are sustained (1) by a person as a result of an offense directly or indirectly related to employment of such person by the CONTRACTOR, or (2) by another person and claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use therefrom.

General Aggregate Limit	$4,000,000
Each Occurrence	$2,000,000

3. **Automobile Liability Insurance** shall be maintained to respond to claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle. This policy shall be written to cover any auto whether owned, leased, hired, or borrowed.

Each Occurrence Limit	$1,000,000

B. CONTRACTOR agrees that with respect to the above required insurance:

1. The CGL policy shall be endorsed for the general aggregate to apply on a "per Project" basis;
2. To provide separate endorsements and to name as additional insureds:
   a. Lake County, its officers, agents and employees, all members of Boards, Commissions, Committees, Trustees and Organizations of the County, all volunteers and members of volunteer organizations and other non-paid personnel, including college and high school interns, while acting on behalf of the County
   b. Lake County’s Consulting Engineer: Donohue & Associates, Inc.
3. To provide thirty (30) days notice, in writing, of cancellation or material change to the required insurance.

4. The Contractor's insurance shall be primary in the event of a claim.
5. Lake County shall be provided with Certificates of Insurance and endorsements evidencing the above required insurance, prior to commencement of this Contract and thereafter with certificates evidencing renewals or replacements of said policies of insurance at least thirty (30) days prior to the expiration of cancellation of any such policies. Said Notices and Certificates of Insurance shall be provided to Lake County Purchasing, 18 N County Street, Waukegan, IL 60085-4350.

C. **Failure to Comply:** In the event the CONTRACTOR fails to obtain or maintain any insurance coverage required under this agreement, Lake County may purchase such insurance coverage and charge the expense thereof to the CONTRACTOR.

SC 6.05. - PROPERTY INSURANCE

Entirely delete paragraphs 6.05.A through 6.05.F and substitute the following:

6.05.A. CONTRACTOR 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 these Supplementary Conditions or required by Laws and Regulations). The insurance shall:

1. Include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultant, and any other persons or entities indicated below, 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 and damage to the Work, temporary buildings, falsework, and Work in transit and shall insure against at least the following perils: fire, lightening, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and other such perils or causes of loss as may be specifically required by these Supplementary Conditions. The form of policy for this coverage shall be //Completed Value// //Reporting//;
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 in transit for incorporation in the Work or 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; and
5. 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.

The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with this Paragraph 6.05 shall comply with the requirements of GC 6.07.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

SC 7.02

Amend Paragraph 7.02.B of the General Conditions as follows:

'…during regular working hours, Monday through Friday 7 AM – 7 PM, and CONTRACTOR will not permit the performance of Work…'

Add the following paragraph immediately after Paragraph 7.06O:

7.06P Contractor shall perform with its own forces at least 30% of the work, unless written consent to subcontract a greater percentage of the work is obtained from OWNER.

SC 7.08.

Revise Paragraph 7.08.A to read as follows:

7.08.A Unless otherwise specified in the Contract Documents, the Owner will obtain and pay for all construction permits and licenses. The Owner has (or will) obtain permits from Lake County and applicable permits from the IEPA. The Owner will pay all charges of utility owners for connections for providing permanent service to the Work. Contractor shall comply with Building permit requirements

SC 7.15.

Add the following paragraphs immediately after Paragraph 7.15.A of the General Conditions, which are to read as follows:

7.15.B In emergencies affecting the safety or protection of persons or property or maintenance of temporary construction at the site or adjacent thereto, and CONTRACTOR cannot be reached, OWNER may act to attempt to prevent threatened damage, injury, or loss. OWNER will give CONTRACTOR and ENGINEER prompt written notice of such action and the cost of correction or remedy shall be charged against CONTRACTOR. A Change Order will be issued to document the change in Contract Price.

7.15.C Accidents occurring on the job which damage public or private property, or result in injury to workers or other persons, shall be promptly reported to the OWNER.

SC 7.16.

Revise paragraph 7.16.B.1.a. of the General Conditions to read as follows:

Unless otherwise directed in the Technical Specifications, four (4) complete sets of Shop Drawings shall be submitted for review by the ENGINEER. Each submittal shall be identified by both a unique submittal number and the specification section and/or paragraph number most clearly describing the equipment to be reviewed. Unrelated equipment shall not be submitted under any one submittal number.

Add a new subparagraph immediately after Paragraph 7.16.D.8 of the General Conditions, which shall read as follows:

7.16.D.9. After ENGINEER has reviewed and approved a Shop Drawing or Sample, CONTRACTOR shall provide the material or equipment approved. ENGINEER will not review subsequent submittals of a different manufacturer or Supplier unless CONTRACTOR provides sufficient information to

ENGINEER that the approved material or equipment is unavailable, time of delivery will delay the construction progress, or OWNER requests a different manufacturer or Supplier.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

SC 9.13.
Add a new paragraph immediately after Paragraph 9.12 of the General Conditions, which is to read as follows:

9.13.A OWNER will furnish a Site Representative, assistants, and other field staff to observe performance of the Work.

A. The duties and responsibilities of OWNER's Site Representative are described as follows:

1. Become familiar with the Contract Documents to observe the progress and quality of the executed Work, and to determine, in general, if the Work is proceeding in accordance with the Contract Documents.
2. Promptly forward to ENGINEER, reports from CONTRACTOR indicating conflict, error or discrepancy in the Contract Documents to enable ENGINEER to issue a written clarification or interpretation as provided for in Paragraph 10.07 of the General Conditions.
3. Provide ENGINEER with copy of Site Representatives' daily log.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

SC 10.01.
Add a new paragraph immediately after Paragraph 10.01.A of the General Conditions:

10.01.B When ENGINEER, ENGINEER'S CONSULTANT and/or OWNER (THEY) are on the project site to perform the duties and responsibilities as set forth in the General Documents, THEY will comply with CONTRACTOR'S safety plans, programs, and procedures. In the event THEY determine that CONTRACTOR's safety plans, programs, and procedures do not provide adequate protection for THEY, THEY may direct their employees to leave the Project site or implement additional safeguards for THEY's protection. If taken, these actions will be in furtherance of THEY's responsibility to their own employees only, and THEY will not assume any responsibility for protection of any other persons affected by the Work. In the event THEY observe situations which appear to have potential for immediate and serious injury to persons, THEY may warn the persons who appear to be affected by such situations. Such warnings, if issued, shall be given based on general humanitarian concerns, and THEY will not, by the issuance of any such warning, assume any responsibility to issue future warnings or any general responsibility for protection of persons affected by the Work.

SC 10.03.
Add the following sentence to the end of Paragraph 10. 03 A of the General Conditions:

10.03 OWNER will provide a Site Representative whose responsibilities and duties are described in SC 9.13 and limitations set forth

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

SC 11.01.
Add the following sentence at the end of Paragraph 11.01.A.2 of the General Conditions:

Notice of the amount or extent of the claim shall include the following certification:

> CONTRACTOR certifies that this claim is made in good faith, that the supporting data are accurate and complete to the best of the CONTRACTOR's knowledge and belief, and that the amount or time requested accurately reflects the Contract adjustment for which CONTRACTOR believes OWNER is liable.

SC-11.04
Add the following after Paragraph 11.04.A:

For each change order the Contractor shall submit to the Owner for review sufficient cost and pricing data to enable the Owner to ascertain the necessity and reasonableness of costs and amounts proposed, and the allowability and eligibility of costs proposed.

SC 11.05.
Add a new paragraph immediately after Paragraph 11.05.B of the General Conditions:

11.05.C. Time extensions provided under Paragraph 11.05 of the General Conditions will be only allowed for controlling items of Work (critical path). Except as provided for in Paragraph 14.06, CONTRACTOR shall make no claim for damages for delay in performance of the Work occasioned by acts or neglect by OWNER or any of its representatives, including ENGINEER or ENGINEER's Consultant, and agrees that any such claim will be fully compensated for by an extension of the time in an amount equal to the time lost due to such delay, and that such time extension shall be CONTRACTOR's sole and exclusive remedy for such delay.

SC 11.06.
Amend Paragraph 11.06.A.1. of the General Conditions by deleting the words "thirty days" in the 2nd line and inserting the words "ten days" in their place

SC 11.07.
Add the following subparagraph immediately after Paragraph 11.07.B of the General Conditions, which is to read as follows:

11.07.C Change Orders will be prepared on the form included in the Appendix of this Project Manual.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

SC 13.03.
Amend the first sentence of paragraph 13.03.C of the General Conditions by inserting the words, "the Cost of the Work in addition to" following the word "include".

Delete Paragraph 13.03.E.1 of the General Conditions in its entirety and insert the following in its place:

13.03.E.1 The total cost of a particular item of Unit Price Work amounts to 5% or more of the Contract Price and the variation in the quantity of that particular item of Unit Price Work performed by CONTRACTOR differs by more than 25% from the estimated quantity of such item indicated in the Agreement;

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

SC 14.02.

14.02.C. At the end of Paragraph 14.02.C, add the following:

"Such inspections, testings, and approvals to be arranged, obtained, and paid for by the Contractor shall include, but not be limited to, all those required for compliance with Illinois Public Act 096-1416 regarding Clean Construction or Demolition Debris (CCDD)."

Add a new subparagraph following Subparagraph 14.02.F of the General Conditions, which is to read as follows:

14.02.G. It is not the intent of this paragraph to require CONTRACTOR to be responsible for the cost of OWNER or ENGINEER to witness inspections or tests unless otherwise set forth in the Specifications.

ARTICLE 15 – PAYMENTS TO CONTRACTORS; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC 15.01.
Amend the first sentence of Paragraph 15.01.B.1 by striking out the words "20 days" and inserting the words "thirty days" in their place.

Delete Paragraph 15.01.D. of the General Conditions in its entirety and insert the following in its place:

1. Payment shall be made by the OWNER to the CONTRACTOR in accordance with the Local Government Prompt Payment Act following presentation of the Application for Payment to OWNER with ENGINEER's recommendations (subject to the provisions of paragraph 15.01.E.).

SC 15.06.
Add a new paragraph immediately after Paragraph 15.06.D. of the General Conditions, which is to read as follows:

15.06.E In addition to the actual damages set forth in the Agreement, CONTRACTOR shall be liable for all additional costs for ENGINEER's services beyond the ENGINEER's review of the CONTRACTOR's first Application for Final Payment. OWNER will deduct these costs from any monies due or that may become due CONTRACTOR or Surety and pay ENGINEER for said services.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

SC 16.04.
Amend Paragraphs 16.04.A. and 16.04.B. of the General Conditions by striking out the words "30 days" in four places and inserting the following words in their place, "sixty days", and by striking out the words "seven days" in two places and inserting the following words in their place, "ten days."

ARTICLE 18 – MISCELLANEOUS

SC 18.01
Insert the following in the first sentence of Paragraph 18.01.A following the words "written notice":

"or the delivery of any Bond, Agreement, Certificate of Insurance or any other item,"

SC 18.09.
Add a new paragraph immediately after Paragraph 18.08 of the General Conditions, which is to read as follows:

18.09 Lien Waivers:

OWNER may at any time require CONTRACTOR to furnish lien waivers for labor and materials covered by Applications for Payment.

SC 18.10
Add a new paragraph immediately after Paragraph 18.09 of the General Conditions, which is to read as follows:

18.10 Notice to Residents

A. The CONTRACTOR shall distribute notices to all residents directly affected by the proposed construction and as otherwise directed by the OWNER. The notices shall inform the resident as to when and where construction is to occur, the Work being performed, the hours which the Work will be performed, if and when any driveways, streets, water or sanitary services will be closed or otherwise interrupted.

The notices shall be submitted and approved by the OWNER and ENGINEER. Notices shall be distributed at least three days, but no more than ten days, prior to construction. In the case of water or sanitary service disruption, a second notice shall be given approximately 24 hours prior to the interruption of service.

SC 18.11

Add a new paragraph following Paragraph 18.10 of the General Conditions, which is to read as follows:

18.11 PREVAILING WAGE REQUIREMENTS

A. This Project is subject to the requirements of the "Wages of Employees on Public Works (Prevailing Wage) Act (Illinois Revised Statutes, Chapter 48, Section 395-1 through 395-120." The Contractor shall comply with these requirements of the Act.

B. In accordance with the Wage Determination of the Secretary of Labor, the Owner has adopted rates for various classifications of workmen on the Project. A copy of the wage rate is attached.

C. The prevailing wage law does not prohibit payment of more than the prevailing rate of wages nor does it limit the hours of Work which may be performed by an employee in any particular period of time.

D. A copy of the wage determination shall be posted by the CONTRACTOR in a prominent place at the site of the Work where it can be easily seen by the employees.

E. Statement on Certified Payroll

State of Illinois Prevailing Wage Act (820 ILCS/130/1)
It is the policy of the State of Illinois that a wage of no less than the general prevailing hourly rate as paid for work of a similar character in the locality in which the work is performed, shall be paid to all laborers, workers and mechanics employed by or on behalf of any and all public bodies engaged in public works.

Effective September 1, 2020, the Illinois Department of Labor (IDOL) has activated an electronic database (Payroll Portal) capable of accepting and retaining certified payrolls submitted under the State of Illinois Prevailing Wage Act (820 ILCS/130/1). All contractors and subcontractors completing work for Lake County pursuant to the Act must submit all certified payroll through the IDOL Payroll Portal.

Any contractor or subcontractor subject to this Act and any officer, employee, or agent of such contractor or subcontractor whose duty as such officer, employee, or agent it is to file such certified payroll who willfully fails to file such a certified payroll on or before the date such certified payroll is required by this paragraph to be filed and any person who willfully files a false certified payroll that is false as to any material fact is in violation of this Act and guilty of a Class A misdemeanor. (820 ILCS 130/5(2)).

Effective September 1, 2020, to receive payment for work conducted for Lake County, contractors must provide the email certification received from their IDOL submittal with each of their pay requests.

A contractor or subcontractor convicted or found guilty under Section 5 or 6 of this Act shall be subject to an automatic and immediate debarment, thereafter prohibited from participating in any public works project for 4 years, with no right to a hearing (820 ILCS 130/11a).

F. The Owner is required to keep the certification records submitted for a period of not less than three years. Furthermore, these records, except an employee's address, telephone number, and social security number, shall be made available in accordance with the Freedom of Information Act.

SC 18.12

Add a new paragraph following Paragraph 18.11 of the General Conditions, which is to read as follows:

18.12 EMPLOYEE CLASSIFICATION ACT

A. This project is subject to the requirements of the Illinois "Employee Classification Act," (820 ILCS 185 1-999). The Contractor shall comply with the requirements of the Act.

* * * END OF SUPPLEMENTARY CONDITIONS * * *

Illinois Department of Transportation

Contractor Certification Statement

Prior to conducting any professional services at the site covered by this contract, the Contractor and every subcontractor must complete and return to the Resident Engineer the following certification. A separate certification must be submitted by each firm. Attach to this certification all items required by Section II.G of the Storm Water Pollution Prevention Plan (SWPPP) which will be handled by the Contractor/subcontractor completing this form.

Route	Marked Route	Section Number

Project Number	County	Contract Number

This certification statement is a part of SWPPP for the project described above, in accordance with the General NPDES Permit No. ILR10 issued by the Illinois Environmental Protection Agency.

I certify under penalty of law that I understand the terms of the Permit No. ILR 10 that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

Additionally, I have read and understand all of the information and requirements stated in SWPPP for the above mentioned project; I have received copies of all appropriate maintenance procedures; and, I have provided all documentation required to be in compliance with the Permit ILR10 and SWPPP and will provide timely updates to these documents as necessary.

☐ Contractor
☐ Sub-Contractor

Signature	Date

Print Name	Title

Name of Firm	Phone

Street Address	City	State	Zip Code

Items which this Contractor/subcontractor will be responsible for as required in Section II.G. of SWPPP

CHANGE ORDER NO. ___

Owner: Lake County Public Works Department Date_____

Project _____

Owner's Contract No. PW#_____ Contractor _____

Date of Contract Start _____ $ _____

You are directed to make the following changes in the Contract Documents. Description:

Reason for Change Order:

CONTRACT PRICE		**CONTRACT TIMES (Calendar Days)**	To substantial completion	To final completion
Original:	$_____	Original:	_____	_____
Previous Change Orders:	$_____	Previous Change Orders:	_____	_____
This Change Order:	$_____	This Change Order:	_____	_____
Contract Price with all approved Change Orders:	$_____	Total of all approved Change Orders:	_____	_____
		Original Completion Date:	_____	_____
		Revised Completion Date:	_____	_____

The Contractor agrees that this Change Order includes any and all costs associated with or resulting from the change(s) ordered herein, including all impact, delays, and acceleration costs. Other than the dollar amount and time allowance listed above, there shall be no further time or dollar compensation as a result of this Change Order.

THIS DOCUMENT SHALL BECOME AN AMENDMENT TO THE CONTRACT AND ALL STIPULATIONS AND COVENANTS OF THE CONTRACT SHALL APPLY HERETO.

PROPOSED:

By: _____ _____
Contractor (Authorized Signature) Date

RECOMMENDED:

By: _____ _____
Engineer (Authorized Signature) Date

APPROVED:

By: _____ _____
Owner (Authorized Signature) Date

NOTE: OWNER is required to complete a Change Order Authorization form if change decrease or increase is for $10,000 or more, or time of completion is 30 days or more.

CHANGE ORDER

INSTRUCTIONS

A. GENERAL INFORMATION

This document was developed to provide a uniform format for handling contract changes that affect Contract Price or Contract Times. Changes that have been initiated by a Work Change Directive must be incorporated into a subsequent Change Order if they affect Price or Times.

Changes that affect Contract Price or Contract Times should be promptly covered by a Change Order. The practice of accumulating Change Orders to reduce the administrative burden may lead to unnecessary disputes.

If Milestones have been listed in the Agreement, any effect of a Change Order thereon should be addressed.

For supplemental instructions and minor changes not involving a change in the Contract Price or Contract Times, a Field Order should be used.

B. COMPLETING THE CHANGE ORDER FORM

Engineer normally initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by Contractor, or requests from Owner, or both.

Once Engineer has completed and signed the form, all copies should be sent to Owner or Contractor for approval, depending on whether the Change Order is a true order to the Contractor or the formalization of a negotiated agreement for a previously performed change. After approval by one contracting party, all copies should be sent to the other party for approval. Engineer should make distribution of executed copies after approval by both parties.

If a change only applies to price or to times, cross out the part of the tabulation that does not apply.

CHANGE ORDER AUTHORIZATION

for

Illinois Public Projects

Contract Number _____ Date: _____

Project _____

This Change Order authorizes: (check one)

[ ] (a) an increase/decrease in the cost of the contract by $10,000 or more
($ _____)
amount

[ ] (b) an increase/decrease in the time of completion by 30 days or more
(_____)
amount

OWNER (or its designee _____) has determined that the

circumstances said to necessitate the change in performance, which are See Attached Change Order Summary
(give circumstances requiring change)

_____

_____:

(check one)

[ ] (a) were not reasonably foreseeable at the time the contract was signed.
[ ] (b) were not within the contemplation of the contract as signed.
[ ] (c) are in the best interest of the district or region and authorized by law.

_____

Prepared by (ENGINEER) Date

_____

Authorized by (OWNER) Date

OWNER shall preserve a copy of this authorization in a permanent contract file that is open to the public in accordance with P.A. 85-1295, Ill. Rev. Stat. ch. 38, par. 33E-9.

CHANGE ORDER #
SUMMARY

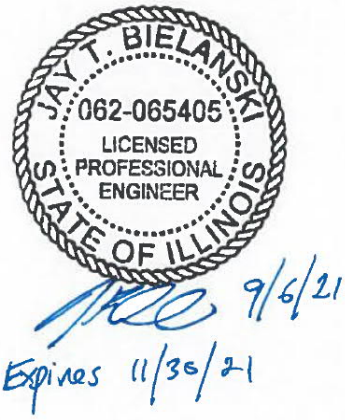
1. This Change Order provides:

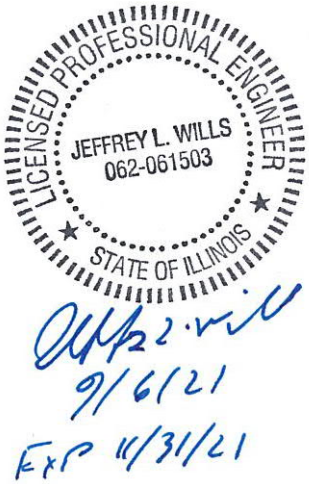
End of Change Order Summary

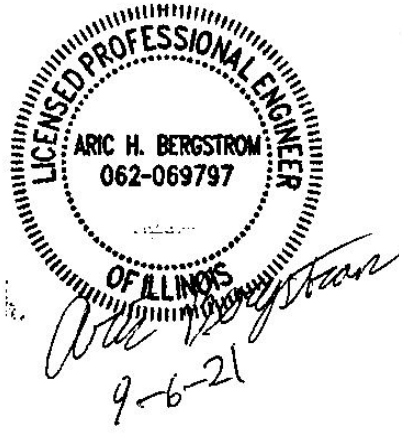
TECHNICAL SPECIFICATIONS

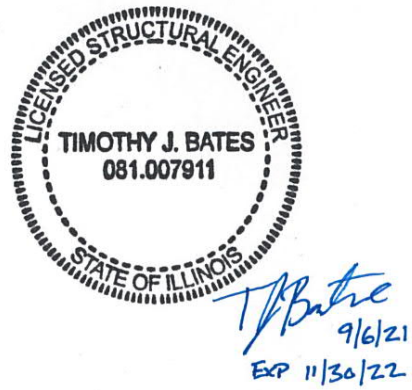
DES PLAINES RIVER - WRF
DEWATERING PHASE 1 IMPROVEMENTS
PW# 2019.162

FOR THE
LAKE COUNTY PUBLIC WORKS DEPARTMENT
LAKE COUNTY, ILLINOIS









Donohue & Associates
3311 Weeden Creek Road
Sheboygan, Wisconsin 53081
Phone: 920-208-0296
Fax: 920-208-0402

Donohue Project No. 13780

TECHNICAL SPECIFICATIONS

DES PLAINES RIVER - WRF
DEWATERING PHASE 1 IMPROVEMENTS
PW# 2019.162

FOR THE
LAKE COUNTY PUBLIC WORKS DEPARTMENT
LAKE COUNTY, ILLINOIS

TABLE OF CONTENTS

APPENDIX

DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. The Work of this Contract is to provide site civil, process, structural, electrical, mechanical and I&C upgrades necessary to provide a new polymer system for current and future dewatering equipment as well as installing a new buried alum line to provide a new alum dosing point to the secondary effluent upstream of the tertiary filters. Additionally, implement the gas monitoring and odor control improvements in the Dryer Building.

1.02 WORK BY OTHERS

A. Utilities

1. None.

B. Work on Site which will be, or has been executed prior to, or after, start of Work on this Contract and may be concurrent to this Contract, but is excluded from this Contract:

1. None.

1.03 WORK SEQUENCE

A. Construct Work in accordance with following requirements and to accommodate operation of existing facilities during construction period. Coordinate construction progress schedule and operations with Engineer and Owner. Owner reserves right to place facilities taken out of service by Contractor back into service on emergency basis upon notification to Contractor.

B. Draining, Cleaning, and Dewatering of Tanks and Piping

1. Unless specified otherwise, draining, cleaning, and dewatering of tanks, piping, and other facilities and proper disposal of removed solids shall be performed by Contractor as required to complete Work.
2. Unless specified otherwise, Owner will not drain, clean, and dewater facilities to enable Contractor to complete Work.
3. Owner will drain Polymer Aging Tanks. When tanks are made available to Contractor, not more than 1 foot of water will remain in tanks at the sidewall. Polymer will remain on tank walls and floors and on existing air diffusion system. Contractor shall clean and remove remaining material, and maintain dewatering of the tanks as required to complete Work.
4. Contractor shall maintain facilities clean and dry as required to complete Work, including control and temporary pumping of leakage from isolation facilities and water resulting from precipitation.

C. All facilities must be maintained in operation at all times except as specified below.

D. Schedule service outages with Owner and Engineer a minimum 14 days prior to service outages. Owner reserves the right to cancel any scheduled service outages at any time due to high flows at the wastewater treatment facility or adverse wastewater treatment facility conditions.

E. Sequences and constraints for the Polymer Feed Pumps shall be as follows:

1. Only one Polymer Feed Pump shall be out-of-service at a time unless specified otherwise.
2. Only one Belt Filter Press shall be out-of-service at a time unless specified otherwise.
3. Systems Demonstration of each Polymer Feed Pump shall be complete prior to the next Polymer Feed Pump service outage.
4. Each Polymer Feed Pump service outage shall be limited to 14 calendar days.

F. Sequences and constraints for removal of the existing dry polymer mixing system and installation of the new Polymer Aging Tanks shall be as follows:

1. Systems Demonstration of New Liquid Polymer Tank, Polymer Mixing System 1 and 2, and Liquid Polymer Circulation Pump shall be complete prior to removal of the existing dry polymer system.
2. Systems Demonstration of all four polymer feeds pump shall be complete before the existing dry polymer system is removed and installation of Polymer Aging Tank 1 and 2.
3. Polymer Aging Tank 3 and 4 shall be placed in service using liquid polymer from Polymer Mixing System 1 and 2 prior to removal of the existing dry polymer system and installation of Polymer Aging Tank 1 and 2.
4. Service outage(s) of the entire polymer system are anticipated for piping connections to and from the Polymer Aging tanks. Each service outage of entire polymer system shall be limited to 2 calendar days if wastewater treatment facility conditions are favorable. If adverse wastewater treatment facility conditions exist, service outages shall occur outside of the operations hours (Monday through Friday, 7 am to 3 pm). The polymer system shall be placed back in-service by the next operating day (Monday through Friday at 7 am).

G. Sequences and constraints for 90MCC-1 and 90MCC-2 work shall be as follows:

1. The MCC shall be de-energized for a maximum of 4 hours.
2. The MCC can be de-energized multiple times if a minimum of 48 hours is provided between shutdowns and the shutdown has been scheduled with the Owner.

H. Sequences and constraints for the buried alum piping shall be as follows:

1. The alum service pipe to the aeration basins shall be out-of-service for a maximum of 8 hours.

I. Modifications to 90-HWUH-7 and shutdown of the hot water heating loop shall occur when the ambient outside air temperature is greater than 50 degrees Fahrenheit.

J. The natural gas service outage shall occur when the ambient outside air temperature is greater than 50 degrees Fahrenheit. The service outage shall not exceed 8 hours.

K. The W2 service outage shall be limited to 4 hours and coordinated with the entire polymer system service outage.

L. Each W3 service outage shall be limited to 4 hours and coordinated with the entire polymer system service outage.

M. In areas where light switches are removed, provide temporary light switch or temporary lighting per Section 01 52 00.

1.04 CONTRACTOR'S USE OF PREMISES

A. Conduct operations to ensure least inconvenience to Owner and operation of existing facility. Cooperate with Owner during construction operations to minimize conflict and to facilitate Owner's operations.

B. When keys to locked areas are needed to provide access to areas to perform Work, obtain from Owner. Return keys at end of day's Work.

C. Employees of Contractor and Subcontractors involved in Work shall wear identifying button or badge when working in facilities occupied by Owner.

D. Due to potential health hazards and requirements of the Illinois EPA, and U.S. EPA, existing wastewater treatment facilities must be maintained in operation during the construction of the new facility. Degree of treatment during construction shall be equal to or exceed efficiency of the facility before construction started.

E. Contractor shall discuss and coordinate with Owner and Engineer prior to removing equipment from service in order to complete Work. Owner will, at Owner's discretion, request equipment to be placed back into service if out of service equipment will cause adverse effects on plant operation.

F. Obtain and pay for use of additional storage or Work areas needed for operations at no additional cost to Owner.

1.05 OWNER FURNISHED MATERIALS OR EQUIPMENT

A. Owner will furnish the following materials or equipment:

1. None.

1.06 OWNER OCCUPANCY OF PREMISES

A. Owner will occupy site and existing facilities during entire construction period for conduct of normal operations.

B. Owner reserves right to partially occupy and to place and install equipment in completed areas of facilities, prior to Substantial Completion, provided that such occupancy does not interfere with completion of Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the Work.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION

SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 SUMMARY

A. Provide a detailed breakdown of the Contract Price showing amounts and quantities allocated to each of the various parts of the Work, as specified herein.

B. Upon request of Engineer, support amounts and quantities with data substantiating their correctness.

1.02 FORM AND CONTENT OF SCHEDULE OF VALUES

A. Schedule shall be typed on 8-1/2-in. by 11-in. white paper. Contractor's standard forms and automated printout will be considered for approval by Engineer upon request. Include following:

1. Project title.
2. Project location.
3. Owner.
4. Engineer.
5. Engineer's project number.
6. Name and address of Contractor.
7. Contract designation.
8. Date.

B. Identify installed value of Work in sufficient detail to serve as basis for computing values for progress payments during construction.

C. Provide a separate listing of general items, such as bonds, insurance, mobilization, field supervision, construction facilities, allowances, and record documents.

D. Follow Project Manual table of contents as format for listing component items. At a minimum, listing shall include material cost and total installed cost for each Specification Section for each structure as listed in this Section.

1. Identify each line item with number and title of respective Specification Division and Section.
2. Include directly proportional amount of Contractor's overhead and profit.
3. For items on which progress payments will be requested for stored materials, break down value into:

a. Cost of materials, delivered and unloaded.
b. Total installed value.

E. Provide listing of items for sitework and for each structure as follows:

1. Contractor's Overhead.

a. Bonds and Insurance
b. Mobilization
c. Office Support
d. Field Supervision

e. Demobilization

2. Sitework.
3. 60 – Biosolids Drying Building
4. 90 – Dewatering Building.
5. 95 – Secondary Effluent Junction Box.

F. Sum of values listed shall equal total Contract Price.

G. Provide additional breakdown as required by Engineer.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Engineer will conduct preconstruction conference in accordance with this Section.

B. To enable orderly review during progress of the Work, and to provide for systematic discussion of problems, the Contractor shall conduct progress meetings, construction foreman's meetings, and specially called meetings throughout the construction period. Owner and Engineer may attend meetings. Contractor shall:

1. Prepare agenda.
2. Distribute written notice of specially called meetings a minimum of 1 working day in advance of the meeting date. Notice by electronic mail is acceptable.
3. Make physical arrangements for meetings.
4. Preside at meetings.
5. Record meeting minutes.
6. Prepare formal minutes within 3 working days after meeting and distribute electronic copies to:

    a. Meeting participants.
    b. Affected parties.
    c. Engineer and Owner

1.02 QUALIFICATIONS

A. Representatives of Contractor, Subcontractors, and Suppliers attending the meetings shall be authorized to act on behalf of entity each represents.

B. Revisions to Minutes:

1. Unless published minutes are challenged in writing prior to the next regularly scheduled progress meeting; they will be accepted as properly stating the activities and decisions of the meeting.
2. Challenge to the minutes shall be settled at the regularly scheduled meeting.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 PRECONSTRUCTION CONFERENCE

A. Location: To be selected by Owner.

B. Attendance:

1. Contractor's Project Manager.
2. Contractor's Resident Superintendent.
3. Contractor's "hands-on" person designated to submit Shop Drawings to Engineer.

4. Subcontractors' or Suppliers' representatives Contractor may desire to invite or Engineer may request.
5. Owner's representatives.
6. Engineer's representatives.
7. Local utility representatives, if applicable.

C. Agenda:

1. Organizational arrangement of Owner's and Engineer's forces.
2. Organizational arrangement of Contractor's, Subcontractors', and material and equipment Suppliers' forces.
3. Contract Documents, including distribution of required copies.
4. Project safety.
5. Preliminary Construction Progress Schedule.
6. Check of required bonds and insurance.
7. Liquidated damages.
8. Preliminary schedule of Shop Drawing submissions.
9. Procedures for handling submittals.
10. O & M submittals.
11. Channels and procedures for communications, correspondence, and project coordination.
12. Weekly and monthly meetings.
13. Equal opportunity requirements.
14. Laboratory and field testing requirements.
15. Provisions for inventory of material stored on-site or off-site.
16. Schedule of values.
17. Application for progress payments.
18. Field Order and Change Order procedures.
19. Project Record Documents.
20. Posting of required signs and notices.
21. Other business.

3.02 MONTHLY PROGRESS MEETINGS

A. Schedule monthly meetings.

B. Location: Contractor's field office.

C. Attendance:

1. Contractor's Project Manager.
2. Contractor's Resident Superintendent.
3. Affected Subcontractors.

D. Suggested Agenda:

1. Review of minutes of previous meeting.
2. Review of Work progress since previous meeting.
3. Project safety concerns.
4. Field observations, problems, conflicts.
5. Problems impeding Construction Progress Schedule.
6. Review of off-site fabrication, delivery schedules.
7. Corrective measures and procedures to regain conformance with Construction Progress Schedule.
8. Revisions to Construction Progress Schedule.
9. Issues raised by Owner and Engineer.
10. Proposed progress and schedule for succeeding Work period.

11. Coordination of schedules.
12. Review and update of submittal schedule.
13. Maintenance of quality standards.
14. Pending changes and Substitutions.
15. Effect of proposed changes on Construction Progress schedule.
16. Review of Project Record Documents.
17. Other business.

E. Agenda containing specific subjects to be discussed shall be provided to each attendee and to the Owner and Engineer at least 5 working days before the meeting.

3.03 CONSTRUCTION FOREMAN'S MEETING

A. Schedule weekly.

B. Location: Contractor's field office.

C. Attendance:

1. Resident Superintendent.
2. Subcontractors' foremen.

D. Suggested Agenda:

1. Review of Work progress since previous meeting.
2. Proposed progress and schedule for succeeding Work period.
3. Field observations, problems, conflicts.
4. Problems that affect Construction Progress Schedule.

END OF SECTION

SECTION 01 32 15
PROGRESS SCHEDULE
(CRITICAL PATH METHOD)

PART 1 – GENERAL

1.01 SUMMARY

A. Submit preliminary Progress Schedule. Preliminary schedule may be in the form of horizontal bar chart and shall outline, in detail, construction activities until the Critical Path Method (CPM) schedule is complete and becomes effective.

B. Prepare and submit detailed CPM Progress Schedule to Engineer within 60 days after Notice to Proceed.

1. Approximately midway through the 60-day period, representatives of Contractor shall meet with Engineer and Owner for the purpose of review and coordination of draft CPM schedule.

1.02 SUBMITTALS

A. Three days before the meetings to discuss schedules, submit preliminary schedule or CPM schedule electronically, and subsequent revisions thereof, to Engineer and Owner for review.

B. Three days prior to monthly progress meetings, submit revised schedule to Owner and Engineer electronically. Furnish revised schedule to Subcontractors as appropriate.

C. In addition to submission requirements defined herein, post progress schedule to document management website.

C. Failure to submit schedules on a timely basis shall be considered cause for withholding progress payments.

D. Within 10 days after Notice to Proceed, submit name and qualifications of firm proposed to prepare schedule.

1.03 QUALITY ASSURANCE

A. Progress Schedule and revisions to schedule shall be as directed by Contractor. Coordinate necessary input from Subcontractors and Suppliers.

B. Engage services of firm specializing in preparation of Progress Schedules or demonstrate to Engineer experience and capabilities to prepare and revise CPM schedules.

1.04 WORKING HOURS

A. No Work shall be done between 6:00 p.m. and 7:00 a.m., nor on Saturdays, Sundays or legal holidays without written permission of Owner. Emergency work may be done without prior permission.

B. Such permission may be revoked at any time by Owner if Contractor fails to maintain adequate equipment and supervision for proper prosecution and control of Work. Revocation shall not entitle Contractor to change in Contract Price or Contract Time.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 FORM OF SCHEDULE

A. Use precedence diagramming method to present manner and timing in which Contractor intends to perform Work. Resource and cost load the schedule in accordance with the payment schedule. Base CPM schedule on 5-day workweek with notations for specific constraints such as winter shut down.

B. Schedule shall cover on- and off- site activities. Detail individual activities to such a degree that path of construction can be easily followed for each item of work. Provide early and late start and completion dates with float times indicated for each. Present schedule as follows:

1. Logic diagram with critical path highlighted.
2. Listing of activity items by activity number.
3. Listing of activity items by early start dates.
4. Listing of activity items by late start date.
5. Listing of activities on critical path.

C. Content:

1. Show complete sequence of construction by activity.
2. Show dates for beginning and completion of each major element of construction and installation dates for major equipment items. Include:

a. Each individual task of construction.
b. Procurement of equipment and systems including Shop Drawing submittals, Engineer's review of submittals, shop tests, and delivery dates.
c. Identification of Work that will affect existing plant operations.
d. Services of manufactures' representatives.
e. Startup dates for major equipment.
f. Field tests.
g. Dates of Substantial and Final completion.
h. Subcontractor Work items.
i. Allowance for inclement weather.
j. MBE, WBE, and SBE activities.
k. O&M data activities.
l. Contractor-provided training.

3.02 REVISIONS TO SCHEDULE

A. Each month Contractor shall receive update information from Subcontractors and Suppliers which shall be included in current schedule. Revised schedule shall indicate changes such as:

1. Major changes in scope.
2. Activities modified since previous submittal.
3. Revised projections of progress and completion.
4. Other identifiable changes.

B. Information supplied by Contractor shall include as minimum, activities started during preceding period, activities completed during preceding period, starting and completion dates for each, status of completion of ongoing activities, and major logic changes.

C. Provide narrative report to define following:

1. Problem area and anticipated delays and their impact on schedule.
2. Corrective action recommended and its effect.

3.03 MONTHLY PROGRESS MEETINGS

A. Once each month, in accordance with Section 01 31 19, Progress Schedule will be reviewed. Progress will be reviewed:

1. To identify those activities started and completed during previous period.
2. For remaining duration required to complete each activity started, but not completed.
3. For durations of selected activities not yet started.
4. For effect of Change Orders and proposed sequencing.

B. During the meeting, logic diagram will be amended as needed and Contractor shall update logic diagram and computer printouts accordingly.

3.04 DELAYS AND RECOVERY

A. If, at any time during the Project, Contractor fails to complete activity by its latest scheduled completion date, Contractor shall, within 5 working days, submit to Engineer written statement as to how and when work force will be reorganized to return to current Progress Schedule.

B. If, during schedule review meetings, it becomes apparent that milestone completion dates or times established in Section 01 11 00 or Contract completion dates will not be met, Contractor shall take some or all of the following actions:

1. Increase construction staffing in such quantities and crafts as shall eliminate backlog of Work.
2. Increase number of working hours per shift, shifts per day, Work days per week, amount of construction equipment or combination of foregoing sufficient to substantially eliminate backlog of Work.
3. Reschedule Work actives to achieve concurrency of accomplishment.

C. Under no circumstances will addition of equipment or construction forces, increasing working hours or other method, manner or procedure to return to current Progress Schedule be considered justification for Contract modification or treated as acceleration.

D. Contractor shall accept risk for delays caused by rate of progress of Work to be performed under other Contracts. If Contractor is delayed in prosecution and completion of work because of such conditions, Contractor shall have no claim for damages to Contract adjustment other than extension of time and waiving of liquidated damages during period of time occasioned by delay.

END OF SECTION

SECTION 01 32 33
CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide digital-format photographs taken at the specified stages during construction, and in accordance with provisions of this Section.

B. Provide color video of existing facilities taken before commencement of construction.

1.02 SUBMITTALS

A. Submit digital photographs on electronic media acceptable to the Engineer. Digital photographs shall be common retrievable format as specified by Engineer during Preconstruction Conference. Submit with each application for payment.

B. In addition to submission requirements described above, post digital photographs and color video to Document Management Web Site. Organize files in similar manner to Contract Drawings (sitework, and by structure).

PART 2 - PRODUCTS

2.01 PHOTOGRAPHS

A. Provide electronic color prints:

1. Electronic files shall be in JPG, TIFF, or other commonly used format. Files shall be named to adequately describe the photo without the need to open the file.
2. Project name.
3. Engineer’s project number.
4. Orientation of view.
5. Date and time of photograph.
6. Photograph number.
7. Contractor’s name and address.

B. Submit approved electronic storage with the appropriate information shown under paragraph above.

PART 3 - EXECUTION

3.01 PHOTOGRAPHIC REQUIREMENTS

A. Take photographs at each major stage of construction.

1. Before commencement of construction.
2. At intervals sufficient to record construction progress but no less than at monthly intervals during construction of facilities. Photographs need show only new Work for that month.

B. Make each photograph clear, in focus, with high resolution and sharpness, and with minimum distortion.

3.02 VIEWS

A. Make photographs from three separate locations around Work and for each major structure.

B. Select locations to provide diversified overall views of Work, from positions that are expected to remain accessible throughout progress of Work. Locations shall adequately illustrate condition of construction and state of Project.

C. When directed by Engineer, because of stage of construction, change one or more locations to new locations inside or outside structure.

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Requirements for Work-related (non-administrative) submittals including Substitutes and "Or-Equal" items, Shop Drawings, product data, Samples, test results, and other miscellaneous Work-related submittals.

1. Submittals for certification of installation, instructional, and post-startup services are specified in Section 01 61 00.
2. Submittals for operation and maintenance data are specified in Section 01 78 23.
3. Submittals for record drawings are specified in Section 01 78 39.

B. Administrative Submittals: Procedures concerning items such as listing of manufacturers, Suppliers, Subcontractors, Progress Schedule, bonds, payment applications, insurance certificates, Schedule of Values, and photographs are specified elsewhere.

C. Work–Related Submittals:

1. Substitute and "Or-Equal" Items:

a. Includes material or equipment described in Section 01 61 00 which Contractor requests Engineer to accept, after Effective Date of the Agreement.

2. Shop Drawings:

a. Includes technical data and drawings specifically prepared for this Project, including fabrication and installation drawings, diagrams, data sheets, schedules, templates, patterns, reports, instructions, design mix formulas, measurements, and similar information not in standard printed form.

3. Product Data:

a. Includes standard catalog type printed information on manufactured materials, equipment and systems that has not been specifically prepared for this Project, including manufactures' product specifications, catalog cut sheets, standard wiring diagrams, printed performance curves, mill reports, and standard color charts.

4. Samples:

a. Includes fabricated and manufactured physical examples of materials, products, and units of Work, including complete units, partial cuts of manufactured or fabricated Work, swatches showing color, texture, and pattern, and units of Work to be used for independent inspection and testing.
b. Mock-ups are special forms of Samples too large or otherwise inconvenient for handling in manner specified for transmittal of Sample submittals.

5. Test Results:

a. Includes source and field quality inspection and test reports, actual performance curves, and certifications of results prepared specifically for equipment, material, and systems provided for this Project.

6. Miscellaneous Submittals:

    a. Work-related submittals that do not fit in previous categories, including schedules, guarantees, warranties, certifications, maintenance agreements, workmanship bonds, survey data and reports, physical work records, copies of industry standards, field measurements, extra materials, keys, and similar information, devices, and materials applicable to Work.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 DOCUMENT MANAGEMENT WEB SITE – ELECTRONIC DOCUMENT SUBMISSION

A. General

1. Document Management Web Site Supplier:

    a. eCommunication
    b. Or Approved Equal.

2. Software tool specifically designed for construction related document management.
3. Primary means of submittal shall be electronic.
4. Provide web based document storage, notification, and transfer.
5. Contractor to include costs to set up and to maintain site throughout the duration of the Project.

B. Minimum System Features.

1. Defined work flow directed submission, review, and approval process for various types of contract related documents. Work flow process shall be specific to type of document. Include specific work flow process for:

    a. Requests for substitutes.
    b. Shop drawings and product data.
    c. Test results.
    d. Operation and Maintenance data.
    e. Request for Proposals
    f. Request for Information
    g. Work Directive Changes
    h. Pay requests, both draft and final versions.
    i. Guarantees, Warranties, Maintenance Agreements, and Workmanship Bonds
    j. Survey Data
    k. Certifications
    l. Closeout Submittals.
    m. Miscellaneous Project related documents including

        1) Contract Documents - plans, specifications, and addenda.
        2) Project schedule.
        3) Schedule of Values,
        4) Permits,
        5) Project forms for document transmittal,
        6) Construction photographs and video,
        7) Inspection reports,

8) Project meeting minutes,
9) Contact information for each team member,

n. Add additional categories as required by Project specific needs at no additional cost to Owner.

2. Defined work flow roles, responsibilities, and capabilities for defined teams including:

a. Owner
b. Engineer
c. Contractor
d. Add additional teams as required by Project specific needs. Examples:

1) Sub Contractor

3. Activities listed below shall be available based on team membership and agreed to team based roles, and agreed to work flow process for a given category of activity:

a. View items
b. Submit new item.
c. Add files
d. Sign and annotate files
e. Process item
f. Send item back to previous step
g. Forward the item
h. Share the item

4. All submittals shall be posted in a searchable, bookmarked PDF format with the exception of Requests for Information (RFIs). RFIs shall be posted in Microsoft Word format. Maximum file size for submission shall be 50 MB. Submittals larger than 50 MB should be submitted as separate files within the same submittal.
5. Include tools to allow basic mark-up and annotation of files.
6. Provide email notification that submittal, RFI, or other item needs the attention of a team member.
7. Active item list of items requiring attention based on team member.
8. Ability of team members to add signature (PNG) or action stamp to files, based on assigned user rights.
9. Document library listing all closed documents posted on site, with ability of team members to view, print, or save items based on assigned user rights.
10. Ability to create and generate logs and reports.
11. Ability to view and download stored documents.

C. Provide System Set Up With Input From the Owner and Engineer.

1. Obtain and input email address of all project members intended to receive notification of submittal availability. Obtain and configure passwords to limit access to site. Include up to 20 persons for distribution and access.
2. Modify system configuration as required for project specific requirements throughout the duration of the Project.

D. Provide Training For All Team Members on Use of the System.

1. Initial training sessions shall consist of a minimum of two (2) one (1) hour sessions. Each session shall be repeated once to accommodate team member availability.
2. Coordinate training dates and times at least one week in advance of proposed training dates.

3. Have training manuals available at least one day prior to training session.
4. Training shall occur in a mutually agreed to location, or may be offered via web based interactive session.
5. Provide additional follow-up training as needed at no additional cost to Owner.

E. Security:

1. Cloud hosted in off-site Tier-1 environment.
2. Include daily back-ups and redundant disk arrays (RAID 6).
3. Enterprise level firewall, monitored for intrusion, spam and virus, and physical security.
4. Capability for encrypted data transmission.

F. Project Closeout, File Retention, and Document Delivery:

1. Within 4 weeks of final closeout of the Project, all project files present on the Document Management Web Site shall be archived for long term storage.
2. Archived files shall be linked within a menu driven file structure accessible using Adobe Acrobat. Files shall be archived using the same file names and within the same file structure used on the web site interface.
3. Archived files shall be delivered on thumb drive or DVD. Provide up to ten (10) copies, and deliver to Owner, Engineer, and Contractor.

3.02 SUBMITTAL PROCEDURES

A. Scheduling:

1. Provide preliminary and final schedule of submittals indicating time requirements for coordination of submittals with performance of Work.
2. Times scheduled shall indicate completion of submittal approval process for Substitute and “Or-Equal” items, Shop Drawings, product data, and Samples not later than 60 days prior to beginning systems demonstrations specified in Section 01 79 10. Completion of submittal process for above submittals will have been achieved when submittals have been returned to Contractor with submittal action of either “Approved” or “Approved As Noted”.
3. Adjust schedule of submittals periodically to reflect revisions to Progress Schedule.

B. Coordination:

1. Coordinate preparation and processing of submittals with performance of Work. Coordinate each submittal with other submittals and related activities such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities.
2. Coordinate submission of different units of interrelated Work so submittal will not be delayed by Engineer’s need to review related submittal. Engineer may withhold action on submittal requiring coordination with other submittals until related submittals are provided.
3. Prepare and transmit each submittal sufficiently in advance of scheduled performance of related Work and other applicable activities.

C. Submittal Preparation:

1. Stamp and sign each submittal certifying to review and approval of submittal, verification of material and equipment, field measurements, field construction criteria, and coordination of information with Contract Documents.
2. Submittals shall contain sufficient detail to confirm compliance with the requirements of the respective specification section. Submittals shall not contain excessive, non-pertinent information.

3. Submittals shall be complete for all material and equipment specified in each section. Partial submittals are not acceptable.
4. Transmittal Form: Use CONTRACTOR'S SUBMITTAL TRANSMITTAL form included in Appendix. Identify following:

    a. Date
    b. Transmittal and Submittal number
    c. Project
    d. Name and signature of Contractor:
    e. If submittal is for substitute, identify as "Substitute" on transmittal.
    f. Specification section and/or Drawing numbers.
    g. Description of submittal (i.e. equipment identification numbers, motor numbers, etc.)
    h. Variations from Contract Documents

5. The electronic submittal shall be in searchable, bookmarked PDF format.
6. Electronic submittal document shall be created with OCR (Optical Character Recognition) to allow for full alphanumeric recognition of printed characters

D. Resubmittal Preparation:

1. Comply with requirements for Submittal Preparation above, and in addition:

    a. Identify on transmittal form submittal is a resubmission.
    b. Make corrections or changes in submittal required by Engineer's notations on returned submittal.
    c. On transmittal or separate page, answer or acknowledge in writing notations or questions indicated on Engineer's transmittal form of returned submittal.

        1) Identify each response by question or notation number established by Engineer.
        2) If Contractor does not respond to each notation or question, resubmission will be returned without action by Engineer until Contractor provides written response.

    d. Contractor-initiated revisions or variations:

        1) On transmittal form, identify variations or revisions from previously reviewed submittal.

3.03 SPECIFIC SUBMITTAL REQUIREMENTS

A. General:

1. Comply with requirements specified below for each indicated type of submittal. Specific submittal requirements for individual units of work are specified in applicable Specification section.
2. If Engineer has responded to Request for Information submitted by Contractor, include Engineer's response with submittal.

B. Requests for Substitutes:

1. Collect data for items to be submitted for review as Substitute into one submittal for each item of material or equipment in accordance with paragraph 7.06 of the General and Supplementary Conditions.
2. Include completed CONTRACTOR'S REQUEST FOR SUBSTITUTION form as required by Supplementary Conditions. Use the form included in the Appendix.
3. Submit with other scheduled submittals for material and equipment allowing time for Engineer to evaluate additional information required to be submitted.

4. If Contractor requests to substitute for materials or equipment specified, but not identified in Specification as requiring submittal, Contractor shall indicate substitution in Submittal Schedule.

C. Shop Drawings:

1. Maximum size 22 in. by 34 in.
2. Submit graphic information at accurate scale with name of preparer indicated.
3. Show dimensions and note which are based on field measurements.
4. Indicate compliance with standards and notation of coordination requirements.
5. Highlight, encircle or otherwise indicate variation from Contract documents or previous submittals and revisions on resubmittals.
6. Do not use Engineer's Drawings as Shop Drawings.
7. Provide blank space for Contractor stamps.
8. Provide 4-in. by 8-in. blank space for Engineer stamps.

D. Product Data:

1. Collect required data into single submittal for each unit of Work or system. Where product data includes information on several similar materials or equipment, some of which are not require for use in Project, mark copies to show which items are not applicable to Project.

E. Samples:

1. Provide Samples physically identical with proposed materials and equipment to be incorporated into work. Where variations in color, pattern, and texture are inherent in product, submit multiple units (not less than 3) showing approximate limit of variations.
2. Provide full set of option Samples where selection by Owner or Engineer is required.
3. Include information with Sample to show generic description, source, product name, manufacturer, limitations, and compliance with standards.
4. Submit Samples with other related elements of work.
5. Submit two (2) sets of Samples where Specifications indicate Engineer's selection of color, pattern, texture or similar characteristics from manufacturer's range of standard choices is necessary. Neither set will be returned.
6. Maintain set of Samples at Project site, in suitable condition and available for quality control comparisons throughout course of Work.

F. Test Results:

1. Identify each test by Specification section and type of test.
2. Submittal is to confirm that results of tests verify materials, products, and systems comply with Contract Documents and are not for approval.

G. Miscellaneous:

1. Guarantees, Warranties, Maintenance Agreements, and Workmanship Bonds:

    a. Refer to Specification sections for requirements.
    b. Provide 2 executed copies. Provide 2 additional copies where required for operation and maintenance data.

2. Survey Data:

a. Refer to Specification sections for requirements of property surveys, building or structure condition surveys, field measurements, quantitative records of actual work, damage surveys, and similar data.

3. Certifications:

a. Refer to Specification sections for requirements.

4. Closeout Submittals;

a. Refer to Specification sections for requirements of spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar units to be submitted.

3.04 ACTION ON SUBMITTALS

A. General:

1. Except for submittals for record and similar purposes, where action and return is not required or requested, Engineer will review each submittal, mark the appropriate action, and return.
2. Where submittal must be held for coordination, Engineer will so advise Contractor without delay.
3. Engineer will stamp each submittal with uniform, self-explanatory action stamp, appropriately marked with submittal action.

B. Unsolicited Submittals:

1. Engineer will return unsolicited submittals without reviewing.

C. Action Stamp:

1. Marking: “Approved”

a. Work covered by submittal may proceed provided it complies with Contract Documents. Acceptance of Work depends on that compliance.
b. After approval, Contractor is to submit two bound copies of all “Approved” submittals to Engineer. Drawings shall be printed at not smaller than 11x17. Engineer, at his discretion, may request drawings printed in 22x34 format. Bound copies shall be stapled, comb bound, or spiral bound. Copies should be in color where required.

2. Marking: “Approved As Noted”

a. Work covered by submittal may proceed provided it complies with Engineer’s notations or corrections on submittal and with Contract Documents. Acceptance of work depends on that compliance. Resubmittal not required.
b. After approval, Contractor is to submit two bound copies of all “Approved As Noted” submittals to Engineer. Drawings shall be printed at not smaller than 11x17. Engineer, at his discretion, may request drawings printed in 22x34 format. Bound copies shall be stapled, comb bound, or spiral bound. Copies should be in color where required.

3. Marking: “Revise and Resubmit”

a. Do not proceed with Work covered by submittal.
b. Revise submittal or prepare new submittal in accordance with Engineer’s notations.

4. Marking: “Not Approved”

    a. Work covered by submittal does not comply with Contract Documents. Do not proceed with Work covered by submittal.
    b. Prepare new submittal complying with Contract Documents.

5. Marking: “No Action Required”

    a. Document has not been reviewed and is only filed for record purposes.

D. General Distribution:

1. Unless required elsewhere, provide distribution of submittals to Subcontractors, Suppliers, governing authorities, and others as necessary for performance of Work.
2. Provide copies of submittals bearing Engineer’s action stamp to:

    a. Job site file.
    b. Record documents file.

END OF SECTION

SECTION 01 35 16
ALTERATION PROJECT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cutting and patching.
2. Alterations to existing buildings or structures.
3. Removal of existing facilities.

B. Work Includes:

1. Cutting, moving or removal of items as shown on Drawings.
2. Cutting, moving or removal of items as necessary to provide access to allow alterations and new Work to proceed.
3. Cutting, moving or removal of items not shown to be cut, moved or removed, but which must be cut, moved or removed to allow new Work to proceed.
4. Patching or reinstalling Work or items which are to remain in finished Work.
5. Removal of existing surface finishes as needed to install new Work and finishes.
6. Removal of abandoned items.
7. Salvage of material and equipment as noted.

1.02 SUBMITTALS

A. Test Results:

1. Facility condition surveys.

B. Miscellaneous Submittals:

1. Alteration schedule and operational sequence.

C. Submit in accordance with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. Conform to requirements of regulatory agencies and utility companies.

1.04 PROTECTION AND CONTINUITY OF OPERATIONS AND UTILITIES

A. Perform Work with trades qualified to perform Work in manner causing least damage to each type of Work.

B. Protect existing finishes, equipment, and adjacent Work which is to remain, from damage.

C. Protect existing and new Work from weather and extremes of temperature.

D. Do not pile material to endanger building or structure.

E. Structural stability of structures adjacent to or affected by Work shall be Contractor's responsibility. Provide shoring, needling, and bracing to keep buildings or structures structurally secure and free of damaging deflection or settlement.

F. Do not close or obstruct streets, walks, or other facilities occupied and used by Owner and public without prior written permission from Owner and others having jurisdiction.

G. Notify utilities prior to razing operations to permit them to disconnect, remove, or relocate equipment serving existing facilities.

H. Protect existing utilities so they will continue to function during and after construction. Where interference with facilities occurs, cooperate with owner of utility and, if necessary, alter utility or facility to eliminate interference.

I. Service Continuity:

1. Perform Work so as not to interfere with Owner's operations.
2. Provide and maintain continuous electrical, plumbing, and HVAC services to functioning portions of facilities during hours normally in use.
3. Temporary outages are permitted during cutover work at such times and places as can be pre-arranged with Engineer and Owner. Keep such outages to minimum number and length. Make no outages without prior approval.
4. Remove temporary equipment and materials when no longer required.

J. Plant Operation:

1. Maintain continuity of plant operation to functioning portions of existing plant.
2. Temporary shutoff is permitted during cutover Work at such times and places as can be pre-arranged with Engineer and Owner. Keep such shutoffs to minimum number and length. Once Work has started on temporary shutoff, continue until Work is complete. Make no shutoffs without prior approval.
3. Remove temporary equipment and materials when no longer required.

1.05 TEMPORARY ELECTRICAL AND MECHANICAL SERVICES

A. Comply with Section 01 52 00.

B. Electrical:

1. Maintain existing electrical service to existing equipment until removed from service.
2. Provide temporary electrical connections to new equipment if permanent wiring is not complete and equipment is required to be placed into service to continue operation of facility.
3. Provide temporary electrical connections to temporary equipment or existing equipment that has been relocated, but is required to continue operation of facility.

C. Mechanical:

1. Maintain existing interior work area above 60°F.
2. Provide weather protection, waterproofing, heat, and humidity control to prevent damage to remaining existing and new Work.

PART 2 – PRODUCTS

2.01 SALVAGED MATERIALS

A. Whenever used in the Documents, the term "salvage" shall indicate material or equipment to be retained by the Owner or to be reused in the Work.

B. Salvage sufficient quantities of cut or removed material to replace damaged Work of existing construction or patch new Work when material not readily obtainable on current market.

C. Salvage material and equipment to be retained by Owner or to be reused in Work:

1. Items noted on Drawings.

D. Salvaged materials and equipment shall be relocated on-site where indicated by Engineer.

E. Prior to commencement of removal activities associated with the salvaging of equipment for either reuse by Owner, or reuse in Work, an inspection shall be completed by the Contractor, with the Owner and Engineer present. The inspection shall identify condition of components to be salvaged and itemize known or observed deficiencies. During the inspection, each component shall be photographically logged. A Salvaged Equipment Condition Report shall be submitted for approval by Owner and Engineer identifying condition of each component as "Good" or "Damaged". Components identified as Damaged shall contain a description of extent of damage. Photo log shall be submitted electronically with file names matching equipment tag.

F. Items to be salvaged for either reuse by Owner, or reuse in Work shall be removed with care to protect the existing condition of the component and ensure component can be reused in a different service. To the greatest extent possible, individual salvaged items shall be removed in one piece. Large items that have bolted connections may be disassembled to facilitate removal, but must be reassembled to same condition at location of storage. If disassembled location contained a gasketing material, a new gasket shall be provided and installed, reuse of the existing gasket will not be permitted unless specifically approved by Engineer.

2.02 PRODUCTS FOR PATCHING, EXTENDING, AND MATCHING

A. Provide same products, salvaged materials, types of construction or finish as that in existing structure, as needed to patch, extend or match existing Work.

PART 3 – EXECUTION

3.01 PREPARATION

A. Prior to alteration of facilities, accomplish following:

1. Owner release of facility.
2. Electrical, HVAC, process, and plumbing services rerouted or shut off outside area of Work.
3. Salvage items scheduled for reuse in new Work or scheduled to be delivered to Owner.
4. Survey and record condition of existing facilities to remain in-place that may be affected by Work. After Work complete, survey conditions again and restore facilities to original condition at no additional cost to Owner. Conduct surveys in presence of Engineer.

B. Where new Work is to be installed or suspended concealing existing surfaces or spaces, Contractor shall remove foreign substances such as grease, sludge, and odoriferous material before starting Work.

C. Where surfaces are to remain exposed, Contractor shall remove foreign substances such as grease, sludge, and odoriferous material.

D. Coordinate alteration Work so new construction installed before, during, and after Work may commence without undue delay.

3.02 CUTTING AND PATCHING

A. Cut finish surfaces such as masonry, tile, plaster or metals, by methods to terminate surfaces in smooth, straight line at natural point of division. Make cuts parallel with walls and/or floors.

B. Make joints and finishes match adjacent or similar work.

C. Do not cut or notch structural members without specific written approval of Engineer.

3.03 REMOVAL OPERATIONS

A. Remove concrete, steel and masonry to extent indicated on Drawings.

B. Remove equipment and appurtenances to extent indicated on Drawings.

C. Remove utilities and piping to elevations and locations shown on Drawings and plug and seal permanently with steel cap, concrete plug, or other approved method in accordance with specified abandonment procedures.

D. Remove abandoned utilities and underground piping within influence zone of proposed structures or piping.

E. Where existing materials and equipment are removed or relocated, remove materials no longer used such as studs, straps, conduits, ducts, junction boxes, pull boxes, wires, anchors, and supports. Remove or cut off concealed or embedded materials and equipment to at least 1 in. below final finished surface. Patch floors and walls to match existing.

F. Repair affected surfaces to conform to type, quality, and finish of adjacent surfaces.

G. Dispose of removed items as specified herein.

3.04 RESTORATION

A. Where existing partitions are removed, patch floors, walls, and ceilings with finish materials matching existing to provide smooth planes without breaks, steps, or bulkheads. Trim and refinish doors as necessary to clear new floors or flooring material.

1. Where change of plane of 2 in. or more occurs, notify Engineer and request direction.

B. Patch and replace portions of existing finished surface damaged by Contractor's operations.

1. Provide adequate support of substrate prior to patching finish.
2. Refinish patched portions of painted or coated surfaces to produce uniform color and texture over entire surface.
3. When existing surface finish cannot be matched, refinish entire surface to nearest intersection.

C. When new Work abuts or finishes flush with existing Work, transition shall match existing adjacent Work in texture and appearance so patch or transition is not visible at a distance of 6 feet.

D. When smooth transition is not possible, terminate existing surface along straight line at natural division, and provide appropriate trim.

E. Clean and repair damage caused by installation or by use of temporary facilities.

1. Remove foundations and underground installations used for construction aids.
2. Grade areas affected by temporary installations to required elevations and slopes.

F. Restore existing facilities used for temporary purposes to specified, or original, condition.

3.05 CLEANING

A. Perform periodic cleaning and final cleaning as specified in Section 01 74 00.

1. Clean Owner occupied areas daily.
2. Clean spillage, overspray, and heavy collection of dust in Owner occupied areas immediately.

B. At completion of alteration and demolition Work in each area, provide final cleaning and return space to condition suitable for use by Owner.

3.06 DISPOSAL

A. Remove debris from site each day.

B. Equipment and materials not scheduled to be salvaged or reused in new Work shall become property of Contractor to be disposed of in accordance with applicable laws.

C. Debris and other undesirable and unsalvageable material resulting from alteration and demolition operations shall be legally disposed offsite.

END OF SECTION

SECTION 01 41 00
REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 PERMITS

A. Contractor shall obtain the following permits:

1. Permits required for construction of the Work which are not listed as being provided by Owner.
2. Contractor shall be responsible for application fees, bond costs, coordination with permitting agencies and review or inspection fees charged by permitting agencies when Contractor obtains permit.
3. Annual or licensing fees which may be charged by permitting agencies for placement of facilities shall be paid for by the Owner.

1.02 NOTICES

A. Provide notices in accordance with applicable construction permits to following agencies or individuals and to others as required elsewhere in Contract Documents.

1. ENGINEER:

a. Notice: 10 working days prior to start of construction.
b. Notice: 5 days prior to start of additional crews.

2. Fire, Police, and Sheriff's Department:

a. Notice: 24 hr minimum, or as required by local agencies, prior to closing streets or performing operations affecting vehicular traffic.

3. Utilities: for work which requires excavation.

a. Notice: 72 hr minimum.

4. Others as required in Contract Documents.

1.03 REGULATIONS

A. Comply with local, state, and federal laws, rules, ordinances, and regulations. Give Engineer notice of variations.

END OF SECTION

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Testing and inspecting to be provided by the Contractor.

B. Provide the services of a testing laboratory approved by Owner.

C. Provide all tests and inspections required by governmental agencies having jurisdiction, and required by provisions of the Contract Documents.

D. Perform additional tests as required by Engineer.

E. Perform additional inspections, sampling, and testing required when initial tests indicate Work does not comply with Contract Documents.

F. Specified inspections and/or tests may be waived only by the specific approval of Engineer, and such waivers will result in credit to the Owner equal to normal cost of such inspection and/or test.

1.02 PAYMENT

A. Include within the Contract Price an amount sufficient to cover all testing and inspecting required under this Section, and to cover all testing and inspecting required by governmental agencies.

B. The Owner will pay for additional testing and inspecting specifically requested by the Engineer when such tests indicate conformance with Contract Documents.

C. When additional tests requested by Engineer, or initial tests, indicate noncompliance with the Contract Documents, all inspection, sampling, and testing and subsequent retesting occasioned by the noncompliance shall be performed by the testing laboratory and the costs thereof shall be paid by the Contractor.

1.03 SUBMITTALS

A. Upon completion of each test and/or inspection, promptly submit written report of each test and inspection; one copy each to Engineer, Owner, material supplier, and Contractor, and one copy to record documents file. Each report shall include following:

1. Date issued.
2. Project title and number.
3. Testing laboratory name, address, and telephone number.
4. Name and signature of laboratory inspector.
5. Date and time of sampling or inspection.
6. Temperature and weather conditions if test performed in field.
7. Date of test.
8. Identification of product and Specification section.
9. Location of sample or test in Project.
10. Type of inspection or test.
11. Results of tests and compliance with Contract Documents.
12. Interpretation of test results, when requested by Engineer.

1.04 QUALIFICATIONS OF LABORATORY

A. Meet requirements of ASTM E329.

B. Authorized to operate in state where Project located.

C. Testing equipment calibrated at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards or other accepted values of natural physical constants.

PART 2 – PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 TAKING SPECIMENS AND TESTING

A. Except as may be specifically otherwise approved by Engineer, testing laboratory shall secure and handle all samples and specimens for testing and conduct testing.

B. Comply with specified standards.

3.02 COOPERATION WITH TESTING LABORATORY

A. Provide access to the Work at all times and at all locations where the Work is in progress. Provide facilities for such access to enable the laboratory to perform its functions properly.

B. Notify laboratory sufficiently in advance of operations to allow laboratory assignment of personnel and scheduling of tests.

1. When tests or inspections cannot be performed due to lack of such notice, reimburse Owner for laboratory personnel, travel expenses, and cost of test normally incurred.

END OF SECTION

SECTION 01 52 00
CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Temporary construction facilities required for the Work, including, but not limited to:

1. Utilities including lighting, and electricity, and water.
2. Sanitary facilities.
3. Fire protection.
4. Roads.
5. Security fencing.
6. Enclosures.
7. Parking.
8. Field office for Contractor's personnel.

B. Maintain temporary facilities in proper and safe condition throughout progress of Work.

C. Comply with federal, state, and local codes and regulations, and utility company requirements.

1.02 LAYOUT OF TEMPORARY FACILITIES

A. Before starting Work, submit to Engineer, for approval, proposed layout of temporary facilities.

B. Should Contractor require space in addition to that shown on Drawings, Contractor shall make arrangements for storage of materials and equipment in locations off Site.

PART 2 - PRODUCTS

2.01 TEMPORARY LIGHTING AND ELECTRICITY

A. General:

1. Temporary lighting shall be sufficient to enable Contractor and Subcontractors to complete Work and enable Engineer to observe Work. Illumination shall meet or exceed state code requirements.

B. Temporary electric power may be obtained from Owner's electrical system as follows:

1. Make arrangements with Owner for temporary electricity.
2. No charge will be made for electricity obtained from Owner's electrical system and used for construction.
3. Provide electrical protection to prevent disruption of plant power from over-current, ground faults, and short circuits.
4. If Contractor requires more than Owner's supply available, Contractor shall obtain an additional source of electric power and pay all costs for power from additional source.

C. Contractor's responsibilities:

1. Provide, maintain, and remove temporary electric service facilities.
2. Provide temporary electric systems and components in conformance with requirements of National Electric Code and local authorities.
3. Facilities exposed to weather shall be weatherproof type.

4. Enclosures shall be locked to prevent unauthorized access.
5. Provide lamps, wiring, switches, sockets, and similar equipment required for temporary lighting and power tools.

2.02 WATER FOR CONSTRUCTION

A. Owner will provide place for temporary connection to non-potable water source at Site.

1. Provide temporary piping and pumping facilities required to bring water to point of use.
2. Owner will provide water at no cost to Contractor.

2.03 WATER FOR TESTING

A. Unless specifically stated otherwise in Specifications, Contractor shall provide water necessary for testing. Comply with requirements specified under WATER FOR CONSTRUCTION in this Section.

2.04 SANITARY FACILITIES

A. Do not use existing sanitary facilities.

B. Provide temporary sanitary facilities conforming to state and local regulations, in sufficient numbers for use of Contractor's and Subcontractor's employees.

C. Maintain in sanitary condition and properly supply with toilet paper.

2.05 TEMPORARY FIRE PROTECTION

A. Provide and maintain minimum of one fire extinguisher on each floor of each building, and other fire protection equipment and devices as would be reasonably effective in extinguishing fires during early stages by personnel at Site.

2.06 TEMPORARY SITE AND OTHER ROADS

A. Construct and maintain temporary roadways in snow free, ice free, driveable condition.

B. Maintain existing roads used during construction free from accumulation of dirt, mud and construction debris. Roads shall be considered "maintained" when material has been removed by a sweeper. Multiple sweeper passes may be required to clean the existing surfaces sufficiently in Engineers opinion. Aggregate surfaced roads and drives will be considered "maintained" when dirt and soil contaminants in excess of 1" diameter have been removed and the total volume of contaminants remaining is estimated to be less than ¼ cubic foot. Contractor shall control dust from operations in all circumstances. Comply with dust control provisions in Section 01 57 19.

C. Temporary granular paving used prior to final paving shall be maintained in smooth condition. Ruts, holes, washboarding, or other surface deformities shall be corrected immediately by filling or scraping. All maintenance work to maintain traffic on existing roads shall be finished with a vibratory roller to recompact the surface.

D. Contractor shall repair or replace existing roads to original or better condition prior to Final Completion. Survey and record condition of existing roads prior to construction.

2.07 CONTRACTOR'S STAGING AND WORK AREA

A. Construct and maintain staging area if required. Coordinate a location with the Owner.

B. Restore areas used for staging to pre-construction conditions.

C. Work Area:

1. Limit construction operations and storage of equipment and materials to areas shown on Drawings and as determined by Owner.
2. Except as provided herein, no sidewalk, private property, or other area adjacent to Site shall be used for storage of Contractor's equipment and materials unless prior written approval is obtained from legal owner of the respective locations.
3. Contractor shall maintain staging areas during construction in a manner that will not obstruct operations on any street areas. Work shall proceed in an orderly manner, maintaining construction site and staging area free of debris and unnecessary equipment or materials.

2.08 SECURITY

A. Security will not be provided by Owner.

B. Contractor shall be responsible for loss or injury to persons or property where Work is involved, and shall provide security and take precautionary measures to protect Contractor's and Owner's interests.

C. Provide and maintain temporary fencing of design and type needed to prevent entry onto Site by public.

2.09 ENCLOSURES

A. Provide and maintain all enclosures, scaffolds, tarpaulins, canopies, warning signs, steps, platforms, bridges, and other temporary construction necessary for proper completion of Work.

2.10 PARKING

A. Staging area and designated areas within construction limits may be used for parking of construction personnel's private vehicles and Contractor's lightweight vehicles.

B. Do not allow heavy vehicles or construction equipment in parking areas.

C. Make arrangements for additional parking off site as required.

2.11 CONTRACTOR'S FIELD OFFICES AND BUILDINGS

A. If required by Contractor, erect where designated by Engineer, and maintain temporary field office for Contractor's use.

B. Buildings shall be neat and well constructed, surfaced with plywood, siding, masonite, or other similar material, well painted and void of advertisements.

PART 3 – EXECUTION

3.01 GENERAL

A. Maintain and operate systems to ensure continuous service for duration of construction.

B. Modify and extend systems, as Work progress requires.

C. Material and Equipment provided as part of the project shall not be used for any temporary services.

3.02 REMOVAL

A. Completely remove temporary materials, equipment, signs, and structures when no longer required.

B. In unfinished areas, clean and repair damaged caused by temporary installations or use of temporary facilities, restore drainage, and evenly grade, seed or plant as necessary to provide appearance equal to or better than original.

C. In finished areas, restore existing or permanent facilities used for temporary services to specified, or original condition.

3.03 DAMAGE TO EXISTING PROPERTY

A. Contractor is responsible for replacing or repairing damage to existing buildings, structures, sidewalks, roads, parking areas, and other existing assets.

B. Contractor shall have option of having Owner contract for such Work and have cost deducted from Contract Price.

3.04 OWNER'S USE

A. Upon acceptance of Work, or portion of work defined and certified as Substantially Complete by Engineer, and Owner commences full-time successful operation of facility or portion thereof, Owner will pay cost for utilities used for Owner's operation. Contractor shall continue to pay for utilities used until final acceptance of Work, except as provided herein. However, heat for building as required for construction purposes shall still be paid by Contractor unless, due to occupancy by Owner, more heat shall be required due to increased temperature or lengthened duration, in which case Owner will bear difference in cost.

END OF SECTION

SECTION 01 57 19
TEMPORARY ENVIRONMENT CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. General requirements pertaining to abatement and control of environmental pollution arising from activities of Contractor and Subcontractors in performance of the Work of the Contract.

B. Contractor, in executing Work, shall maintain work areas free from environmental pollution that would be in violation of federal, state or local regulations.

PART 2 – PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. The land resources within boundaries of the Project, but outside the limits of permanent Work performed under this Contract shall be preserved in their present condition or be restored to a condition after completion of construction that will appear to be natural and not detract from the appearance of the Project.

B. Insofar as possible, confine activities to pertinent areas defined on the Drawings or elsewhere in the Contract Documents.

1. Return construction areas to their preconstruction elevations except where surface elevations are otherwise noted to be changed.
2. Maintain natural drainage patterns.
3. Conduct construction activities in such a manner that ponding of stagnant water conducive to mosquito breeding habitat will not occur at any time.

C. Land resources:

1. Do not remove, cut, deface, injure, or destroy trees or other vegetation outside the Work area limits.
2. Do not remove, cut, deface, injure, or destroy trees or other vegetation inside the Work area limits, designated to be preserved, except as permitted by Engineer.
3. Land resources damaged by Contractor shall be promptly replaced or repaired to the approval of Engineer at Contractor’s expense.

3.02 ARCHAEOLOGICAL FINDS DURING CONSTRUCTION

A. There are no known archaeological remains at the Project site.

B. Should skeletons, artifacts, or other archaeological remains be uncovered:

1. Suspend operations of this Contract at the site of discovery.
2. Continue operations in other areas.
3. Notify Engineer immediately of the finding.

C. Should the discovery site require archaeological studies resulting in delays and/or additional work, Contractor will be compensated by an adjustment under pertinent provisions of the Contract.

3.03 PROTECTION OF STORM SEWERS

A. Prevent construction materials, concrete, earth or other debris from entering existing storm sewers or sewer construction.

3.04 PROTECTION OF WATERWAYS

A. Observe rules and regulations of Lake County, the State of Illinois, and agencies of U.S. government prohibiting pollution of lakes, streams, rivers or wetlands by dumping of refuse, rubbish, dredge material or debris.

B. Comply with the Illinois Urban Manual (IUM), current edition, and Lake County Stormwater Management Commission Standards.

3.05 STORMWATER DISCHARGE

A. Contractor shall comply with the Lake County Watershed Development Permit and approved Erosion Control plan included in the Contract Documents.

1. Engineer will inspect construction site and Contractor shall make corrections or repairs required.
2. Contractor shall keep permit and plan on site during construction.

3.06 DISPOSAL OF EXCESS EXCAVATED AND OTHER WASTE MATERIALS

A. Excess excavated material not required or suitable for backfill and other waste material shall be disposed of in accordance with federal, state, and local regulations.

B. In accordance with the Illinois Environmental Protection Act, 415 ILCS 5/22.51, Contractor shall obtain all certifications required by federal, state, and local regulation and by owner/operator of off-site disposal sites certifying that the excess excavated and other waste materials are uncontaminated. Certifications shall be made by a licensed professional engineer in accordance with federal, state, and local regulations. Contractor shall conduct tests and analyses in order to certify that excess excavated material and other waste materials are uncontaminated.

C. Provide watertight conveyance of liquid, semi-liquid or saturated materials which tend to bleed during transport. Liquid loss from transported materials is not permitted, whether being delivered to construction site or hauled away for disposal.

3.07 PROTECTION OF AIR QUALITY

A. Minimize air pollution by requiring use of properly operating combustion emission control devices on construction vehicles and equipment and encourage shutdown of motorized equipment not in use

B. Do not burn trash on Site.

C. If temporary heating devices are necessary for protection of Work, they shall not cause air pollution.

3.08 THAWING OF FROZEN GROUND

A. Obtain permit from appropriate authority before building fire to thaw frozen ground, and comply with conditions of permit.

B. Use fuel which does not create air pollution or inconvenience public

C. Engineer reserves right to prohibit fires for thawing frozen ground whenever deemed undesirable.

3.09 USE OF CHEMICALS

A. Chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall be approved by U.S. EPA or U.S. Department of Agriculture or any other applicable regulatory agency.

B. Use and disposal of chemicals and residues shall comply with manufacture's instructions.

3.10 NOISE CONTROL

A. Conduct operations to cause least annoyance to residents in vicinity of Work, and comply with applicable local ordinances.

B. Equip construction equipment and other apparatus with mechanical devices necessary to minimize noise.

C. Equip compressors with silencers on intake lines.

D. Equip gasoline or oil-powered equipment with silencers or mufflers on exhaust lines.

E. Line storage bins and hoppers with material that will deaden sounds.

F. Route vehicles carrying rock, concrete, or other material over such streets as will cause least annoyance to public and do not operate on public streets between hours of 6:00pm and 7:00am, nor on Saturdays, Sundays or legal holidays, unless approved by Owner.

3.11 DUST CONTROL

A. Take special care in providing and maintaining temporary roads, Owner's existing roads, and public roads used during construction operations in clean, dust free condition.

B. Comply with local regulations for dust control. If Contractor's dust control measures are considered inadequate by Engineer, Engineer may require Contractor to take additional dust control measures.

3.12 FUELS AND LUBRICANTS

A. Comply with local, state, and federal regulations concerning transportation and storage of fuels and lubricants.

B. Fuel storage area location shall be approved by Owner prior to installation.

C. Report spills or leaks from fueling equipment or construction equipment to Owner and cleanup as required.

D. Owner may require Contractor to remove damaged or leaking equipment from Site.

END OF SECTION

SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SUBSTITUTE AND “OR EQUAL” ITEMS

A. When equipment or material is specified by naming one or more manufacturers or suppliers followed by words “No Substitute is Permitted”, Contractor shall provide one of the named manufacturers or suppliers.

B. ”Or Equal” Items: For material or equipment specified by naming one or more suppliers or manufacturers followed by the words “Or Equal”, Contractor shall make submittal in accordance with Section 01 33 00. Engineer will review submittal in accordance with Supplementary Conditions.

C. Substitute Items:

1. For material or equipment specified by naming one or more suppliers or manufactures and not followed by the words “Or equal” or “No Substitute is Permitted”, Contractor shall submit “Request for Substitution” for material or equipment not specifically named.
2. Requests for Substitution will be considered by Engineer, subject to Contractor’s representations and review provisions of Contract Documents, when one or more of the following conditions are satisfied.

    a. Where required equipment or material cannot be provided within Contract Time, but not as result of Contractor’s failure to pursue Work promptly or coordinate various activities properly.
    b. Where packaging of several items of equipment from single source will provide maintenance and coordination advantages to Owner.
    c. When Contractor proposes to provide Owner with cost savings.

3. If Engineer approves Contractor’s Request for Substitution, Contractor shall make submittal in accordance with Section 01 33 00.

D. Conditions Which Are Not Substitutions:

1. Contractor options provided for in Specifications.
2. Revisions to Contract requested by Owner or Engineer.
3. Contractor’s determination of and compliance with governing regulations, except as provided for in Contract Documents.

1.02 REUSE OF EXISTING MATERIAL

A. Except as specifically indicated or specified, do not use removed materials and equipment in new Work. All material and equipment incorporated into the Work shall be new, and as specified, except as otherwise provided in the Contract Documents.

B. For material and equipment specifically indicated or specified to be reused in new Work:

1. Use special care in removal, handling, storage, and reinstallation to ensure proper function in completed Work.
2. Provide for transportation, storage, and handling of products which require off-site storage, restoration, or renovation.

1.03 MANUFACTURER'S INSTRUCTIONS

A. Installation of equipment and materials shall comply with manufacturer's written instructions. Maintain one set of complete instructions at job site. Distribute printed copies of instructions to parties involved in installation, including 1 copy to Engineer. Provide 1 electronic copy as a searchable, bookmarked PDF document to the Engineer.

B. Handle, store, install, connect, clean, condition, and adjust materials and equipment in accordance with manufacturer's written instructions and in conformance with Specifications.

C. If job conditions or specified requirements conflict with manufacturer's written instructions, consult Engineer for further direction. Do not proceed with Work without written instruction of Engineer.

1.04 TRANSPORTATION AND HANDLING

A. Arrange deliveries of material and equipment in accordance with Construction Progress Schedule.

B. Deliver materials and equipment in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

C. Protect bright-machined surfaces, such as shafts and valve faces, with heavy coat of grease prior to shipment.

D. Immediately upon delivery, inspect shipments to ensure compliance with Contract Documents and approved submittals, and products have been protected and are undamaged.

E. Provide equipment and personnel to handle materials and equipment by methods recommended by manufacturer to prevent soiling or damage to materials or equipment, or packaging.

1.05 STORAGE, PROTECTION, AND MAINTENANCE

A. Store, protect, and maintain material and equipment in accordance with manufacturer's written instructions.

B. Temporary storage areas and buildings shall conform to Section 01 52 00.

C. Owner assumes no responsibility for damage or loss due to storage of materials and equipment.

D. Interior Storage:

1. Store with seals and labels intact and legible.
2. Store materials and equipment subject to damage by elements in weather tight enclosures.
3. Maintain temperature and humidity within ranges required by manufacturer.

E. Exterior Storage:

1. Store fabricated materials and equipment above ground, on blocking or skids, to prevent soiling or staining. Cover materials and equipment subject to deterioration with impervious sheet coverings. Provide ventilation to avoid condensation.

2. Store loose granular materials in well-drained area on solid surfaces to prevent mixing with foreign matter.
3. Store materials such as pipe, reinforcing steel, structural steel, and equipment on pallets or racks, off ground.

F. Inspection and Maintenance:

1. Arrange storage to provide easy access for inspection, maintenance, and inventory.
2. Make periodic inspections of stored materials and equipment to ensure materials and equipment maintained under specified conditions are free from damage or deterioration, and coverings are in place and in condition to provide required protection.
3. Perform maintenance on stored material and equipment in accordance with manufacturer's written instructions and in presence of Owner and Engineer.

a. Notify Engineer 24 hrs before performing maintenance.
b. Submit report of completed maintenance to Engineer with each Application for Payment.
c. Failure to perform maintenance, to notify Engineer, or to submit report may result in rejection of material or equipment.

G. Assume responsibility for protection of completed construction and repair and restore damage to completed Work.

H. Wheeling of loads over finished floors, with or without plank protection, not permitted in anything except rubber tired wheelbarrows, buggies, trucks or dollies. This applies to finished floors and exposed concrete floors, as well as those covered with other applied surfacing.

I. Where structural concrete is also finished surface, avoid marking or damaging surface.

1.06 SPECIAL TOOLS AND LUBRICATING EQUIPMENT

A. Furnish, in accordance with manufacturer's recommendations, special tools and lubricating equipment required for checking, testing, parts replacement, and maintenance.

B. Instruct Owner's operating personnel in operation, repair, and maintenance of equipment and use of special tools.

1.07 LUBRICATION

A. Where lubrication is required for proper operation of equipment, incorporate necessary and proper provisions in equipment in accordance with manufacturer's requirements. Where possible, lubrication shall be automated and positive.

B. Where oil is used, reservoir shall be of sufficient capacity to supply unit for 24-hr period.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Conform to applicable Specifications and standards. Comply with size, make, type, and quality specified or as approved on submittals.

B. Design, fabricate, and assemble in accordance with engineering and shop practices standard with industry.

C. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable. Two or more items of same kind shall be identical, by same manufacturer.

D. Material and equipment shall be suitable for service conditions. Design so working parts are readily accessible for inspection and repair, and easily duplicated and replaced.

E. Equipment capabilities, sizes, and dimensions shown or specified shall be adhered to, unless specifically approved.

F. Equipment shall be adapted to best economy in power consumption and maintenance. Parts and components shall be portioned for stresses occurring during continuous or intermittent operation, and for additional stresses occurring during fabrication or installation.

G. Do not use material or equipment for purpose other than for which it is designed or specified. Equipment shall not be used for any purpose, or any reason until manufacturer has completed installation services.

PART 3 – EXECUTION

3.01 GENERAL

A. Include and pay for Supplier's services, including, but not limited to, those specified.

B. Workday is defined as an 8-hr period during a calendar day. Workday for purposes of this section does not include travel to and from the Project Site.

3.02 INSTALLATION SERVICES

A. Where installation services are called for in Specifications, provide competent and experienced technical representatives of manufacturers' equipment and systems to resolve assembly or installation procedures attributable to, or associated with, equipment furnished.

B. After equipment installation, manufacturer's representative shall inspect equipment for proper installation in accordance with manufacturer's instructions, equipment has been serviced with the proper lubricants, applicable safety equipment has been properly installed, and that proper electrical and mechanical connections have been made.

C. Manufacturer's representative shall assist Contractor in performing functional testing.

D. Perform functional testing to determine if equipment has been installed correctly and operates as intended. Functional testing shall include, but not be limited to, checking for proper rotation, alignment, speed, excessive vibration, and noisy operation. Equipment adjustment and calibration shall be performed to conform with Specifications, manufacturer's requirements and instructions, and industry standards.

E. Provide "Certificate of Installation Services" stating that equipment has been properly installed, that functional testing has been performed, that proper adjustment and calibration has been made, and that equipment is ready for Startup and Systems Demonstration. Use form in Appendix and furnish two copies to Engineer.

3.03 INSTRUCTIONAL SERVICES

A. Provide in accordance with Section 01 79 30 – Instructional Services.

3.04 SYSTEMS DEMONSTRATIONS SERVICES

A. Provide manufacturer's and Supplier's services as required to successfully complete the Work specified in SECTION 01 79 10 – SYSTEMS DEMONSTRATIONS.

3.05 POST STARTUP SERVICES

A. After equipment or system has been in operation for at least 2 months, but not longer than 3 months, each equipment manufacturer or authorized equipment representative shall make a final inspection where so required by Specifications. Final inspection will provide assistance to Owner's personnel in making adjustments or calibrations required to ensure equipment or system is operating in conformance with design, manufacturer, and specifications.

B. Provide "Certificate of Post Startup Services" cosigned by Owner and equipment representatives, verifying this service has been performed. Use form in Appendix and furnish 2 copies to Owner.

END OF SECTION

SECTION 01 74 00
CLEANING AND WASTE MANAGEMENT

PART 1 - GENERAL

1.01. SUMMARY

A. Perform cleaning throughout construction period and at completion of Work.

B. Refer to Specification sections for specific cleaning products or Work.

C. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 - PRODUCTS

2.01. CLEANING MATERIALS AND EQUIPMENT

A. Use only the cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material.

B. Use only those cleaning materials which will not create hazards to property and persons.

PART 3 - EXECUTION

3.01 DURING CONSTRUCTION

A. Provide on-site containers for collection and removal of waste materials, debris, and rubbish in accordance with applicable regulations.

B. As required preparatory to installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using equipment and materials required to achieve the necessary cleanliness.

C. Following the installation of finish floor materials, clean the finish floor daily (and more often if necessary) at all times while work is being performed in the space in which finish materials are installed.

3.02 FINAL CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing and mirrors.

C. Polish glossy surfaces to clear shine.

D. Ventilating Systems:

1. Clean permanent filters and replace disposable filters if units were operating during construction.
2. Clean ducts, blowers, and coils if units were operated without filters during construction.

E. Electrical Systems:

1. Leave electrical equipment rooms broom clean.
2. Clean interior of panel cabinets, pull boxes, and other equipment enclosures.
3. Clean lighting fixtures, lamps, and other electrical equipment soiled during installation.
4. Touch-up paint or repaint finishes on electrical items delivered to Project with finished coat of paint. Engineer will make final determination of items to be repainted or touched-up.

F. Broom clean interior hard surface floors and exterior paved surfaces. Rake clean other surfaces of grounds.

G. Clean roads and streets used as haul roads during construction of accumulated material. Clean paved streets with water.

H. Prior to Final Completion or Owner occupancy, Contractor, with Engineer and Owner, shall conduct inspection of exposed interior and exterior surfaces and work areas to verify Work and Site is clean.

3.03 CLEANING DURING OWNER'S OCCUPANCY

A. Should the Owner occupy the Work or any portion thereof prior to its completion by the Contractor and acceptance by the Owner, responsibilities for interim and final cleaning shall be as determined by Engineer.

3.04 CLEANING OF TANKS

A. Tanks shall be washed down and swept before water or chemicals are allowed to enter.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SUMMARY

A. To aid the continued instruction of Owner's operating and maintenance personnel, and to provide a positive source of information regarding products incorporated into the Work, furnish and deliver the Operation and Maintenance (O&M) data described in this Section and as specified in other sections of these Specifications.

B. Engineer's review and acceptance of O&M data will be only for conformance with requirements of this section, for form of submittal and organization of data and completeness of information provided, but not for technical content or coordination between individual suppliers. Engineer will be sole judge of completeness of data.

1.02 PAYMENTS

A. Progress payments for equipment delivered, stored or installed under these Contract Documents will not be made until copies of O&M data delivered to and approved by Engineer.

B. Progress payments for control systems packaged with equipment will not be made until O&M data incorporated into equipment and control system manual delivered to and approved by Engineer.

1.03 REVIEW SUBMITTALS

A. Submit electronic copy of complete O&M data to document management website for approval by Engineer within 30 days after Contractor receives approved Shop Drawings for equipment. The electronic formatted data shall contain all the information to be bound in O&M manuals. The information provided shall comply with the following requirements:

1. The O&M manual shall be in searchable, bookmarked PDF format.
2. Electronic O&M document shall be created with OCR (Optical Character Recognition) to allow for full alphanumeric recognition of printed characters
3. Submit in accordance with Section 01 33 00.

B. Electronic Media Label: Label each with "OPERATION AND MAINTENANCE INSTRUCTIONS" and following:

1. Project Title: Des Plaines River WRF Phase 1 Dewatering Project.
2. Name of equipment as set forth in Contract Documents.
3. Specification section number for equipment as set forth in Contract Documents.

C. Submit in accordance with Section 01 33 00.

1.04 FINAL SUBMITTAL

A. After approval of the review submittal, submit 2 paper copies and 2 copies on electronic media of complete O&M data.

B. Paper Copy Format:

1. Size: 8-1/2 in. by 11 in., or 11 in. by 17 in. folded, with standard 3-hole punching.
2. Paper: 20-lb minimum, white.
3. Text: Manufacturer's printed data or typewritten.

4. Drawings:

    a. Bind in text.
    b. Fold larger drawings and place in text page size envelope bound into binder. Place identification on outside of envelope.

5. Provide tabbed section dividers.

    a. Provide title of section on divider.
    b. Provide tab index in Table of Contents.

6. Cover: Label each submittal cover with “OPERATION AND MAINTENANCE INSTRUCTIONS” and following:

    a. Project Title: Des Plaines River WRF Phase 1 Dewatering Project.
    b. Names of applicable buildings or structures as shown on Drawings in which equipment is located.
    c. Name of equipment as set forth in Contract Documents.
    d. Specification section number for equipment as set forth in Contract Documents.

7. Binders:

    a. Bind each submittal into a D-ring commercial quality binder with durable and cleanable plastic covers.
    b. Filled to not more than 75% of capacity.
    c. When multiple binders used, contents shall be organized into related groupings and each binder cover shall bear identification of specific content.
    d. Label spine of binder with “OPERATION AND MAINTENANCE INSTRUCTIONS” and following:

        i. Project Title: Des Plaines River WRF Phase 1 Dewatering Project.
        ii. Name of equipment as set forth in Contract Documents.
        iii. Specification section number for equipment as set forth in Contract Documents.

8. Page number submittals.

C. Electronic media copy format shall be as defined above.

1.05 QUALITY ASSURANCE

A. In preparing data required by this section, use only personnel thoroughly trained and experienced in operation and maintenance of the described items, completely familiar with the requirements of this section, skilled in technical writing to the extent needed for communicating the essential data, and skilled in drafting to prepare required drawings.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Review O&M submittal and complete Form 1 to Section 01 78 23, CONTRACTOR SUBMITTAL FORM, in its entirety indicating requirements of this section have been met. Engineer will reject submittals without completed Form 1.

3.02 GENERAL CONTENT OF DATA

A. Each submittal shall contain equipment data pertaining to not more than one Specification section number indicated in Contract documents.

B. Title Sheet: First page inside cover listing following:

1. Title: OPERATION AND MAINTENACE INSTRUCTIONS.
2. Project Title: Des Plaines River WRF Phase 1 Dewatering Project.
3. Names of applicable buildings or structures as shown on Drawings in which equipment is located.
4. Name of equipment as set forth in Contract Documents.
5. Specification section number for equipment as set forth in Contract Documents.
6. Contractor's name, address, and telephone number.
7. Subcontractor's name, address, and telephone number if equipment provided by Subcontractor.
8. Purchase order number, manufacturer's shop order number or other such number required for parts and service.
9. Manufacturer's name, address, and telephone number.
10. Name, address, and telephone number for local source of parts and service.

C. Product List: Immediately after title sheet. List of each product and major components, indexed to content of submittal, and identified by product name and model number as set forth by manufacturer and Specification section and article number.

D. Table of Contents: Immediately following product list. Arrange in logical, systematic order and shall be at minimum a tabbed section index. Provide each tabbed section with table of contents for section.

E. Product Data Sheets: Provide specification and catalog sheets showing configuration, manufacturer's specifications, models, options, and styles of equipment and major components being provided. Product data sheets shall show project specific information with inapplicable information deleted by removal. Insert in tabbed sections.

F. Drawings:

1. Supplement text with drawings to clearly illustrate following:

a. Product and components.
b. Relations of component parts of equipment and systems.
c. Control and flow diagrams.

2. Drawings to be actual drawings of equipment from manufacturer. "Typical" drawings not acceptable, unless they accurately illustrate actual equipment.

G. Special Information:

1. Provide explanation of interrelationships of equipment and components, and effects one component has on another or system.
2. Provide overall instructions and procedures for equipment tying in instructions and procedures for separate components into unified instructional package.
3. Provide glossary of special terms used by manufacturer.
4. Organize in consistent format under separate headings for different procedures.
5. Provide logical sequence on instructions for each procedure.

H. Warranty, Bond, or Service Contract.

1. Provide copy of each issued.

2. Provide information sheets to explain proper procedures in event of failure or malfunction to prevent voiding warranty or bond, and instances affecting validity of warranty or bond.

3.03 SPECIFIC CONTENT OF DATA

A. Specific content, for each unit of equipment and system, shall include following:

1. Description of Unit and Component Parts:

a. Function, normal operating characteristics, and limiting conditions.
b. Performance curves, engineering data, and tests as applicable.
c. Complete nomenclature and commercial number of replacement parts.
d. Complete nameplate data.
e. P&ID numbers for equipment as set forth in Contract Documents.

2. Operating Procedures:

a. Startup, break-in, and normal operating instructions.
b. Regulation, control, stopping, shutdown, and emergency instructions.
c. Summer and winter operating instructions.
d. Special operating instructions.

3. Maintenance Procedures:

a. Routine maintenance operations.
b. Guide to troubleshooting.
c. Disassembly, repair, and reassembly instructions.
d. Alignment, adjusting, and checking instructions.

4. Servicing and Lubrication Schedule:

a. List of lubricants required and quantity to be applied.
b. Schedule of lubrication.
c. Schedule for other routine maintenance.

5. Manufacturer's printed instructions regarding safety precautions for both protection of personnel and prevention of damage to equipment.
6. Description of sequence of operation of controls.
7. Manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
8. Recommended spare parts to be stocked, and quantity.
9. Predicted life of parts.
10. Control diagrams (ladder diagrams, instrumentation loop diagrams, and electrical schematics as appropriate).
11. Bill of material.
12. Completed EQUIPMENT DATA FORM typewritten on copy of Form 2 to Section 01 78 23. (Example of completed form is Form 3 to Section 01 78 23.)
13. Other data as required under pertinent section of Specifications.

B. Specific content for each electric and electronic system, as applicable to equipment.

1. Description of System and Component Parts:

a. Function, normal operating characteristics, and limiting conditions.
b. Performance curves, engineering data, rating tables, and tests as applicable.
c. Complete nomenclature and commercial number of replaceable parts.
d. Complete nameplate data.
e. P&ID numbers for equipment as set forth in Contract Documents.

2. Circuit Directories of Panelboards:

    a. Electrical service.
    b. Controls.
    c. Communications.

3. Complete instrumentation loop diagrams with tabulated listing of components in each control circuit or loop.
4. Operating Procedures:

    a. Routine and normal operating instructions.
    b. Sequences required.
    c. Special operating instructions.

5. Maintenance Procedures:

    a. Routine maintenance operations.
    b. Guide to troubleshooting.
    c. Disassembly, repair, and reassembly instructions.
    d. Adjustment and checking instructions.

6. Manufacturer's printed instructions regarding safety precautions for both protection of personnel and prevention of damage to equipment.
7. Recommended spare parts to be stocked, and quantity.
8. Other data as required under pertinent sections of Specifications.

C. Prepare and include additional data when need for such data becomes apparent during instruction of Owner's personnel.

FORM 1 TO SECTION 01 78 23 **Page 1 of 5**
CONTRACTOR SUBMITTAL FORM

TO: (Engineer) (Address) (Attn:)		DATE	
		SPECIFICATION SECTION TITLE	
		SECTION NO.	
FROM: (Contractor) (Address)		MANUFACTUER/ VENDOR	
		NO. OF COPIES	

TO ALL:

We have checked the O&M data submittal dated _____ and have found it to be in accordance with Specification Section 01 78 23 and as noted below.

_____
Signature of Contractor

	Provided	Not Applicable	Page No.
FORMAT			
Size: 8-1/2 x 11 or 11 x 17			
Paper: 20-lb min, white			
Text: Printed data / typewritten			
Drawings:			
Standard size bound in text			
Text-size labeled envelopes			
Tabbed Section Dividers			
Cover:			
Title			
Project title			
Building / structure name			
Equipment name			
Specification section no.			
Binders: Plastic cover			
Pages: Numbered			

	Provided	Not Applicable	Page No.
GENERAL CONTENT			
One Specification Section			
Title Sheet:			
Title			
Project title			
Building / structure name			
Equipment name			
Specification section no.			
Contractor ID			
Subcontractor ID			
Purchase order data			
Manufacturer ID			
Service / parts supplier ID			
Product List			
Table of Contents			
Product Data Sheets: Tabbed sections			
Drawings:			
Illustrate product and components			
Control and flow diagrams			
Special Information:			
Interrelationships of equipment and components			
Unified instruction package			
Glossary			
Instructions organized in consistent format			
Instructions in logical order			
Warranty, Bond, Service Contract			

	Provided	Not Applicable	Page No.
SPECIFIC CONTENT (EQUIPMENT / SYSTEM)			
Description of Unit and Components:			
Equipment function			
Normal operating characteristics			
Limiting conditions			
Performance curves			
Engineering data			
Test data			
Replaceable parts list			
Nameplate data			
P&ID numbers			
Operating Procedures:			
Startup			
Normal operation			
Regulation and control			
Stopping and shutdown			
Emergency			
Seasonal operation			
Special instructions			
Maintenance Procedures			
Routine			
Troubleshooting			
Disassembly / repair / reassembly			
Adjustment and checking			
Service and Lubrication:			
List of lubricants			
Lubrication schedule			
Maintenance schedule			
Safety Precautions / Features			
Sequence of Operation of controls			
Assembly Drawings			
(Continued)			

	Provided	Not Applicable	Page No.
Parts List and Illustrations:			
Spare parts list			
Predicted life			
Control Diagrams / Schematics			
Bill of Material			
Completed EQUIPMENT DATA FORM			
Other Data as Required			

	Provided	Not Applicable	Page No.
SPECIFIC CONTENT (ELECTRIC / ELECTRONIC)			
Description:			
Equipment Function			
Normal operating characteristics			
Performance curves			
Engineering data			
Test data			
Replaceable parts list			
Nameplate data			
P&ID numbers			
Panelboard Directories			
Electrical			
Controls			
Communications			
Instrumentation Loops:			
Diagrams			
Components each circuit / loop			
Operating Procedures			
Normal operation			
Sequences			
Special instructions			
Maintenance Procedures:			
Routine			
Troubleshooting			
Disassembly / repair / reassembly			
Adjusting and checking			
Safety Precautions / Features			
Spare Parts List			
Additional Data			

FORM 2 TO SECTION 01 78 23 **Page 1 of 4**
EQUIPMENT DATA FORM

PROJECT NAME			
CONTRACT NO.			
CONTRACTOR			
EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	
LOCATION			
MANUFACTURER			
PURCHASED FROM			
VENDOR ORDER NO.			
DATE OF PURCHASE		PURCHASE PRICE	$
LOCAL SUPPLIER			
ADDRESS			
PHONE NO.			
MODEL NO.			
NO. OF UNITS			
SERIAL NUMBERS			

*By Owner

EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	
NAMEPLATE DATA			
ELECTRIC MOTOR		**PUMP / HVAC UNIT**	
MANUFACTURER		MANUFACTURER	
TYPE	[ ]AC [ ]DC	TYPE	
HORSEPOWER		SIZE	
RPM		CAPACITY	
VOLTAGE		PRESSURE	
AMPERAGE		ROTATION	
PHASE		IMPELLER SIZE	
FRAME		IMPELLER MATL.	
DRIVE / REDUCER		**OTHER (I&C)**	
MANUFACTURER		MANUFACTURER	
TYPE	[ ]GEAR [ ]V-BELT [ ]CHAIN [ ]VARIDRIVE	TYPE	
		SIZE	
SERVICE FACTOR		CAPACITY	
RATIO		RANGE	

*By Owner

MAINTENANCE SUMMARY

EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	

MAINTENANCE OPERATION	FREQUENCY
List briefly each maintenance operation and refer to specific information in Manufacturer's Manual, if applicable. Refer by symbol to "Lubrication List" for lubrication operation.	List required frequency of each maintenance operation.

*By Owner

LUBRICATION / RECOMMENDED SPARE PARTS LIST

EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	

LUBRICANT LIST

REFERENCE SYMBOL	LUBRICANT TYPE (MILITARY STANDARD)	RECOMMENDED LUBRICANT AND MANUFACTURER
List of symbols in "Maintenance Operation"	List general lubrication type.	List specific lubrication name, viscosity, and manufacturer.

RECOMMENDED SPARE PARTS LIST

PART NO.**	DESCRIPTION	UNIT	QUANTITY	UNIT COST

ADDITIONAL DATA AND REMARKS

*By Owner
**Identify parts provided by this contract with two asterisks.
Note: Attach additional sheets if necessary.

"EXAMPLE"

FORM 3 TO SECTION 01 78 23

EQUIPMENT DATA FORM

PROJECT NAME	Anytown WWTP		
CONTRACT NO.	10023		
CONTRACTOR	Built-to-Last		
EQUIPMENT NO.	P-8-6-5, P-8-6-6	ASSET NO.*	
DESCRIPTION	Feed Pumps	MAINT. NO.*	
LOCATION	Chemical Building		
MANUFACTURER	Pumptech		
PURCHASED FROM	Suppliers Inc.		
VENDOR ORDER NO.	SI-1324-aa		
DATE OF PURCHASE	May 7, 1997	PURCHASE PRICE	$1,200
LOCAL SUPPLIER	Helpful Tech.		
ADDRESS	464553 N. Balyor, Outthere, Ohio 45362		
PHONE NO.	354-576-9876		
MODEL NO.	CC-2-5674		
NO. OF UNITS	2		
SERIAL NUMBERS	P674A123456-A / P674A123456-B		

*By Owner

EQUIPMENT NO.	P-8-6-5, P-8-6-6	ASSET NO.*	
DESCRIPTION	Feed Pumps	MAINT. NO.*	
NAMEPLATE DATA			
ELECTRIC MOTOR		**PUMP / HVAC UNIT**	
MANUFACTURER	Westinghouse	MANUFACTURER	Pumptech
TYPE	[X]AC [ ]DC	TYPE	Centrifugal
HORSEPOWER	25	SIZE	2 inch
RPM	2000	CAPACITY	9 gpm
VOLTAGE	460	PRESSURE	14 psig
AMPERAGE	1.4 FL	ROTATION	CW
PHASE	3	IMPELLER SIZE	NA
FRAME	28a	IMPELLER MATL.	NA
DRIVE / REDUCER		**OTHER (I&C)**	
MANUFACTURER	Westinghouse	MANUFACTURER	
TYPE	[X]GEAR [ ]V-BELT [ ]CHAIN [ ]VARIDRIVE	TYPE	
		SIZE	
SERVICE FACTOR		CAPACITY	
RATIO	1:1	RANGE	

*By Owner

MAINTENANCE SUMMARY

EQUIPMENT NO.	P-8-6-5, P-8-6-6	ASSET NO.*	
DESCRIPTION	Feed Pumps	MAINT. NO.*	

MAINTENANCE OPERATION	**FREQUENCY**
List briefly each maintenance operation and refer to specific information in Manufacturer's Manual, if applicable. Refer by symbol to "Lubrication List" for lubrication operation.	List required frequency of each maintenance operation.
1) Lubricate	Reassembly
2) Clean pump	As needed
3) Adjust and check clearance	As needed

*By Owner

"EXAMPLE"

FORM 3 TO SECTION 01 78 23

EQUIPMENT DATA FORM

LUBRICATION / RECOMMENDED SPARE PARTS LIST

EQUIPMENT NO.	P-8-6-5, P-8-6-6	ASSET NO.*	
DESCRIPTION	Feed Pumps	MAINT. NO.*	

LUBRICANT LIST

REFERENCE SYMBOL	LUBRICANT TYPE (MILITARY STANDARD)	RECOMMENDED LUBRICANT AND MANUFACTURER
List of symbols in "Maintenance Operation"	List general lubrication type.	List specific lubrication name, viscosity, and manufacturer.
1	Lithium base grease	Texaco TH268

RECOMMENDED SPARE PARTS LIST

PART NO.**	DESCRIPTION	UNIT	QUANTITY	UNIT COST
**2-567-098	Mechanical seal	1	1	
3-987-456567	O-Ring	1	2	$6.75

ADDITIONAL DATA AND REMARKS

*By Owner

**Identify parts provided by this contract with two asterisks.

Note: Attach additional sheets if necessary.

END OF SECTION

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Throughout progress of the Work, maintain an accurate record of changes in the Contract Documents.

B. Maintain at Site one record copy of:

1. Drawings.
2. Project Manual.
3. Addenda.
4. Change Orders and other modifications to Contract.
5. Engineer Field Orders, written instructions, or clarifications.
6. Approved Shop Drawings and other Work-related submittals.
7. Field modifications made to equipment by Contractor, Subcontractors and Suppliers.
8. Field test records.
9. Construction photographs.
10. Associated permits.
11. Certificates of inspection and approvals.

1.02 PAYMENTS

A. Progress payments will not be made until the Contractor has demonstrated to the Engineer that a marked up set of Drawings is being satisfactorily maintained on the site and is available for Engineer's review as specified herein.

1.03 SUBMITTALS

A. Prior to Substantial Completion, submit revised operation and maintenance data for field modifications made by Contractor, Subcontractors, and Suppliers. Revised operation and maintenance data shall include electronic files and paper copies.

B. Prior to Substantial Completion, submit revised copies of approved Shop Drawings and other Work-related submittals for equipment modified in field by Contractor, Subcontractors, and Suppliers.

C. Prior to submitting request for Substantial Completion, deliver one complete coordinated marked up set of Drawings to Engineer for use in preparation of record drawings.

D. Prior to submitting request for final payment, submit the remaining Project Record Documents to Engineer for Owner.

E. Accompany submittals with transmittal letter containing following:

1. Date.
2. Project title and number.
3. Contractor's name and address.
4. Title of record document.
5. Signature of Contractor or authorized representative.

PART 2 – PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Store documents and Samples in Contractor's field office apart from documents used for construction.

1. Provide files and racks for storage of documents.
2. Provide secure storage space for storage of Samples.

B. Maintain documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

C. Label each document "PROJECT RECORD" in neat, large letters.

D. Make documents and samples available for inspection by Engineer and Owner.

E. Failure to properly maintain record documents may be reason to delay a portion of progress payments until records comply with Contract Documents.

3.02 RECORD DRAWINGS

A. Maintain one record set of Drawings legibly annotated to show all changes made during construction and the final location of all underground piping and utilities.

1. The marked up set of Drawings shall be a compilation of all of the changes made by all of the trades involved. Individual sets from the various subcontractors will not be accepted.
2. The marked up set of Drawings shall graphically show the changes. Reference to RFI's, Change Orders, Field Orders, etc. will not be accepted.
3. The marked up set of Drawings shall incorporate changes made to the primary drawings, and shall include the corresponding changes made to the ancillary drawings.
4. Changes made to the process drawings, electrical drawings, and I&C drawings shall be depicted on the P&ID's.

B. Record information concurrently with construction progress.

C. Drawings:

1. Graphically depict changes by modifying or adding to plans, details, sections, elevations, or schedules.
2. Using a red colored pencil or pen, clearly describe the changes by graphic line and note as required. Provide supplemental photographs where required to clarify drawing mark up.
3. Note the following:

a. Depths of various elements of foundation in relation to finished first floor elevation.
b. Horizontal and vertical locations of underground cable, conduit, duct runs, underground utilities and appurtenances, and underground piping referenced to visible and accessible features. These features shall be located where they leave or enter any structure and at changes in horizontal or vertical direction. The invert elevation of piping and the top of conduit or duct banks shall be noted. GPS coordinates may be used.

c. Field changes.
d. Details not on original Drawings.
e. Location and identification of exposed interior piping, including those shown schematically on Drawings.
f. Location and size of equipment including connections.
g. Departures from original Drawings.

3.03 RECORD SPECIFICATIONS

A. Specifications:

1. Mark Specification sections to show substantial variations in actual Work performed from that indicated in Specifications and modifications to Specifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation.
2. Note related record drawing information and product data.

END OF SECTION

SECTION 01 79 10
SYSTEMS DEMONSTRATIONS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Before Substantial Completion is considered, Contractor shall demonstrate satisfactory operation of specific equipment systems and associated facilities. Conduct demonstrations on systems listed below. Each system shall include facilities listed and associated structures, channels, conduits, piping, valves, gates, electrical, instrumentation, water, and other utilities necessary for system operation.

1. System 1 – Polymer Storage and Mixing System

    a. Liquid Polymer Tank shown on Drawing No. 009-N-1.
    b. Liquid Polymer Circulation Pump shown on Drawing No. 009-N-1.
    c. Polymer Mixing System 1 and 2 shown on Drawing No. 009-N-1.
    d. All instrumentation and controls shown on Drawing No. 009-N-1.

2. System 2 – Polymer Feed Pump 1

    a. Polymer Feed Pump 1 shown on Drawing No. 009-N-2.
    b. Polymer Dilution Solenoid 1 shown on Drawing No. 009-N-2.
    c. Static Mixer 1 shown on Drawing No. 009-N-2.
    d. FE/FIT-8-9-1 shown on Drawing No. 009-N-2.
    e. Polymer Feed Pump 1 Variable Frequency Drive shown on Drawing No. 009-N-2.

3. System 3 – Polymer Feed Pump 2

    a. Polymer Feed Pump 2 shown on Drawing No. 009-N-2.
    b. Polymer Dilution Solenoid 2 shown on Drawing No. 009-N-2.
    c. Static Mixer 2 shown on Drawing No. 009-N-2.
    d. FE/FIT-8-9-2 shown on Drawing No. 009-N-2.
    e. Polymer Feed Pump 2 Variable Frequency Drive shown on Drawing No. 009-N-2.

4. System 4 – Polymer Feed Pump 3

    a. Polymer Feed Pump 3 shown on Drawing No. 009-N-2.
    b. Polymer Dilution Solenoid 3 shown on Drawing No. 009-N-2.
    c. Static Mixer 3 shown on Drawing No. 009-N-2.
    d. FE/FIT-8-9-3 shown on Drawing No. 009-N-2.
    e. Polymer Feed Pump 3 Variable Frequency Drive shown on Drawing No. 009-N-2.

5. System 5 – Polymer Feed Pump 4

    a. Polymer Feed Pump 4 shown on Drawing No. 009-N-2.
    b. Polymer Dilution Solenoid 4 shown on Drawing No. 009-N-2.
    c. Static Mixer 4 shown on Drawing No. 009-N-2.
    d. FE/FIT-8-9-4 shown on Drawing No. 009-N-2.
    e. Polymer Feed Pump 4 Variable Frequency Drive shown on Drawing No. 009-N-2.

6. System 6 – Polymer Aging Tanks

    a. Polymer Aging Tanks 1, 2, 3, and 4 shown on Drawing No. 009-N-2.
    b. LT-8-16-1, 2, 3, and 4 shown on Drawing No. 009-N-2.

c. LSH-8-16-1, 2, 3, and 4 shown on Drawing No. 009-N-2.

7. System 7 – Odorous Air Treatment

a. Odorous Air Blower shown on Drawing No. 009-N-3.
b. Carbon Vessel shown on Drawing No. 009-N-3.

8. System 8 – Gas and Ventilation Monitoring and Alarms

a. Gas monitoring and controls shown on Drawing No. 009-N-3.
b. Ventilation controls shown on Drawing No. 009-N-3.
c. Alarm lights shown on Drawing No. 009-N-3.

B. Preliminary:

1. Before Contractor begins Systems Demonstrations, the following Work shall be complete:

a. Electrical systems testing as specified in Section 26 01 26.
b. Installation services specified in Section 01 61 00.
c. Operation and maintenance (O&M) data in accordance with Section 01 78 23 has been submitted to and approved by Engineer.
d. Process control system testing as specified in Section 40 61 21.
e. Application software programming by Systems Integrator.
f. Instructional Services specified in Section 01 79 30.

2. Contractor shall provide services of qualified, certified representatives of Suppliers to be present at Project Site as necessary to successfully complete Systems Demonstrations.
3. Contractor shall submit evidence of the representative's certification and qualifications to the Engineer for review and approval 30 days prior to the start of Systems Demonstrations.

C. Coordination:

1. Designate representative of Contractor to be responsible for Systems Demonstrations.
2. Contractor shall submit schedule of Systems Demonstrations for review by Engineer and Owner 30 days prior to Systems Demonstrations.
3. Notify Engineer at least 7 days before Systems Demonstrations are to begin.
4. Reschedule cancelled Systems Demonstrations 7 days in advance.

1.02 SUBMITTALS

A. Reports:

1. Prepare report for each system on results and activities encompassing system demonstration. Submit report within two working days of completion of System Demonstration.
2. Report shall describe operational conditions; daily results of systems operation; dates and names of people involved and observing operation; and statement regarding system ability to meet operational criteria.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

3.01 SYSTEMS DEMONSTRATIONS

A. Demonstrate operation and performance of each system for 7 consecutive days.

1. Where no specific performance requirements are stated in Specifications, demonstrate to show equipment operates in accordance with acceptable industry standards for application of equipment.
2. System Demonstration shall show equipment operates within manufacturer's tolerances for noise and vibration, equipment is responsive to manual and automatic controls, control and protective devices are properly set, and equipment operates on controlled or intermittent basis when such operation is intended.
3. Demonstrate proper function and process control for each control point, alarm, and safety lockout system.

B. Temporary facilities and services are Contractor's responsibility. Contractor shall provide temporary facilities and services as required to complete testing and systems demonstrations. Contractor shall also provide required equipment maintenance during the time between the systems demonstration testing and the issuance of a Certificate of Substantial Completion.

C. For each system, Engineer will consider system demonstration successful and complete when system operates properly for 7 consecutive days without significant interruption.

D. If, in Engineer's opinion, system is not operating properly at any time during System Demonstration, Contractor shall stop demonstration and adjust, calibrate, or replace material and equipment as required to correct problem. After corrections have been made, restart System Demonstration and operate system for 7 consecutive days without significant interruption.

3.02 SUBSTANTIAL COMPLETION

A. Engineer will not consider Work substantially complete until Systems Demonstrations have been successfully completed.

END OF SECTION

SECTION 01 79 30
INSTRUCTIONAL SERVICES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Training manuals.
2. Classroom instructions.
3. Field hands-on training.
4. Other activities to provide comprehensive training program.

1.02 SUBMITTALS

A. Training Program:

1. Submit proposed training program to electronic document management system, including student training manual and instructor guide, for review by Engineer.
2. After training program is approved by Engineer, and at least 30 days prior to training, submit 6 student training manuals, one reproducible student training manual, and one instructor guide.
3. The reproducible student-training manual shall be non-bound and not folded for reproduction in a standard copy machine. The reproducible manual shall be packaged under a protective cover, all pages shall be paper clipped together, in order, using appropriately sized binder clips.

B. Resumes:

1. Submit resumes, including three outside references, for each instructor proposed for training program.
2. Engineer will review resumes. Based upon review of resumes, and contacts with references, Engineer will approve, request additional information, or reject proposed instructors for training program.
3. If proposed instructor is rejected, Contractor shall submit resume and references on an alternate instructor for acceptance.

C. Submit in accordance with Section 01 33 00.

D. Provide “Certificate of Instructional Services” cosigned by OWNER and instructor, verifying training accomplished to satisfaction of all parties. Use the form in Appendix and furnish 2 copies to Engineer.

PART 2 – PRODUCTS

2.01 TRAINING PROGRAM

A. Instruct and train Owner’s personnel in maintenance and operation of equipment and systems supplied and installed under this Contract.

B. Incorporate following maintenance and operational data and training services into training program.

1. Shop Drawings.
2. Equipment Manuals.

C. Prepare instruction materials and objectives, student notes and guides, and tests required for complete classroom and field hands-on training.

D. Field hands-on training shall be conducted with a maximum of 8 students for each instructor.

2.02 INSTRUCTORS

A. Preparation of training materials and conduct of training shall be performed by personnel:

1. Trained and experienced in maintenance and operation of equipment and systems installed under this Contract.
2. Familiar with training requirements of Owner's personnel, that is, understand Owner's personnel training needs.

2.03 FORM OF TRAINING MANUALS

A. Prepare training packages in form of an instruction manual for use by Owner's personnel.

B. Format:

1. Size: 8-1/2 inch by 11 inch.
2. Paper: 20-pound minimum, white, for typed pages.
3. Text: Manufacturer's printed data, or neatly typewritten, including:

a. Table of Contents.
b. Learning Objectives.
c. General Operation, Theory, Specific Equipment Information.
d. Test.

4. Drawings:

a. Provide reinforced, punched binder tabs, bind in with text.
b. Reduce larger Drawings and fold to size of text pages, not larger than 11 inch by 17 inch.

5. Cover: Identify each volume with typed or printed title "Training Manual; NAME OF EQUIPMENT."

a. Title of Project.
b. Identify separate structure or system as applicable.
c. Identify general subject matter in Manual.

C. Binders:

1. Commercial quality binder with durable and cleanable plastic covers. Binders shall include title pockets for holding notes. Binders shall not be filled more than 75 percent capacity.
2. When multiple binders are used, correlate information into related consistent groupings.

PART 3 – EXECUTION

3.01 FACILITIES FOR TRAINING

A. Use Owner's designated training facilities for specific classroom and field hands-on training.

B. Facilities include installation sites, which shall be used for hands-on training programs.

C. Coordinate use of Owner's facilities with Owner and Engineer.

3.02 SCHEDULE

A. Coordinate training periods with Engineer and Supplier's representatives.

1. Notify Engineer at least 14 days before training sessions are to begin so Engineer can make arrangements with Owner's operating personnel.
2. Reschedule canceled training sessions 14 days in advance.
3. Failure of instructors to appear for scheduled training, failure to notify Engineer 48 hours in advance of need to cancel training session, or failure to arrive within 30 minutes of start of scheduled training session shall result in reimbursement to Owner for time lost by Owner's personnel in waiting for arrival of instructor.

B. Provide training after completion of application software programming by Designer and before the start of Systems Demonstrations specified in Section 01 79 10. See section 01 11 00 for sequencing and constraints.

C. Owner's personnel will require training both for operating and maintenance functions. These individuals shall be trained during one session during the Monday through Friday workweek.

3.03 MAINTENANCE OF PROCESS EQUIPMENT

A. Training Requirements:

1. Describe functions of process equipment.
2. Component preventative and corrective maintenance activities required to keep unit equipment in good operating conditions.
3. Instruct trainees in locating probable source of equipment malfunctions, determining symptoms of trouble, establishing probable cause, and effecting solution.

B. Course Materials:

1. Pertinent portions of operation and maintenance manuals as well as alignment tolerances, lubrication schedules, vibration analysis instructions and parameters, and special calibration test and procedures.
2. Detailed course outlines and troubleshooting guides for each piece of equipment. Troubleshooting guides shall include symptoms, probable causes, and solutions for trouble described during training program.
3. Course outlines shall include objectives that indicate information to be learned. The objectives shall state the answers to the test questions. Example of objective: "Students shall identify the points and frequency of grease lubrication on the machine."
4. Provide a 15 to 20 question test of the objectives being taught.
5. The objectives shall be equally divided between operation and maintenance and cover the subjects listed in 3.04 and 3.05.

C. Method of training maintenance personnel shall include Contractor using Owner's equipment to demonstrate troubleshooting, preventative and corrective maintenance procedures.

3.04 OPERATION OF PROCESS EQUIPMENT

A. Training Requirements:

1. Describe functions of equipment including how components of system are controlled together and what effects of control methods are on system and on other upstream and downstream processes.

2. Being able to implement start-up and shutdown procedures for each piece of equipment individually, as well as start-up and shutdown of systems comprising equipment. This instruction shall include normal operation, alternative operations, and emergency operations.
3. Understand functions of instrumentation, describing individual components and how each component is used in monitoring and/or controlling equipment and/or processes.
4. Understand operating modes possible as result of modifications and installations.
5. Locating probable source of system inefficiency, determining symptoms, establishing probable cause, and restabilizing system efficiency for systems.
6. Understand necessary precautions for safe operation of equipment, instrumentation, and control system installed under this Contract.
7. Emergency procedures for equipment and systems during pump malfunction, chemical spills, and other extreme conditions.

B. Course Materials:

1. Pertinent portions of operation and maintenance manuals, including start-up and shutdown procedure; descriptions of equipment and instrumentation functions and modes of operations, control, and monitoring; troubleshooting instructions and process control instructions.
2. Detailed course outlines and troubleshooting guides for equipment and processes for field use. Operations guides shall include general operating procedures, start-up and shutdown procedures, optimization procedures, and emergency operating procedures.
3. Course outlines shall include objectives that indicate information to be learned. The objectives shall state the answers to the test questions. Example of objective: “Students shall identify the points and frequency of grease lubrication on the machine.”
4. Provide a 10 to 20 question test of the objectives being taught.
5. The objectives shall be equally divided between operation and maintenance and cover the subjects listed in 3.04 and 3.05.

C. Methods of training Owner’s operating personnel shall include field-training program at Owner’s site consisting of classrooms and field hand-on training using Owner’s equipment and systems.

3.05 FIELD QUALITY CONTROL

A. Training Effectiveness:

1. Effectiveness of training operations personnel shall be assessed through written and in-the-field skill evaluation of trainees. Evaluations shall be designed to determine trainees’ ability to control processes, as well as their ability to operate and maintain equipment.
2. Unsatisfactory evaluations shall include recommendations for corrective action.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 – GENERAL

1.01 SUMMARY

A. Provide concrete reinforcement where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.02 REFERENCES

A. ACI: American Concrete Institute

B. ASTM: American Society for Testing and Materials

C. CRSI: Concrete Reinforcing Steel Institute

1.03 SUBMITTALS

A. Shop Drawings:

1. Conform to ACI SP-66 showing bending diagrams, assembly diagrams, location diagrams, splicing and laps of bars, shapes, dimensions, and details for reinforcing, and stirrup spacing, accessories, and additional reinforcing at openings.

B. Product Data:

1. Dowel Adhesive manufacturer's product data.

C. Miscellaneous Submittals:

1. Welder's certification in accordance with AWS D1.4 prior to welding when welding indicated, specified, or approved by Engineer.

D. Submit in accordance with Section 01 33 00.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver reinforcement to site bundled and tagged.

B. Use necessary precautions to maintain identification after bundles are broken.

C. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond-breaking coatings.

PART 2 – PRODUCTS

2.01 REINFORCEMENT MATERIALS AND ACCESSORIES

A. Deformed Steel Bars: ASTM A615, Grade 60.

B. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place:

1. Comply with CRSI recommendations.

2. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
3. Exterior exposed surfaces, surfaces in contact with earth or liquid, and interior exposed surfaces in humid areas shall have all plastic or stainless steel supports.
4. Interior exposed surfaces in dry areas shall have all plastic, stainless steel, or plastic tipped steel supports.
5. When supports bear directly on the ground and it is not practical to use steel or plastic supports, solid precast concrete blocks may be used to support only the bottom mat of reinforcement. Precast blocks must be of equal or greater strength than the concrete being placed.

C. Dowel Adhesive:

1. Epoxy or acrylic adhesive.
2. Manufacturers:

a. HIT RE 500 V3 or HIT-HY 200-R System by Hilti Corp.
b. Pure 110+, AC100+ Gold or PE 1000+ by Dewalt.
c. SET-XP Epoxy or AT-XP Acrylic Adhesive System by Simpson Strong-Tie Co., Inc.
d. Red Head A7+, G5+ or C6+ by ITW Commercial Construction.

2.02 FABRICATION

A. Fabricate reinforcing bars to conform to the required shapes and dimensions and in accordance with ACI 318 and CRSI Manual.

B. In case of fabricating errors, do not straighten or rebend reinforcement in a manner that will weaken or injure the material.

C. Reinforcement with any of the following defects will not be acceptable.

1. Bar lengths, depths, and/or bends exceeding the specified fabrication tolerances.
2. Bends or kinks not shown on the Drawings.
3. Bars with reduced cross-section due to excessive rusting or other causes.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.

B. Position, support, and secure reinforcement against displacement by formwork, construction, and concrete placing operations. Unless otherwise noted, provide clear cover as follows:

1. Cast against:

Earth: 3 inches
Mud Slab: 2 inches

2. Exposed to earth, weather, or water:

   a. Slabs:

      #5 Bars and smaller: 1 ½ inches
      #6 through #11 Bars: 2 inches

   b. Walls: 2 inches

3. Not exposed to earth, weather, or water:

   a. Slabs and Walls:

      #3 through #7 Bars: 1 inch
      #8 through #11 bars: 1 ½ inches

C. Correct displacement of reinforcement prior to and during concrete placement. Maintain clear cover as noted on Drawings. Tolerances shall be in accordance with ACI 117 and ACI 318, unless noted otherwise.

D. Support reinforcing steel in accordance with CRSI “Placing Reinforcing Bars” with maximum spacing of 4 feet.

E. Tie reinforcing steel at intersections in accordance with CRSI “Placing Reinforcing Bars”.

1. Spacing for Footings, Walls, and Columns: Every third intersection, 3 feet maximum.
2. Spacing for Slabs and Other Work: Every fourth intersection, 3 feet maximum.
3. Tie each dowel in-place.

F. Reinforcement shall be continuous through construction joints.

G. Reinforcement may be sliced at construction joints provided that the entire lap is placed within only 1 pour.

H. Do not field bend bars, including bars partially embedded in concrete unless indicated.

I. Tack welding of, or to, reinforcement prohibited.

J. Placement of reinforcement shall be approved by Engineer before placing concrete.

K. Anchor dowels into drilled holes with epoxy dowel adhesive where noted. Conform to details shown.

3.03 SPLICES

A. Lap reinforcing at splices. Tie securely to prevent displacement of splices during placement of concrete.

B. Welding of reinforcing bars is not permitted.

.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 SUMMARY

A. Provide cast-in-place concrete where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. NRMCA: National Ready Mixed Concrete Association

C. ACI: American Concrete Institute

D. AASHTO: American Association of State Highway and Transportation Officials

1.03 SUBMITTALS

A. Shop Drawings:

1. Verification of Mix Design:

a. Proposed mix design for each class of concrete to be used as specified using designations indicated. Provide dry weight of cement, saturated dry weight of coarse and fine aggregate, brand name and quantities of admixtures when applicable, fly ash when applicable, gallons of water required for 1 cubic yard of concrete, and chloride ion content.
b. Source and material certificates of cement and fine and coarse aggregate, including sieve analysis that will be used in each class of concrete.
c. Admixture product data.
d. Source and test reports of fly ash.
e. Source of blast furnace slag and documented ability of supplier to consistently furnish these materials in accordance with applicable ASTM and AASHTO requirements.
f. Test data supporting proportions of design mixes based on laboratory trial batches or past field experience in accordance with ACI 318.
g. Mix design shall be approved by Engineer before concrete delivered to site.

B. Product Data:

1. Waterstop: Samples of material and manufacturer's literature.
2. Curing Compound and Floor Sealer: Proposed rate of coverage and manufacturer's literature.
3. Bonding Agent manufacturer's literature.
4. Patching Mortar manufacturer's literature.

C. Test Results:

1. Concrete test results.
2. Concrete delivery tickets: With each load of concrete delivered, provide duplicate tickets, one for Contractor, one for Engineer, with following information.

a. Serial number of ticket.
b. Date and truck number.
c. Name of supplier.
d. Class of concrete.
e. Type of cement and cement content in bags/cubic yard.
f. Admixture brand names.
g. Aggregate size.
h. Time loaded.
i. Amount of concrete in load.
j. Gallons of water added at site and slump of concrete after addition of water.
k. Temperature of concrete at delivery.
l. Time unloaded.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Plant Certification: Plant or concrete supplier shall comply with requirements of NRMCA certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, nonagitating units, and ticketing system.

B. Do not commence placement of concrete until mix designs have been reviewed and approved by Engineer.

C. Concrete Testing: Testing shall be provided by Contractor in accordance with Section 01 45 29 and this Section.

1. Conduct tests on sample material in accordance with methods listed below:

a. Slump: ASTM C143.
b. Air-Entrainment: ASTM C231.
c. Compressive Strength: ASTM C31 and ASTM C39.

1.05 PROJECT / SITE CONDITIONS

A. Hot Weather:

1. Comply with ACI 305.1.
2. Concrete temperature shall not exceed 90°F.
3. At air temperatures of 80°F or above, keep concrete as cool as possible during placement and curing.
4. When concrete temperature exceeds 80°F, water reducing, set-retarding admixtures shall be used.

B. Cold Weather:

1. Comply with ACI 306.1.
2. Temperature of reinforcement, forms, fillers, and other material in contact with concrete at time of placement shall not be less than 35°F. Preheat if temperature below 35°F.
3. Maintain air and forms in contact with concrete sections having minimum dimension less than 12 inches at temperature above 50°F for at least 3 days and at temperature above 32°F for remainder of specified curing period.
4. Maintain air and forms in contact with concrete in more massive sections at temperature above 40°F for at least 3 days and at temperature above 32°F for remainder of specified curing period.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cement:

1. Portland cement conforming to ASTM C150.
2. Type I or II except tricalcium aluminate (C_3A) content of Type I shall not exceed 8%. If this type of Type I not available, Type I with C_3A content less than 12% shall be used in combination with fly ash.
3. Type III may be substituted for Type I when approved by Engineer and additional requirements for Type I are met.
4. When aggregates determined to be deleteriously reactive, as defined by ASTM C33, alkali content of cement defined by ASTM C150 shall not exceed 0.60%.

B. Fly Ash:

1. ASTM C618, Class C or F including requirements of Table 1A.
2. Supplemental Requirements:

    a. Loss on Ignition (maximum): 3%.
    b. Water Requirement (maximum): 100% (as percent of control).
    c. Fineness (maximum retained on No. 325 sieve): 25%.

C. Blast Furnace Slag:

1. Blast furnace slag shall conform to the requirements of ASTM C989 Grade 100 or 120.
2. Blast furnace slag from different sources or of different grades shall not be mixed in the same construction.

D. Aggregates:

1. ASTM C33, modified as follows:

    a. Fine aggregate: Natural sand.
    b. Coarse aggregate: Crushed gravel, crushed stone or gravel, Size 467 (1-1/2 inch maximum), size 67 (3/4 inch maximum), Size 8 (3/8 inch maximum).

2. Potential reactivity of aggregates shall be determined in accordance with ASTM C33.

E. Admixtures:

1. Air-Entraining: ASTM C260.
2. Chemical Admixtures: ASTM C494, non-corrosive and chloride free.

F. Waterstop:

1. Provide waterstops where shown on the Drawings.
2. Waterstop shall be resistant to chemicals present such as Sika Westec TPER Retrofit or equal.
3. Provide prefabricated tees, crosses, and other configurations as required.

G. Floor Sealer:

1. Manufacturers:

a. Dress and Seal 30 by L&M Construction Materials, Inc.
b. Tuf-Seal J-35 by Dayton Superior.

H. Membrane Forming Curing Compound:

1. Manufacturers:

a. Dress and Seal 30 by L&M Construction Materials, Inc.
b. MasterKure CC 200 WB by BASF.

2. ASTM C309, and compatible with scheduled finishes and coatings, except permeability shall not exceed 0.39 kilogram/meter^2/72 hours.

I. Finishing Grout

1. Manufacturers:

a. MasterSeal 581 by BASF.
b. Concrete Finisher with AKKRO-7T by Tamms Industries Co.
c. SikaTop Seal 107 by Sika Corp.

J. Cement Grout: Mixture of cement and fine sand in proportions used in concrete being finished.

K. Epoxy Bonding Agent:

1. Manufacturers:

a. Sikadur 32 Hi-Mod by Sika Corp.
b. Epoxtite 2362 by A.C. Horn.
c. Sure Bond J-58 by Dayton Superior.
d. Epobond by L&M Construction Materials, Inc.
e. Five Star Bonding Adhesive by Five Star Products, Inc.

2. Use when joining new to existing concrete.
3. Conforming to ASTM C881.

L. Non-Epoxy Bonding Agent:

1. Manufacturers:

a. Weld-Crete by Larsen Products Corp.
b. MasterEmaco A660 by BASF.
c. Acrylset by Master Builders Co.
d. Everbond by L&M Construction Materials, Inc.

2. Use when joining new to existing concrete when bonding agent cannot be placed immediately prior to placement of new concrete.
3. Conforming to ASTM C1059 Type II.

M. Patching Mortar.

1. Manufacturers:

a. Sikatop by Sika Corp.
b. Duratop by L&M Construction Materials, Inc.

c. MasterEmaco N 300 by BASF.

2. Polymer modified cementitious fast setting mortar for repair of concrete surfaces. Consisting of polymer and selected Portland cements, aggregates, accelerator, admixtures for controlling set, water reducers for workability, and corrosion inhibitor. Shall contain no chlorides, nitrates, gypsum, or lime. Shall not produce vapor barrier. Shall be thermally compatible with concrete and shall be freeze-thaw resistant.

   a. Concrete gray.
   b. 5000 pounds per square inch minimum compressive strength.
   c. 400 pounds per square inch minimum bond strength.

2.02 CONCRETE MIX DESIGN

A. Concrete Mix: Measure and combine cement, aggregate, water, and admixtures in accordance with ASTM C94 and ACI 211.1.

1. Cement: When used in exposed concrete shall be one brand from one source. Do not mix different cements in same element of Work.
2. Water-Cementitious Ratio (if fly ash or slag is used, water-cement plus fly ash and slag ratio): 0.42 maximum for Class A concrete, 0.50 maximum for Class B concrete.
3. Air-Entrainment: Air-entrain concrete exposed to exterior or exposed to liquids. Air-Interior concrete floor with trowel-finished surface, limit air content to 3% max.
4. Chemical Admixtures: Use is optional to aid concrete properties and allow for efficient placement. Manner of use and amount shall be in accordance with manufacturer's written recommendations and as approved by Engineer. Do not use admixtures that increase early shrinkage or negatively affect finishing.
5. Fly Ash: Use is optional unless otherwise noted. Combine fly ash with cement at rate of 1 pound fly ash for each pound reduction of cement. Amount of fly ash shall not be less than 15% or more than 25% of weight of cementitious material.
6. Blast Furnace Slag: Use is optional unless otherwise noted. Combine blast furnace slag with cement at a rate of 1 pound blast furnace slag for each pound reduction of cement. Amount of blast furnace slag shall not be greater than 50% of weight of cementitious material.
7. Fly Ash and Blast Furnace Slag Combination: Use is optional unless otherwise noted. Combine fly ash and blast furnace slag with cement at a rate of 1 pound fly ash or blast furnace slag for each pound reduction of cement. Amount of fly ash and blast furnace slag combination shall not be greater than 50% of weight of cementitious material. Amount of fly ash shall not be greater than 25% of weight of cementitious material
8. Use no admixtures other than specified, unless approved by Engineer.

B. Class of Concrete:

1. Furnish in accordance with table. Cement contents listed are minimum values and shall be increased as required to attain other specified characteristics.
2. Slumps listed are maximum, except when high range water reducer is used. Maximum slump when high-range water reducer is used, 10 inches.
3. Chloride ion content shall not exceed values listed in ACI 318, Table 4.4.1.
4. Mid-range water reducer: ASTM C494, Type A required for Class A1 and A2 concrete.

Class	28-Day Compressive Strength (psi)	Coarse Aggregate (size no.)	Minimum Cementitious Material (lbs/cu yd)	Air Content (%)	Slump (in.)
A1	4500	467	517	5.5±1.5	3±1
A2	4500	67	564	6±1.5	3±1
B1	3000	467	423	5.5±1.5	3±1
B2	3000	67	446	6±1.5	3±1
B3	3000	8	470	7.5±1.5	4 max
psi = pounds per square inch cu yd = cubic yard in. = inch max = maximum					
Note: Interior concrete floor with trowel-finished surface, limit air content to 3% max.					

C. Concrete Usage:

1. Class A: All locations, except where Class B and C specified.
2. Class B: Interior equipment bases and where specifically noted.
3. Do not use coarse aggregate Size 467 in sections less than 12 inches thick, where clear cover of reinforcement is less than 1-1/2 inches or where clear spacing between reinforcement bars is less than 3 inches.

2.03 MIXING AND DELIVERY

A. Use ready mixed concrete conforming to ASTM C94.

B. Deliver and complete discharge within 1-1/2 hours of commencing of mixing. Limitations may be waived by Engineer if concrete slump, after 1-1/2 hours, is sufficient so that concrete can be placed without addition of water. In hot weather, time criteria may be reduced by Engineer.

C. Do not add water on-site unless slump and water-cement ratio, after addition of water, is below maximum allowed.

D. Deliver concrete to site having temperature not less than 50°F or greater than 90°F.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FORMS

A. Formwork design, detailing, and installation shall be Contactor's responsibility and shall conform to ACI 347.

B. Type of forms used is Contractor's option, except as other wise indicated or shown. Plywood and other wood surfaces shall have smooth, level surfaces treated with formoil or sealer to produce clean release of concrete from forms.

1. Where walls remain exposed use pylwood, prefabricated metal or wood forms; do not use boards.

2. Form ties shall be plastic cone snap ties. Cone shall be min 3/4 inch diameter by 1 inch deep. Ties for liquid holding structures or dry structures below grade shall have integral waterstop. Taper tie through-bolt form ties may be used as an alternate to plastic cone snap ties; conform to details shown. Do not use wire ties on exposed concrete.
3. Removal of ties shall leave holes clean cut and without appreciable spalling at face of concrete.
4. Provide 3/4 inch chamfer on external corners of exposed concrete walls, equipment bases and exposed edges of construction joints. Do not chamfer edges flush with masonry walls.
5. Provide openings at base of vertical forms as access for cleaning and inspection of forms and reinforcing prior to depositing concrete.

C. Coat plywood and wood forms with non-staining form release agent. Apply release agent before reinforcement is placed.

D. Clean, patch, and repair form material before reuse.

E. Formwork shall prevent leakage of mortar, shall not deflect under weight of concrete and workmen, and shall withstand fluid pressure of concrete.

F. Conform to tolerances as specified in ACI 117.

3.03 SUBGRADE PREPARATION

A. Subgrade and bedding shall be compacted and free of frost. If placement occurs at temperatures below freezing, provide temporary heat and protection to remove frost. Do not place concrete on frozen material.

B. Provide mud slabs where noted, where necessary, and when required by Engineer to obtain dry and stable working platform for placement of concrete. Unless otherwise approved by Engineer, 2 inch thick mud slabs shall be provided between free-draining fill and concrete as detailed.

C. Provide vapor barrier between subgrade and building floor slabs where noted, overlap joints minimum 6 inches.

D. Remove standing water, ice, mud, and foreign matter before placing concrete.

3.04 PLACING CONCRETE

A. Notify Engineer 24 hours in advance of placing operations.

B. Place concrete, except as modified herein, in accordance with ACI 304R.

C. Concrete will not be allowed to drop freely where reinforcing will cause segregation of mix.

1. Superplasticized Concrete: 10 feet maximum drop.
2. Other Concrete: 5 feet maximum drop.

D. If pumping used, do not use aluminum piping for delivery system.

E. When placing concrete temporarily halted or delayed, provide construction joints as shown and as specified.

F. Place in lifts not exceeding 24 inches and compact with internal mechanical vibrator equipment.

G. Minimum of 2 hours shall elapse after depositing concrete in walls before depositing concrete in adjoining slabs.

H. If in process of pouring wall, pour is stopped unexpectedly, leave surface of joint level but rough. Roughened surface shall have amplitude of 1/4 inch minimum. In water holding structures, before depositing new concrete against hardened concrete, retighten forms.

I. Provide bonding agent between new and hardened or existing concrete where shown. Existing concrete shall be sandblast cleaned to remove all foreign materials, to expose the coarse aggregate, and result in a roughened surface with minimum amplitude of 1/8 inch.

J. When hot and/or wind conditions will result in evaporation of 0.2 pounds per square foot per hour or more, evaporation retardant shall be used in accordance with manufacturer's written recommendations to minimize plastic shrinkage cracking.

3.05 JOINTS

A. Unless otherwise noted, construction joints shown are optional. Joints not shown on Drawings shall be approved by Engineer. Locate to miss splices in reinforcement.

B. Before concrete placed, construction joints shall be cleaned, laitance removed, and surface wetted. Remove standing water.

C. Locate construction joints in floors within middle third of span. Construction joints in floors supported by walls may be located at center of wall.

D. Locate vertical joints in walls a min of one-half wall height from corners or other intersecting walls or at mid point between corners or intersecting walls. Locate horizontal joints in walls within the middle third of wall height.

E. Construction joints shall have keys or roughened surfaces. Where roughened surfaces are used, surface shall have amplitude of 1/4 inch minimum.

F. Install premolded joint filler where noted in accordance with manufacturer's recommendations. Joint filler shall be compatible with sealant and suitable for intended purpose.

3.06 WATERSTOP

A. Provide waterstop in construction joints in:

1. Locations shown on Drawings.

B. Install in accordance with manufacturer's recommendations. Secure waterstop utilizing hog rings or grommets spaced maximum 12 in. on center and within 1 in. of edge. Wire tie bottom and top of waterstop to adjacent reinforcements prior to concrete placement. Secure as required to prevent deflection or misalignment during the concrete placement.

C. Splice joints in waterstop to form continuous watertight diaphragm. Splice in accordance with manufacturer's recommendations. Spark test joints as required by Engineer.

3.07 EMBEDDED ITEMS

A. Cast pipe and other embedded items into concrete as placement progresses. Do not provide blockouts.

B. Following restrictions shall be adhered to, unless otherwise noted.

1. No duct, conduit, pipe, or fitting placed vertically shall be larger in cross-sectional area than 4% of column into which it is placed.
2. Duct, conduit, pipe, and fittings, when placed within slabs or walls

    a. Shall not be larger than 1/3 thickness of slab or wall.
    b. Shall be placed within the middle 1/3 thickness of slab or wall where possible.
    c. Shall not be placed closer than 3 outside diameter clear from each other when parallel.
    d. Shall cross each other at right angles.
    e. Shall be secured to prevent shifting or “floating” during concrete placement.
    f. Multiple conduits shall not cross each other at the same location.
    g. Except for conduits that must run up a column, keep conduits a minimum of 2 to 3 feet away from columns.
    h. Where conditions require conduit to be tied to the inside face of the reinforcing mat, the conduit shall be galvanized steel or PVC, shall not be tied directly adjacent to a parallel reinforcement bar, and shall be placed 3 outside diameter clear away from the parallel reinforcement bar.

3. Reinforcing steel shall be in place before embedded items placed and reinforcing cut or removed shall be replaced with additional reinforcing as indicated.
4. Do not pass sleeves through columns without Engineer’s approval.

C. Do not place ducts, conduit, and pipes in slabs on grade. Place minimum 4 inches below slab.

D. Set items such as bolts, anchors, piping, and frames in concrete as shown.

E. Place items constructed of dissimilar metals to avoid physical contact with reinforcing. Secure item and reinforcing to ensure they will not shift and come into contact during concrete placement. Contact between reinforcing steel and other metal, other than bare, coated, or plated carbon steel not permitted.

3.08 REPAIR OF SURFACE DEFECTS

A. General:

1. Prior to starting repair work, obtain Engineer’s approval of proposed repair techniques and materials.
2. Method of repair shall not adversely affect the appearance of the finished structure.
3. Develop repair techniques on portion of as-cast surface selected by Engineer. Surface of repair remaining exposed to view shall match color and texture of adjacent surfaces.
4. Prepare surfaces, apply and install materials, and cure as recommended by material manufacturers.

B. Tie Holes: Fill plastic cone snap tie holes with Patching Mortar. Fill taper tie through-bolt form tie holes with Non-Shrink Grout.

C. Defective Areas:

1. Remove honeycombing, stone pockets, spalls, and other defective concrete down to sound concrete. If chipping required, make edges perpendicular to surface. Do not feather edges.
2. Fill defective area with Patching Mortar.

D. Leaks or Wet Spots:

1. Inject, patch and repair areas where leaks or wet spots have occurred inside dry structures.
2. Inject, patch and repair areas where leaks or wet spots have occurred in wet wells, basins, tanks, and other structures which are to hold water in accordance with Section 03 08 10.

3.09 FINISHING SLABS AND FLATWORK

A. Slab Finishes:

Description	Concrete Finish
Surfaces to Receive Grout or Topping	Float
Submerged and Buried Slabs	Float
Sealer Applied Floors and Slabs	2Trowelings
Exterior Exposed Slabs	Float and Broom Finish

B. After placement, screed concrete with straightedges, power strike-offs or vibrating screeds.

C. After screeding, bull float or darby surfaces to eliminate ridges and to fill in voids left by screeding.

D. Float:

1. Use magnesium or aluminum hand floats or power floats with slip on float shoes.
2. Float finish shall result in uniform smooth granular texture.

E. Trowel:

1. Use steel trowels.
2. Use power or hand troweling.
3. Final troweling shall be by hand and continue until concrete surface consolidated to uniform, smooth, dense surface free of trowel marks and irregularities.

F. Broom Finish: Use fine, soft-bristled broom and broom at right angles to direction of traffic to give nonskid finish approved by Engineer.

G. Floor Sealer:

1. Apply in accordance with manufacturer's written instructions.
2. Apply first cost after final troweling, surface water glaze has dissipated, and when surface is hard enough to sustain foot traffic on same day as pour.
3. When floor has been water cured, apply first coat after curing has been completed. Apply within one day of floor being dry enough for application.
4. Apply second coat after Work completed and ready for occupancy.

H. For special coatings or finishes, see room finish schedule.

I. Tolerances:

1. Concrete slabs shall be within 3/16 inch of 10 foot straightedge in all directions except where slabs are dished for drains. Deviations from elevation indicated shall not exceed 3/4 inch.
2. Pitch floor to floor drains minimum 1/8 inch per foot or as shown. Pitch bottom of slab or beam to match top slope to maintain thickness or depth indicated. As an alternate, bottom of slab or beam may be placed level provided that min thickness or depth is maintained.

3.10 FINISHING FORMED CONCRETE

A. As-Formed Finish: Finish resulting directly from formwork for surfaces which will be hidden from view by earth, submergence in water, or subsequent construction.

1. Repair surface defects as specified herein.
2. Where joint marks or fins on submerged surfaces exceed 1/4 inch, grind smooth.

B. Smooth Finish: Interior concrete surfaces permanently exposed to view and concrete surfaces scheduled to be coated.

1. Repair surface defects as specified herein.
2. Grind joint marks and fins smooth with adjacent surface. Remove stains and rinse.
3. Dampen concrete and paint entire surface with Cement Grout. Work grout into surface with suitable float. When grout has set to where it will not be pulled out of holes or depressions, brush off surface with burlap or carpet.
4. Prepare surface to be coated in accordance with Section 09 96 00 and coating manufacturer's recommendations.

C. Rubbed Finish: Exterior concrete surfaces permanently exposed to view extending to 6 inch below finished grade or liquid level.

1. Repair surface defects as specified herein.
2. Grind joint marks and fins smooth with adjacent surface. Remove stains and rinse.
3. Apply heavy coat of Finishing Grout. After first coat has set, apply second coat. When second coat has set, float to uniform texture.
4. Follow manufacturer's written recommendations.
5. Finish color shall be gray.

3.11 PROTECTION AND CURING

A. Protect concrete from frost and keep moist for min curing period of 7 days after placement in accordance with ACI 308.

B. Formed Surfaces:

1. Wet cure by spraying surfaces as frequently as drying conditions may require to keep concrete surfaces moist.
2. Surfaces may be cured by leaving forms in-place. For vertical surfaces, apply water to run down inside of forms, if necessary, to keep concrete moist.
3. After forms are removed, wet cure for remainder of curing period or apply curing compound.
4. Do not use curing compound where mortar, grout, concrete, or other coatings or adhesives will be applied.

C. Flatwork:

1. Cure using curing compound or wet cure.
2. Do not use curing compound where mortar, grout, concrete, or other coatings or adhesives will be applied.

D. Curing Compound:

1. Apply curing compound at uniform rate sufficient to comply with requirements for water retention as specified and as measured in accordance with ASTM C156.

2. Cover areas subjected to direct sunlight with ambient temperature expected to exceed 80°F with white pigmented compound, other surfaces may be covered with fugitive dye compound.

E. Protect from damaging mechanical disturbances, load stresses, heavy shock, and excessive vibration.

F. Protect finished concrete surfaces from damage caused by construction equipment, materials, and methods, and from rain or running water.

G. Do not load self-supporting structures to overstress concrete.

3.12 REMOVAL OF FORMING AND SHORING

A. Do not remove forming or shoring until member supported has acquired sufficient strength to safely support own weight and any imposed loads. Forming shall remain in place for at least min time recommended by ACI 347. In addition, forming for horizontal members shall remain in place minimum 7 days. In no case shall forming for horizontal members be removed before concrete has reached 70% of specified design strength.

B. Reshore areas as required to carry additional imposed loads.

3.13 FIELD QUALITY CONTROL

A. Obtain samples of concrete in accordance with ASTM C172. Place cylinders on-site where they can be stored under conditions similar to concrete they represent without being disturbed for first 24 hours.

B. Make slump tests daily and when requested by Engineer, in accordance with ASTM C143. Make slump tests from same load from which strength tests are made.

C. Make air content tests daily and when requested by Engineer, in accordance with ASTM C231. Make air content tests from same load from which strength tests are made.

D. If measured slump or air content falls outside specified limits, make check test immediately on another portion of same sample. In event of second failure, concrete shall be considered to have failed to meet requirements of Specifications and will be rejected.

E. Make strength test for each of the following conditions for each class of concrete

1. Each day's pour.
2. Each change of source.
3. Each 100 cubic yards poured.

F. Strength test for each class of concrete consists of 4 cured standard cylinders made from composite samples secured from same load of concrete in accordance with ASTM C172. Make compressive strength tests on 1 cylinder at 7 days and 2 cylinders at 28 days. Test results at 28 days shall be average strength of 2 specimens as determined in accordance with ASTM C39. Test remaining cylinder if needed.

1. When temperatures are expected to fall below 45°F within 48 hours after concrete placement, make 2 additional cylinders and cure in the field under conditions similar to concrete they represent. Test 1 cylinder at 7 days and the other at 28 days.

G. Strength of concrete considered satisfactory if following requirements met.

1. Average of all sets of 3 consecutive strength tests equal or exceed specified 28-day compressive strength.
2. No individual strength test falls below specified 28-day compressive strength by more than 500 pounds per square inch.

H. If analysis of strength tests indicate above requirements are not being met, make immediate adjustments to mix design and make additional tests as required by Engineer to determine strength of concrete in-place in portion of structure represented by deficient cylinders. If tests verify Work in-place is not in conformance with Specifications, Engineer will determine if Work in-place is adequate for intended use. If Work in-place is determined to be inadequate, Contractor shall follow such remedial or replacement measures which Engineer may require. Contractor shall bear costs associated with testing, engineering analysis, remedial work, and replacement required under terms of this paragraph.

END OF SECTION

SECTION 03 62 00
NON-SHRINK GROUTING

PART 1 – GENERAL

1.01 SUMMARY

A. Cement based grout for setting equipment and column base plates.

1.02 RFERENCES

A. ASTM: American Society for Testing and Materials

1.03 SUBMITTALS

A. Product Data:

1. Manufacturer’s literature.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Manufacturers:

1. Five Star Grout by Five Star Products, Inc.
2. SET Grout by BASF.
3. Duragrout by L&M Construction Chemicals, Inc.
4. SikaGrout 212 by Sika Corp.

B. Grout:

1. Preblended, cement based, nonmetallic, nongas forming, nonshrink and shall not bleed.
2. Comply with ASTM C1107 and CRD C621, Grade B.
3. Moderate fluidity.
4. 5000 pounds per square inch minimum compressive strength.

C. Water: Potable.

PART 3 – EXECUTION

3.01 PREPARATION

A. Clean grout contact surfaces of oil, grease, scale, and other foreign matter.

B. Chip away unsound concrete leaving surface rough but level.

C. Clean base plates, rails, anchors, bolts, etc. in contact with grout of oil, grease, dirt, and coatings.

3.02 MIXING AND PLACING

A. Mix and place in accordance with manufacturer’s written instructions.

B. Provide forming materials where necessary to retain grout until hardened.

C. Work grout from one side. Avoid trapping air under base plate.

D. Do not load grout until it has reached a minimum of 3000 pounds per square inch compressive strength.

3.03 CURING

A. Cure as recommended by grout manufacturer.

END OF SECTION

DIVISION 04

MASONRY

SECTION 04 22 00
CONCRETE UNIT MASONRY

PART 1 – GENERAL

1.01 SUMMARY

A. Provide concrete unit masonry where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. ACI: American Concrete Institute

1.03 SUBMITTALS

A. Shop Drawings:

1. Source, material certificates, and proportions by weight of cement, fine and coarse aggregates, and admixtures for mortar and masonry grout.
2. Bar reinforcement shop drawings.

B. Product Data:

1. Wall reinforcing and anchors manufacturer's literature.

C. Miscellaneous Submittals:

1. Material certification for masonry units. Test data shall not be more than 3 year old.

D. Submit in accordance with Section 01 33 00.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units above ground on level platforms which allow air circulation under the stacked units.

B. Cover and protect against wetting prior to use.

C. Deliver decorative units packaged in manner to prevent damage.

1.05 PROJECT / SITE CONDITIONS

A. Cold Weather Protection:

1. Temperature of masonry units shall not be less than 32°F when laid.
2. When air temperature falls below 40°F or when temperature of masonry units is below 40°F:

a. Remove visible ice on masonry units before unit is laid.
b. Heat mortar sand or mixing water to produce mortar temperature between 40°F and 120°F.

c. When air temperature is between 25°F and 40°F, completely cover masonry by covering with weather resistant membrane for 24 hours after construction.
d. When air temperature is between 20°F and 25°F, use heat sources, install wind breaks when wind velocity exceeds 15 miles per hour, and completely cover masonry with insulating blankets for 24 hours after construction.
e. When air temperature is below 20°F, provide enclosure and use heat source to maintain temperature within enclosure above 32°F for 24 hours after construction.

B. Hot Weather Protection:

1. When air temperature exceeds 100°F, or 90°F with wind velocity greater than 8 miles per hour:

a. Do not spread mortar more than 4 feet ahead of masonry.
b. Set units within 1 minute of spreading mortar.

PART 2 – PRODUCTS

2.01 MORTAR AND GROUT

A. Materials:

1. Portland Cement: ASTM C150, Type I.
2. Masonry Cement: ASTM C91, Type S.
3. Lime: Hydrated lime, ASTM C207, Type S.
4. Aggregates:

a. Mortar: ASTM C144, acceptable in color, 10% passing No. 100 sieve.
b. Masonry Grout: ASTM C404.

5. Water: Potable.
6. Do not use antifreeze compounds.

B. Proportions:

1. Mortar: ASTM C270, property specification Type S (1800 pounds per square inch).
2. Masonry Grout: ASTM C476 (2500 pounds per square inch minimum).

2.02 CONCRETE MASONRY UNITS

A. Hollow Normal Weight Concrete Block: ASTM C90.

B. Provide special block for corners, control joints, jambs, sills, lintels, bond beams, etc. Joints at outside corners are not acceptable.

C. Provide bull nose edges where shown and at all interior exposed vertical corners, including door and window openings.

2.03 REINFORCEMENT AND ANCHORS

A. Horizontal Joint Reinforcement:

1. Truss-Mesh, Ladder-Mesh, Ladder-Tri-Mesh, Ladder-Box-Mesh, Truss-Box-Mesh, Adjustable Ladder, Adjustable Truss by Hohmann & Barnard, Inc.
2. 2 or 3 longitudinal 9 gauge galvanized rods welded to 9 gauge cross rods at 16 inches on center, conforming to ASTM A82.

3. Provide special manufactured corner and wall intersection pieces.
4. Zinc coated.

    a. Interior walls: ASTM A641, Class I.

B. Reinforcing Bars: Conform to requirements of Section 03 20 00.

C. Dovetail Anchor Slots and Anchors:

1. 20 gauge galvanized dovetail foam filled anchor slots compatible with anchors.
2. 16 gauge by 1 inch galvanized corrugated, dovetailed metal anchor straps. Where heavy duty anchors are called for, provide 3/16 inch thick anchor straps.
3. Zinc coated in accordance with ASTM A153, Class B2.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 CONCRETE MASONRY UNITS

A. General:

1. Lay only dry masonry units.
2. Use masonry saws to cut and fit masonry units.
3. Set units plumb, true to line, and with level courses accurately spaced.
4. Clean the top surface of foundation free from dirt and debris prior to start of installing first course.
5. Accurately fit the units to plumbing, ducts, openings, and other interfaces, neatly patching all holes.
6. Keep the walls continually clean, preventing grout and mortar stains. If grout does run over, clean immediately.

B. Unless otherwise shown on the Drawings, provide running bond with vertical joints located at center of masonry units in the alternate course below.

C. Do not use chipped or broken units. If such units are discovered in the finished wall, Engineer may require their removal and replacement with new units at no additional cost to the Owner.

D. Laying up:

1. Place units in mortar with full bed and head joints where cells are to be filled with mortar or masonry grout. Other masonry shall have face-shell bedding.
2. Align vertical cells of hollow units to maintain a clear and unobstructed system of flues.
3. Reinforce walls with continuous horizontal joint reinforcement spaced at 16 inches on center. Reinforce parapets with continuous horizontal joint reinforcement spaced at 8 inches on center. Lap reinforcement minimum of 8 inches, and stagger laps minimum of 32 inches.
4. Bond intersections of walls with horizontal joint reinforcement, conform to details shown.
5. Tie / reinforce cavity walls with horizontal joint reinforcement.
6. Where block laid against cast-in-place or precast concrete, provide vertical dovetail anchor slots at 2 feet on center with dovetail anchors at 16 inches on center.

E. Bar Reinforcement:

1. Provide reinforcement as shown on the Drawings.
2. Provide required metal accessories to ensure adequate alignment of steel during grout filling operations.
3. Unless otherwise shown, provide continuous bond beam around top of buildings at roof bearing elevation. Reinforce with 2 No. 5 bars.

F. Tooling:

1. Tool joints to a dense, smooth surface.
2. Unless otherwise shown on the Drawings, provide joints of "concave" pattern throughout.
3. Brush with soft brush to remove projecting mortar.
4. Cut mortar flush with surface on concealed surfaces.

G. Provide control joints where shown. Conform to details shown.

H. Provide reinforced masonry lintels over openings where noted and where steel lintels not provided. Form lintels by using bond beam units to match wall texture. Lintels shall bear on masonry minimum 8 inches beyond each side of opening. Openings 4 feet and less in width, that do not have a lintel scheduled, shall have 8 inch high reinforced masonry lintels reinforced with 2 No. 5 bars, double steel angle lintels or W8 beam with ledge angle lintels per details on drawings. Steel lintels shall conform to requirements of Section 05 50 00.

I. Build into masonry rough frames, metal frames, lintels, anchors, anchor bolts, inserts, sleeves, brackets, bearing plates, etc.

J. Tolerances: Conform to requirements of ACI 530.1.

3.03 GROUTING

A. Perform grouting in strict accordance with the provisions of ACI 530.1.

1. Spaces to be grouted shall be free of mortar droppings, debris, and loose aggregate.
2. Provide cleanouts at the bottom of each cell containing vertical reinforcement when pour height exceeds 4 feet.
3. Solidly fill vertical cells containing reinforcement with masonry grout.
4. Fill cores under lintels with masonry grout.
5. Consolidate grout at time of pour by puddling with a mechanical vibrator, filling all cells of the masonry, and then reconsolidating later by puddling before the plasticity is lost.

3.04 PROTECTION

A. Protect masonry from damage.

B. Cover freshly laid masonry and walls not being worked on to prevent rapid drying and to exclude rain and snow.

C. Brace walls until roof or floor system in-place.

D. Do not apply superimposed loads until completed masonry reaches design strength.

3.05 CLEANING

A. Clean as units are set, daily, and upon completion. Acid shall not be used.

B. Remove surplus mortar and leave surface clean and finished.

C. Clean acoustical block, decorative block, and glass block in accordance with manufacturer's instructions.

END OF SECTION

DIVISION 05

METALS

SECTION 05 50 00
METAL FABRICATIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide miscellaneous metal work shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Section Includes:

1. Concrete anchors.
2. Ladders.
3. Lintels.
4. Miscellaneous items.

1.02 DEFINITIONS

A. Submerged: At or below level 1 foot 6 inches above maximum water level in water holding structures.

1.03 REFERENCES

A. AISC: American Institute of Steel Construction

B. AA: Aluminum Association

C. AWS: American Welding Society

D. ASTM: American Society for Testing and Materials

E. AISI: American Iron and Steel Institute

F. OSHA: Occupational Safety and Health Administration

1.04 SUBMITTALS

A. Shop Drawings:

1. Indicate materials, sizes, connections, anchors, and finishes.

B. Product Data:

1. Manufacturer's catalog sheets on premanufactured items.

C. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Perform shop and/or field welding required in connection with the work of this Section by certified welders in strict accordance with pertinent recommendations of AWS.

B. Conform to AISC and AA standards.

PART 2 – PRODUCTS

2.01 MATERIALS

A. In fabricating items which will be exposed to view, limit materials to those which are free from surface blemishes, pitting, and roughness.

B. Comply with following standards, as pertinent.

1. Structural Steel Shapes:

a.	W Shapes:	ASTM A992, 50 ksi.
b.	M Shapes:	ASTM A36.
c.	S, C and MC Shapes:	ASTM A36.
d.	L Shapes:	ASTM A36.
e.	HP Shapes:	ASTM A572 Grade 50.
f.	HSS Square and Rectangular Shapes:	ASTM A500, Grade B, 46 ksi.
g.	HSS Round Shapes:	ASTM A500, Grade B, 42 ksi
h.	Pipe Shapes:	ASTM A53, Grade B, 35 ksi.
i.	Plates and Bars:	ASTM A36.

2. Stainless Steel:

a. Exterior and submerged uses: AISI, Type 316.
b. Interior uses: AISI Type 316.
c. Wet areas: AISI, Type 316

3. Aluminum shapes and plates: Alloy 6061-T6 or 6063-T6.
4. Floor Plate: Checkered surface aluminum plate.
5. Connection Bolts:

a. For steel members: Type 316 Stainless Steel
b. For aluminum and galvanized steel members: Type 316 Stainless steel.

6. Cast-in-place Anchor Bolts:

a. 1/2 inch minimum diameter.
b. Nonsubmerged: Type 316 Stainless steel
c. Submerged: Type 316 Stainless steel.

7. Malleable Iron: ASTM A47.
8. Cast Iron: ASTM A48, Class 35B.
9. Ductile Iron: ASTM A536, Grade 65-45-12.
10. Cast Aluminum: ASTM B26.

2.02 CONCRETE ANCHORS

A. Wedge Anchors:

1. Manufacturers:

a. Power-Stud+ SD1, SD2, SD4 or SD6 by Dewalt.
b. Kwik Bolt TZ by Hilti Corp.
c. Ankr-TITE Wedge Anchor by Wej-it Fastening Systems.
d. Strong-Bolt 2 by Simpson Strong-Tie Co., Inc.

2. Usage: In concrete.
    a. 316 stainless steel.
    b. Do not use when submerged or subjected to dynamic loads.

B. Expansion Anchors:

1. Manufacturers:

    a. Power-Bolt+ by Dewalt.
    b. HSL-3 by Hilti Corp.

2. Usage: In concrete.

    a. 316 stainless steel unless noted otherwise.
    b. Do not use when submerged, in overhead applications, or subjected to dynamic loads.

C. Sleeve Anchors:

1. Manufacturers:

    a. Lok-Bolt AS by Dewalt.
    b. HLC by Hilti Corp.
    c. Sleeve-TITE Sleeve Anchors by Wej-it Fastening Systems.
    d. Sleeve-All by Simpson Strong-Tie Co., Inc.
    e. Dynabolt by Red Head.

2. Usage: In masonry.

    a. 316 stainless steel.

D. Adhesive Anchors (Concrete):

1. Manufacturers:

    a. HIT RE 500-V3 or HIT-HY 200 Adhesive Anchor by Hilti Corp.
    b. Pure 110+ or AC200+ by Dewalt.
    c. SET-3G, SET-XP or AT-XP Adhesive System by Simpson Strong-Tie Co., Inc.
    d. A7+, G5+ or C6+ by Red Head.

2. Adhesive with 316 stainless steel stud assembly.
3. Usage:

    a. In concrete, submerged.
    b. Do not use in overhead applications.

E. Adhesive Anchors (Masonry):

1. Manufacturers:

    a. HIT-HY 270 Adhesive Anchor by Hilti Corp.
    b. AC100+ Gold by Dewalt.
    c. SET-XP Adhesive System by Simpson Strong-Tie Co., Inc.
    d. A7+ or C6+ by Red Head.

2. Adhesive with 316 stainless steel stud assembly.

3. Usage:
    a. In masonry.
    b. Grout masonry cores at anchor locations unless noted otherwise or approved by Engineer.
    c. Provide screen tube inserts for hollow masonry units or multi-wythe masonry.
    d. Do not locate anchors in vertical mortar joints.

2.03 FINISHES

A. Primer: Conform to requirements of Section 09 96 00.

2.04 FABRICATION

A. Except as otherwise shown on the Drawings or the approved Shop Drawings, use materials of size, thickness, and type required to produce reasonable strength and durability in the work of this Section.

B. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

C. Fabricate with accurate angles and surfaces which are true to the required lines and levels, with projecting corners clipped, grinding exposed welds smooth and flush, forming exposed connections with hairline joints, and using concealed fasteners wherever possible.

D. Weld shop connections and bolt or weld field connections.

E. Use AISC standard 2-angle web connections or single plate framing connections capable of supporting min of 50% of total uniform load capacity of member.

F. Connections shall consist of minimum two 3/4 inch diameter bolts or welds developing minimum of 10,000 pounds capacity.

G. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish and for the proposed use of the item. Conform to Section 09 96 00.

1. Do not coat ferrous metal surfaces embedded in concrete.
2. Coating of cast iron or ductile iron floor access hatches and pressure relief valves not required.
3. On surfaces inaccessible after assembly or erection, apply two coats of the specified primer. Change color of second coat to distinguish it from the first.
4. Coat aluminum surfaces in contact with concrete in accordance with AA and Section 09 96 00. Under no circumstances shall aluminum contact dissimilar metal.

2.05 LADDERS

A. Ladders shall conform to OSHA and local building code safety requirements.

B. Construct from AISI 316 stainless steel members.

1. Stringers: 1-1/2 inch diameter schedule 40 pipe.
2. Rungs: 1 inch diameter rod.
3. Other materials shall be minimum 1/4 inch thick.
4. Punch stringers and pass rungs through stringers, weld on both sides.
5. Fabricate brackets for fastening ladders to wall, weld to ladder.

2.06 LINTELS

A. Provide steel lintels over openings in masonry walls as noted and wherever reinforced masonry or concrete lintels are not provided.

B. Fabricate lintels from structural steel shapes as detailed, selected for straightness of section, with minimum of 8 inches bearing each side of opening.

C. Openings 1 foot to 4 feet in width without lintel scheduled, shall have double steel angle lintels or reinforced masonry lintels. Total width of horizontal legs shall be 1 inch less than nominal thickness of wall. Weld angles together. Masonry lintels shall conform to requirements of Section 04 22 00.

2.07 MISCELLANEOUS ITEMS

A. Fabricate miscellaneous framing, supports, and items of structural shapes, plates, bars, and tubing of sizes and arrangements indicated and as required.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. General:

1. Set work accurately into position, plumb, level, true, and free from rack.
2. Tolerance: 1/8 inch in 10 feet.
3. Anchor firmly into position.
4. Where field welding is required, comply with AWS recommended procedures for appearance and quality of weld and for methods to be used in correcting welding work.
5. Grind exposed welds smooth, and touchup shop prime coats.
6. Do not cut, weld, or abrade surfaces which have been hot-dip galvanized after fabrication and which are intended for bolted or screwed field connections.
7. Perform cutting, drilling, and fitting as required for proper installation. Drill field holes for bolts, do not burn holes.
8. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint the exposed areas with same material used for shop priming.

B. Concrete Anchors:

1. Do not install until concrete or masonry has reached its design strength.
2. Do not install closer than 6 bolt dia to edge of concrete or masonry, or closer than 12 bolt diameter to another anchor unless otherwise shown.
3. Minimum embedment shall be 8 bolt diameter.
4. Install in accordance with manufacturer's recommendations.

3.03 ADJUSTING AND CLEANING

A. Clean exposed surfaces, removing dirt, dust, and other foreign matter.

B. Prepare surfaces for finished painting as specified is Section 09 96 00.

END OF SECTION

SECTION 05 5316
PLANK GRATING

PART 1 – GENERAL

1.01 SUMMARY

A. Provide metal plank grating as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.02 REFERENCES

A. NAAM: National Association of Architectural Metal Manufacturers

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design Loads:

a. 100 pounds per square foot uniform live load.
b. 400 lbs moving concentrated live load.

2. 1/4 inch maximum deflection under 100 pounds per square foot uniform live load.

1.04 SUBMITTALS

A. Shop Drawings:

1. Type, layout, dimensions, fasteners, welds, and locations.

B. Product Data:

1. Manufacturer's literature.

C. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Grating shall be end product of one manufacturer to achieve standardization of appearance.

B. Conform to Metal Bar Grating Manual and NAAMM requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide shop-fabricated grating and accessories such as frames, support angles, and fasteners.

B. Grating shall be aluminum alloy 6061-T6 or 6063-T6 unpunched panels with raised longitudinal ridges for skid resistance.

C. Provide fastening devices to firmly anchor grating and treads to supports. Sections designated as removable shall not be attached to supports.

1. Minimum of 4 per panel.
2. Shall allow for repeated removal.
3. Minimum 1/4 inch bolts or self tapping screws.
4. 316 stainless steel.

D. Provide trim banding or load carrying banding on edges and cutouts welded to grating.

E. Panels shall bear on supports a minimum of 1-1/2 inches.

F. Bolt or nest individual sections together to form larger panels.

G. Minimum width of panels shall be 16 inches except for locations requiring a single piece.

H. Max width of panels shall be 48 inches.

I. Grating supports shall conform to requirements of Section 05 50 00.

2.02 ALUMINUM GRATING

A. Manufacturers:

1. IKG/Borden, Aluminum Plank.
2. Ohio Grating, Aluminum Plank.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Clearances:

1. 1/4 inch maximum from metal sections.
2. 1/2 inch maximum from concrete or masonry walls.
3. 1/4 inch maximum between sections.

END OF SECTION

DIVISION 06

WOOD, PLASTICS, AND COMPOSITES

SECTION 06 74 13
FIBERGLASS REINFORCED GRATING

PART 1 – GENERAL

1.01 SUMMARY

A. Provide fiberglass platforms consisting of fiberglass grating and support framing or support legs shown on the Drawings, as specified herein, and as needed for a complete and proper installation

B. Section Includes:

1. Design, fabrication, and erection of fiberglass grating and support framing or support legs.
2. System accessories.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. OSHA : Occupational Safety and Health Administration

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design Loads:

a. 100 pounds per square foot uniform live load.
b. 1000 pounds moving concentrated live load.

2. 1/4 inch maximum deflection under 100 pounds per square foot uniform live load for grating and treads.

3. L/240 maximum deflection for support members.

1.04 SUBMITTALS

A. Shop Drawings:

1. Type, layout, dimensions, design loads, fasteners, and locations.
2. Stamped by Structural Engineer registered in the State of Illinois.

B. Product Data:
1. Manufacturer’s literature.

C. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Grating shall be end product of one manufacturer to achieve standardization of appearance.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide shop-fabricated grating and accessories such as frames, support angles, and fasteners.

B. Seal cut edges with compatible resin.

C. Provide fastening devices to firmly anchor grating and treads to supports. Sections designated as removable shall not be attached to supports.

1. Minimum of 4 per panel, maximum 4 feet on center.
2. Shall allow for repeated removal.
3. Minimum 1/4 inch bolts or self tapping screws.
4. 316 stainless steel or fiberglass.

D. Provide additional supports at openings in grating panels.

E. Panels shall bear on supports a minimum of 1-1/2 inches.

F. Minimum width of panels shall be 16 inches except for locations requiring a single piece.

G. Maximum width of panels shall be 60 inches.

H. Concrete anchors shall conform to requirements of Section 05 50 00.

2.02 GRATING AND TREADS

A. Manufacturers:

1. Ultra Fiberglass Systems
2. Fibergrate.
3. Strongwell DURAGRATE.
4. IMCO Reinforced Plastics, Inc.
5. Corgrate Molded SM.
6. Or equal.

B. Materials:

1. Premium vinyl ester UV inhibited resin with continuous glass filament reinforcement.
2. Resin rich exterior surfaces free of air bubbles and dry glass.

C. Provide surface with skid resistant grit finish.

D. Molded square or rectangular mesh.

2.03 GRATING SUPPORT ANGLES

A. Fiberglass angles especially fabricated to be cast into the concrete to provide a suitable bearing ledge to support the grating.

B. Support angles shall be supplied by the grating manufacturer.

C. The angle materials shall meet the criteria established for Structural Shapes as described herein.

2.04 STRUCTURAL SHAPES

A. Manufacturers:

1. Ultra Fiberglass Systems
2. Dynaform by Fibergrate.
3. Pultex Series by Creative Pultrusions, Inc.
4. Extren Series by Strongwell.
5. Or equal.

B. Materials:

1. Pultruded fiberglass angles, channels, and other structural shapes.
2. Reinforcement shall consist of combination fiberglass roving, continuous strand, and veil material.
3. Premium vinyl ester UV inhibited resin with surface veil on all faces.
4. Resin rich exterior surfaces free of air bubbles and dry glass.

2.05 ADJUSTABLE SUPPORT LEGS

A. Manufacturers:

1. Ultra Fiberglass Systems
2. Fibergrate Grating Pedestals.
3. IMCO FRP Pedestals.
4. IKG/Borden Grate-Leg Pedestals.
5. Strongwell adjustable legs.
6. Or Equal.

B. Materials:

1. Fiberglass adjustable support legs.
2. Constructed of same materials as fiberglass grating.

2.06 ACCESSORIES

A. Bolts, rivets, and other connectors shall be 316 SST.

B. Concrete anchors shall be stainless steel conforming to requirements of Section 05 50 00.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install in accordance with manufacturer’s written instructions.

B. Clearances:

1. 1/4 inch maximum from metal sections.
2. 1/2 inch maximum from concrete or masonry walls.
3. 1/4 inch maximum between sections.

C. Seal cut edges with compatible resin.

END OF SECTION

DIVISION 08

OPENINGS

SECTION 08 11 16
ALUMINUM DOORS AND FRAMES

PART 1- GENERAL

1.01 SUMMARY

A. Section Includes:

1. Interior aluminum doors.
2. Aluminum frames for interior doors.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. AAMA: American Architectural Manufacture's Association

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Design and fabricate exterior assemblies to comply with requirements for system performance characteristics listed below as demonstrated by testing manufacturer's corresponding stock systems according to test methods designated.

a. Thermal Movement: Allow for expansion and contraction resulting from ambient temperature range of 120°F.
b. Wind Loading: Provide capacity to withstand loading indicated below, test in accordance with ASTM E330.

1) Uniform pressure of 20 pounds per square foot inward and 20 pounds per square foot outward.

c. Transmission Characteristics of Assemblies: Provide exterior doors with jamb and head frames complying with requirements indicated below for transmission characteristics and test methods.

1) Air Leakage: Air infiltration/linear foot of perimeter crack of not more than 0.50 cubic feet per minute for single doors and 1.0 cubic feet per minute for pairs of doors per ASTM E283 at pressure differential of 1.567 pounds per square foot.
2) Condensation Resistance: Not less than 48 condensation resistance factor per AAMA 1502.7.
3) Thermal Transmittance: U-value of not more than 0.93 Btu/ (hour per square foot per °F) per AAMA 1503.1.

1.04 SUBMITTALS

A. Product Data: Manufacturer's specifications, standard details, and installation recommendations for components of aluminum doors and frames required for project including test reports certifying products have been tested and comply with performance requirements.

B. Shop Drawings: Shop drawings for fabrication and installation of aluminum doors and frames including elevations, detail sections of typical composite members, hardware mounting heights,

anchorages, reinforcement, expansion provisions, and glazing. Use same designation as indicated on Drawings.

C. Samples: Samples of each type and color of aluminum finish on 12-inch long sections of extrusions or formed shapes and 6-inch square sheets. Where normal color and texture variations to be expected, include 2 or more units in each set of samples showing limits of such variations.

D. Submit in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Special Lite, Inc.

B. Kawneer Company, Inc.

C. Cross Aluminum Products

D. Or equal.

2.02 MATERIALS AND ACCESSORIES

A. Aluminum Members: Alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish; ASTM B221 for extrusions, ASTM B209 for sheet/plate.

B. Fasteners: Aluminum, non-magnetic stainless steel, or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum components.

1. Do not use exposed fasteners except where unavoidable. Match finish of adjoining metal.
2. Provide Phillips flat head machine screws for exposed fasteners.

C. Concealed Flashing: Dead soft stainless steel, 26 gauge minimum or extruded aluminum, 0.062 inch minimum of alloy and type selected by manufacturer for compatibility with other components.

D. Brackets and Reinforcements: Manufacturer's high strength aluminum units where feasible; otherwise, non-magnetic stainless steel or hot dip galvanized steel complying with ASTM A386.

E. Concrete/Masonry Inserts: Cast iron, malleable iron, or hot dip galvanized steel complying with ASTM A386.

F. Bituminous Coatings: Cold applied asphalt mastic.

G. Compression Weatherstripping: Manufacturer's standard replaceable stripping of either molded neoprene gaskets complying with ASTM D2000 or molded PVC gaskets complying with ASTM D2287.

H. Sliding Weatherstripping: Manufacturer's standard replaceable stripping of wool, polypropylene, or nylon woven pile with nylon fabric or aluminum strip backing, complying with AAMA 701.2.

2.03 HARDWARE

A. Conform to requirements of Section 08 71 00 unless otherwise noted herein.

B. Astragal: As recommended by manufacturer.

2.04 FABRICATION

A. General:

1. Sizes and Profiles: Required sizes for door and frame units, including profile requirements, are indicated on Drawings.
2. Prefabrication: Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to greatest extent possible. Disassemble components only as necessary for shipment and installation.
3. Preglaze door and frame units to greatest extent possible in coordination with installation and hardware requirements.
4. Do not drill and tap for surface-mounted hardware items until time of installation at Project site.
5. Perform fabrication operations including cutting, fitting, forming, drilling, and grinding of metal work preventing damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.

B. Welding: Comply with AWS recommendations to avoid discoloration. Grind exposed welds smooth and restore mechanical finish.

C. Reinforcing: Install reinforcing as necessary for performance requirements. Separate dissimilar metals with bituminous paint or other separator preventing corrosion.

D. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

E. Fasteners: Conceal fasteners wherever possible.

2.05 FRAMING SYSTEM

A. Thermal Break Construction: Fabricate aluminum framing system with integrally concealed, low conductance, thermal barrier located between exterior materials and exposed interior members eliminating direct metal-to-metal contact.

B. Fabricate frames from tubular box type members with four sides closed and min wall thickness of 0.125 inches. Open channel frames not acceptable.

2.06 FLUSH TYPE ALUMINUM DOORS

A. Systems:

1. Special Lite SL-16 Series
2. Kawneer Flushline Series
3. Cross FL-400 Series

B. Frame: Provide tubular frame members fabricated with reinforced mechanical or welded joints in accordance with manufacturer's standard fabrication methods. Limit frame exposure to 3/4 inch maximum width on door faces.

C. Core: Fabricate core of resin impregnated kraft paper honeycomb, rigid, closed-cell polyurethane insulation or rigid, noncombustible mineral insulation board.

D. Faces: Fabricate faces of aluminum sheet of 0.064 inches minimum thickness, mechanically interlocked with frame members or laminated to core and framing with waterproof glue to form door thickness of 1-3/4 inch.

E. Glazing: Provide glazed openings in doors as indicated with manufacturer's standard aluminum moldings and stops with removable stops on inside.

2.07 FINISHES

A. Class I Color Anodized Finish: AA-M12C22A42/A44 (non-specular as fabricated mechanical finish; chemical etch, medium matte; 0.7 mil minimum thick integrally or electrolytically deposited colored anodic coating).

1. Provide color as selected by Architect from within standard industry colors and color density range.
2. Color: Match existing doors.

B. Apply temporary protective coating of clear acrylic lacquer, complying with AAMA recommendations.

PART 3 - EXECUTION

3.01 PREPARATION

A. Field Measurement: Wherever possible, take field measurements prior to preparation of Shop Drawings and fabrication to ensure proper fitting of work.

3.02 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of aluminum doors and frames.

B. Set units plumb, level, and true to line without warp or rack of framing members, doors or panels. Anchor securely in place, separating aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.

C. Drill and tap frames and doors and apply surface-mounted hardware items complying with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

D. Set sill members and other members in bed of sealant as indicated or with joint fillers or gaskets as indicated to provide weathertight construction.

3.03 ADJUST AND CLEAN

A. Adjust operating hardware to function properly without binding, preventing tight fit at contact points and weatherstripping.

B. Institute protective measures and other precautions required to ensure aluminum doors and frames will be without damage or deterioration other than normal weathering at time of acceptance.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A Section includes:

1. Hardware for aluminum doors.

1.02 QUALITY ASSURANCE

A. Manufacturers: Companies specializing in manufacturing door hardware with minimum three years experience.

1.03 SUBMITTALS

A. Shop Drawings.

B. Product Data.

C. Submit in accordance with Section 01 33 00.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify package with door opening code to match hardware schedule.

B. Protect hardware from theft by cataloging and storing in secure area.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Locksets.

1. Passage Set x lever action x stainless steel x US 32D x removable core x Box Strike.

a.	L9010 x 03	Schlage
b.	8801 x CRE	Yale
c.	ML2010 x LSM	Corbin Russwin
d.	3810 x William	Hager

2. Dummy Trim Lockset x lever action x stainless steel x US 32D. Do not provide lever on inside face.

a.	L9176 x 03	Schlage
b.	CRE	Yale
c.	LSM	Corbin Russwin
d.	3827 x William	Hager

B. Hinges x 4-1/2 x 4-1/2 x US 32D.

1. BB 1191 Hager

2. FBB 191 Stanley
3. BB 4101 Lawrence

C. Closers x delayed action x AL - size as recommended by manufacturer. Install closers on room side, using parallel arms where necessary.

1. DC6000 Series Corbin Russwin
2. 4010 / 4110 Smoothee Series LCN
3. 7500 Series Norton
4. 5100 Series Hager

HO - indicates hold open

D. Flush Bolts with Dustproof Strike long enough to pass through threshold.

1. FB458 x 26D Ives
2. 0600 x 26D Baldwin
3. 555 x 26D Rockwood
4. 282D x 26D Hager

E. Astragals x Full Height Door - Clear Anodized Aluminum with thermoplastic rubber.

1. Doors with one active leaf:

a. 87C Reese
b. 352CR Pemko
c. 844SNMIL Hager

2.02 KEYING

A. Key in accordance with schedule provided by Owner.

B. Supply 5 keys for each lock.

C. Cylinder locks on doors to match existing master keying.

2.03 FINISHES

A. Manufacturer responsible for surface preparation and priming. Finish coating of doors either in plant or field. System shall comply with Section 09 96 00, refer to Schedule. Coordinate finish color with Engineer.

B. Finishes are US 32 satin stainless steel unless otherwise noted. Closer finishes may be paint.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions.

B. Use the templates provided by hardware item manufacturer.

3.03 HARDWARE SCHEDULE

A. Set No. 6.
   3 PR Butts x NRP
   1 Passage Set
   1 Dummy Trim
   2 Closers x 110 degrees x HO
   1 Astragal
   2 Flushbolts (top & bottom)

END OF SECTION

DIVISION 09

FINISHES

SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Coating of surfaces as noted on the Drawings and as specified herein, including:

1. New and existing surfaces described in Finish Schedules and notes on Drawings.
2. Interior masonry wall surfaces.
3. Exposed interior and exterior ferrous metal, ductile iron, or cast iron piping, regardless of factory-applied finish.
4. Exposed interior and exterior structural steel surfaces.
5. Exterior and interior equipment, pumps, valves, motors, etc. and all appurtenances.
6. Color-coded equipment and piping above ceilings.
7. Concrete tank and channel surfaces only where noted on drawings.
8. Copper piping and galvanized steel piping and conduit mounted to coated surfaces.
9. Steel doors and frames.
10. Existing surfaces remodeled or damaged during construction which presently have a finish. Refinish surrounding areas as required so touch-up not visible from 6 feet away.
11. Existing surfaces exposed by removals where adjacent surface has a finish. Finish areas as required so touch-up not visible from 6 ft away.
12. Touchup and finish coatings on Owner-furnished equipment, material, and appurtenant items.

B. Labeling and directional arrows on piping, equipment, valves, and ducts whether coated or not coated is specified in Section 40 05 05.

C. Do not coat the following unless specifically noted otherwise:

1. Factory-finished electrical motor control center (MCC), main instrument panels (MIP), flow indicators, and related equipment.
2. Moving parts of operating units, electrical parts, linkages, sensing devices, and motor shafts.
3. Buried equipment and piping.
4. Surfaces above ceilings.
5. Factory-finished trim.
6. Stainless steel, chrome plate, copper, bronze, galvanized surfaces, and similar finished materials.
7. Aluminum ductwork or aluminum faced insulation.
8. Aluminum louvers and trim.
9. Concrete tanks.
10. Plastic and FRP piping, equipment, and ductwork.

D. Do not coat over any code-required labels such as UL and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

E. Equipment manufacturers are responsible for surface preparation and coating of equipment, motors, and appurtenances. Equipment to be coated and coating system is identified in the equipment specification sections.

1.02 DEFINITIONS

A. Definitions as used in Finish Schedule shown on Drawings and Coating Schedule included herein.

1. Coatings: Paint or heavy duty finishes for use on surfaces subject to interior and exterior exposure, submergence, high moisture, splash, or chemical environment, including primers, sealers, fillers, and intermediate and finished coats.
2. Submerged P: Surfaces submerged in potable water plus 1 foot-6 inches above high water level.
3. Submerged NP: Surfaces submerged in non-potable liquid plus 1 foot-6 inches above high liquid level.
4. First Coat: Field primer, factory primer, or shop primer. When only one coat is required, first coat is the finished coat.
5. Second, Third, or Intermediate Coats: Successive finished coats applied over first coat.
6. DFT: Dry film thickness (mils/coat).
7. sfpg: Square feet per gallon (per coat).

1.03 SUBMITTALS

A. Product Data:

1. Manufacturer's literature including application recommendations and generic makeup for each coating scheduled.
2. Factory or shop-applied primer manufacturer's literature including application recommendations and generic makeup shall be submitted with all material and equipment submittals. All primers shall conform to the requirements of this Section.

B. Samples:

1. Actual color samples available for each coating scheduled.

C. Miscellaneous:

1. Schedules:

a. Schedule of proposed coating systems within 60 days after Notice to Proceed.
b. Schedule of proposed coating systems shall contain all information as indicated in Coating Schedule included herein.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:

1. All coatings shall conform to OSHA requirements for allowable exposure to lead and other hazardous substances.
2. All coatings in contact with potable water or within potable water reservoirs shall be NSF 61 approved.

B. Applicator Qualifications:

1. Engage an experienced applicator who has successfully completed coating system applications similar in material and extent to those indicated.

C. Single-Source Responsibility:

1. Provide coating material produced by same manufacturer for each system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to site in original containers with labels intact and seals unbroken.

B. Protect and heat or cool material storage location to maintain temperature ranges recommended by coating manufacturers, but not less than 55°F.

C. Avoid danger of fire. Oily rags and waste must be removed from buildings each night or kept in appropriate metal containers. Provide fire extinguishers of type recommended by coating manufacturer's in areas of storage and where finishing is occurring. Allow no smoking or open containers of solvent.

D. Empty containers shall have labels canceled and clearly marked as to use.

1.06 PROJECT / SITE CONDITIONS

A. Environmental Requirements:

1. Dry-heat and ventilate areas to obtain conditions recommended by coating manufacturer.
2. Relative humidity conditions as specified by coating manufacturer shall be adhered to.
3. No unprotected, unheated exterior coating shall be undertaken when cold, damp, foggy, or rainy weather appears probable, nor when the temperature of the substrate is below 55°F, unless approved in writing by coating manufacturer.
4. Maintain manufacturer's environmental requirements until coating is fully cured.
5. Apply no coating in areas where dust is being generated.
6. Testing and disposal of any waste and coating shall be the responsibility of the Contractor.

B. Protection:

1. Drop cloths shall be provided in all areas where coating is done to fully protect other surfaces.
2. Remove hardware, accessories, plates, lighting fixtures, and similar items or provide protection by masking. Upon completion, replace items or remove protection and clean.

C. It is the intent of this Section that all ferrous metal items scheduled for coating be shop-primed. If items are not shop-primed, surfaces shall be prepared and coated in the field as specified.

D. Upon Substantial Completion, remaining unused material will become property of Owner. Seal material as required for storage, mark contents with color, type, location, and shelf life, and store on Site where required by Owner. Provide minimum of two gallons of each system component and color used.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Tnemec.

B. Sherwin-Williams

2.02 MATERIALS

A. Coatings shall meet surface burning characteristics as required by code and established by ASTM E84.

B. Coating products listed in the Coating Schedule, are set as a standard of quality. Coatings of substitute manufacturers shall meet or exceed the characteristics of the products listed as established by the flowing ASTM standards; B117, C307, C413, C579, C580, C868, D870, D1014, D1653, D2047, D2240, D2370, D2794, D3363, D4060, D4141, D4541, D4585, D4587, and G85.

C. If the Contractor wishes to offer a substitute to the products specified, the request for a substitute shall conform to the requirements of Section 01 61 00.

D. The Contractor and top coat coating manufacturer shall verify the compatibility of their products with the various primers used on shop primed materials and equipment.

2.03 COLORS

A. Color shall be formed of pigments free of lead, lead compounds, or other materials which might be affected by presence of hydrogen sulfide or other gases likely to be present at Site.

B. Colors shall be as selected by Owner. System color-coding shall be as specified in Section 40 05 05.

C. Coat access doors of electrical distribution panels and grilles to match color of adjacent wall or ceiling surfaces.

D. In areas scheduled for finishing, coat exposed piping, conduit, and ducts to match color of adjacent or near surfaces, except for color-coding.

E. In areas where existing surfaces are finished, coat new exposed piping, conduit, and ducts to match color of adjacent or near surfaces, except for color-coding.

F. Equipment Colors:

1. Equipment includes pumps, blowers, valves, flow meters, etc, and associated motors, structural supports, hangers, and attached portions of electrical conduit, and other associated components.
2. Color of non-submerged equipment, including equipment with a manufacturer-applied finish coat, shall be same color as piping equipment serves; see Section 40 05 05.
3. Color of submerged equipment can be manufacturer’s standard color.

2.04 THINNING, MIXING, AND TINTING

A. Where thinning is necessary, only the products of the manufacturer furnishing the coating will be allowed. All such thinning shall be done in strict accordance with coating manufacturer’s recommendations.

B. Mix in accordance with manufacturer’s recommendations.

C. Each coat shall be slightly darker than preceding coat, unless otherwise noted. Tint undercoats similar to finish coat.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work.

B. Materials removed and replaced to correct defects due to Work placed on unsuitable surfaces shall be at Contractor's expense.

3.02 SURFACE PREPARATION

A. General:

1. All surfaces to be coated shall be prepared as specified herein and in accordance with coating manufacturer's recommendations. The object shall be to obtain a uniform, clean, and dry surface.
2. Quality of surface preparation described herein is considered a minimum. If coating manufacturer requires a higher degree of preparation, comply with coating manufacturer's recommendations.
3. Where surface dryness is questioned, test with dampness indicating instrument. Do not apply coatings over surfaces where moisture content exceeds that permitted by coating manufacturer.
4. Shop primed surfaces shall be scarified before applying top coats. Conform to top coat manufacturers recommendations.
5. If recoat time between application of primer and second coat or between top coats is exceeded, scarify surface before applying coatings. Conform to top coat manufacturers recommendations.
6. Workmanship for surface preparation shall conform to the following SSPC specifications:

    a. Solvent Clean: SP-1.
    b. Hand Tool Cleaning: SP-2.
    c. Power Tool Cleaning: SP-3.
    d. White Metal Blast Cleaning: SP-5.
    e. Commercial Blast Cleaning: SP-6.
    f. Brush-Off Blast Cleaning: SP-7.
    g. Pickling: SP-8.
    h. Near-White Blast Cleaning: SP-10.
    i. Power Tool Cleaning to Bare Metal: SP-11.
    j. Surface Preparation by Water Jetting: SP-12.

B. Ferrous Metal:

1. Ferrous metal primed in the shop shall have all rust, dust, scale, and other foreign substances removed by abrasive cleaning conforming to SSPC SP-10. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
2. Ferrous metal not primed in the shop shall be abrasive blast cleaned in the field prior to application of primer, pretreatment, or coating. Blast cleaning shall conform to SSPC SP-10 for submerged service. Blast cleaning shall conform to SSPC SP-6 for non-submerged service.
3. Prior to finish coating, primed areas that are damaged shall be cleaned and spot primed.

C. Concrete:

1. Concrete must be at least 28 days old and shall pass the overnight visqueen test for dryness before applying coating.

2. Repair surface defects / voids as recommended by coating manufacturer.
3. Concrete surfaces, including precast concrete, to be coated shall be cleaned of all form oil, curing compound, laitenance, and other foreign substances.
4. Surfaces shall be brush-off abrasive blast cleaned in order to prepare the surface for adherence of the coating system. Acid etching will be allowed only where brush blasting is impractical. Resulting surface shall have a toothed or grainy texture.
5. After cleaning, surfaces shall be washed and all dust, sand, and loose particles removed by vacuuming. If Contractor elects to blow off the surfaces with air, it shall be oil-free air and the method shall conform to OSHA requirements.

D. Galvanized Metal:

1. Where galvanized metal items are not submerged or buried, they shall be abrasive sweep blast cleaned and then solvent cleaned in accordance with SSPC SP-1.

E. Copper:

1. Where copper piping is not submergerd or buried, it shall be lightly sanded and then solvent cleaned in accordance with SSPC SP-1.

F. Plastic and FRP:

1. Where scheduled to coated, plastic and FRP shall be lightly sanded and then solvent cleaned in accordance with SSPC SP-1.

G. Aluminum:

1. Where scheduled to coated, aluminum shall be lightly sanded and then solvent cleaned in accordance with SSPC SP-1.

H. Masonry:

1. Remove loose grit and mortar.
2. Remove grease, oil, dirt, salts, or other chemicals, or other foreign substances by solvent, detergent, or other suitable cleaning methods.

I. Existing Surfaces:

1. Remove and replace or mask attachments if attachments are not to be coated.
2. Remove surface contamination such as oil, grease, loose or defective coatings, mill scale, dirt, rust, mold, mildew, mortar, efflorescence, and sealers to assure sound bonding to tightly adhered old coatings. Glossy surfaces of old coatings shall be cleaned and dulled before overcoating.
3. Sand surfaces and feather edges where chips have occurred.
4. Cut out and fill cracks or other defects to match adjacent surface.
5. Exact nature of existing coatings is not known. Check compatibility of new coating by application to small area prior to starting coating. If lifting or other problems occur, notify Engineer for direction.
6. Comply with new coating manufacturer’s recommendations for preparation of previously coated surfaces.
7. Prepare surfaces subject to submerged service as specified for new surfaces.

3.03 APPLICATION

A. Surfaces shall be dry at time of application.

B. The minimum surface temperature shall be 55°F and rising.

C. Apply in strict accordance with manufacturer's recommendations by brush, roller, spray, or other application method. The number of coats and thickness required is the same regardless of application method.

D. Each coat shall be allowed to dry in accordance with manufacturer's requirements. Drying time shall be construed to mean "under normal conditions". Where conditions other than normal exist, because of weather or because of confined space, longer times will be necessary. Units shall not be put in service until coatings are thoroughly dry and cured.

E. Surfaces to be coated that will be inaccessible in the completed work shall receive the final coat before enclosure.

F. Coatings 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. Areas cut-in by brush prior to rolling shall have uniform appearance in comparison with adjoining surfaces.

G. Make edges of coating adjoining other materials or colors sharp and clean without overlapping.

H. Concrete block walls shall be back-rolled in conjunction with application of sprayed prime coat.

I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of field applied prime coat or intermediate coat. This includes, but is not limited to: between pipe flanges, pipe flange/barrel joints, equipment fittings, and other narrow openings.

J. Finish edges of doors as specified for faces. Apply first finish coat on edges before fitting. After doors fitted and hung apply second finish coat.

K. Manufacturer-Applied Coatings:

1. Repair abraded areas on factory-finished items in accordance with equipment manufacturer's recommendations.
2. Blend repaired areas into original finish.

3.04 FIELD QUALITY CONTROL

A. Examination of Work on Site by coating manufacturer's representative shall be preformed when requested by Engineer.

B. Sampling of Materials:

1. Engineer reserves the right to select unopened containers of materials furnished for the Project and have the materials tested at an independent laboratory. Owner will pay for first tests.
2. Retests of rejected materials and tests of replacement materials shall be paid for by Contractor.
3. Remainder of contents of containers not required for testing will be returned to Contractor.

C. Coverage:

1. Before beginning Work, finish one complete room, space, surface, and item of each color scheme required, showing selected colors, finished texture, material, and workmanship. After approval, sample room, space, surface, and item shall serve as standard for similar Work.
2. If coverage is not acceptable to Engineer, Engineer reserves the right to require additional application of coating at no extra cost to Owner.

D. Work at Site, where coat of material is to be applied, shall be observed by Engineer after surface has been prepared and before application of specified prime coat and each succeeding coat, otherwise no credit for applied coat will be given and Contractor automatically assumes responsibility to recoat Work in question. Surfaces coated without such observation shall be abrasive blast cleaned, reprepared, and recoated at no addition cost to Owner. Notify Engineer when surface preparation complete, coat applied, and when ready for inspection to comply with above.

3.05 FINAL TOUCH-UP AND CLEANING

A. Prior to Substantial completion, examine coated surfaces and retouch or refinish surfaces to leave in condition acceptable to Engineer.

B. Remove masking, coatings, and other material from floors, glass, and other surfaces not scheduled to be coated.

3.06 COATING SCHEDULE

A. Scheduled thickness or coverage rate is minimum as recommended by manufacturer. Manufacturer's recommendations shall be followed, but in no case shall the thickness or coverage rate be less than scheduled.

B. Coatings shall conform to the following schedule and coating manufacturer's recommendations. Examples of surfaces to be coated may not be all inclusive.

COATINGS SCHEDULE

System No.	Generic Type	Application	Tnemec	Sherwin-Williams
1	Polyamidoamine Epoxy	Interior Concrete Block Walls / Satin	First Coat – Series N69 @ 105 sfpg, sprayed and backrolled Second Coat – Series N69 @ 150 sfpg Third Coat – Series N69 @ 165 sfpg	First Coat – Macropoxy 646 @ 90 sfpg, sprayed and backrolled Second Coat – Macropoxy 646 @ 130 sfpg Third Coat – Macropoxy 646 @ 140 sfpg
3	Polyamidoamine Epoxy	Interior Concrete Floors / Satin	First Coat – Series N69, thinned 10%, @ 115 sfpg, hand broadcast anti-skid aggregate while still wet Second Coat – Series N69 @ 190 sfpg	First Coat – Macropoxy 646, thinned 10%, @ 100 sfpg, hand broadcast anti-skid aggregate while still wet Second Coat – Macropoxy 646 @ 160 sfpg
4	Polyamidoamine Epoxy	Interior Concrete Walls / Satin	First Coat – Series N69 @ 115 sfpg Second Coat – Series N69 @ 190 sfpg	First Coat – Macropoxy 646 @ 100 sfpg Second Coat – Macropoxy 646 @ 160 sfpg
5	Polyamidoamine Epoxy	Exposed Concrete Ceilings / Satin	First Coat – Series N69, thinned 10%, @ 115 sfpg Second Coat – Series N69 @ 190 sfpg	First Coat – Macropoxy 646, thinned 10%, @ 100 sfpg Second Coat – Macropoxy 646 @ 160 sfpg
8	Modified Aromatic Polyurethane - Polyamidoamine Epoxy	Ferrous Metal, Cast Iron, Ductile Iron / Interior Non-Submerged / Satin	First Coat – Series 1 @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Series N69 @ 5 mils DFT Third Coat – Series N69 @ 5 mils DFT	First Coat – Corothane I Mio-Zinc @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Macropoxy 646 @ 5 mils DFT Third Coat – Macropoxy 646 @ 5 mils DFT
9	Modified Aromatic Polyurethane - Polyamidoamine Epoxy – Aliphatic Acrylic Polyurethane	Ferrous Metal, Cast Iron, Ductile Iron / Exterior Non-Submerged / Gloss	First Coat – Series 1 @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Series N69 @ 5 mils DFT Third Coat – Series 1074 @ 3 mils DFT	First Coat – Corothane I Mio-Zinc @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Macropoxy 646 @ 5 mils DFT Third Coat – Hi-Solids Polyurethane Gloss @ 3 mils DFT
10	Polyamide Epoxy – Polyamidoamine Epoxy	Doors, Frames, Motors and other Equipment with Non-Epoxy Primer / Interior / Satin	Lightly Hand Sand Solvent Clean SP-1 First Coat – Series 27-1255 Beige @ 3 mils DFT Second Coat – Series N69 @ 5 mils DFT	Lightly Hand Sand Solvent Clean SP-1 First Coat – Recoatable Epoxy Primer Tan @ 3 mils DFT Second Coat – Macropoxy 646 @ 5 mils DFT
11	Polyamide Epoxy – Aliphatic Acrylic Polyurethane	Doors, Frames, Motors and other Equipment with Non-Epoxy Primer / Exterior / Gloss	Lightly Hand Sand Solvent Clean SP-1 First Coat – Series 27-1255 Beige @ 3 mils DFT Second Coat – Series 1074 @ 3 mils DFT	Lightly Hand Sand Solvent Clean SP-1 First Coat – Recoatable Epoxy Primer Tan @ 3 mils DFT Second Coat – Hi-Solids Polyurethane Gloss @ 3 mils DFT
12	Polyamidoamine Epoxy	Galvanized Metal, Copper, PVC / Non-Submerged / Interior / Satin	First Coat – Series N69-1255 Beige @ 2 mils DFT, touch-up primer prior to second coat Second Coat – Series N69 @ 3 mils DFT Third Coat – Series N69 @ 3 mils DFT	First Coat – Macropoxy 646 – SW4004 @ 2 mils DFT, touch-up primer prior to second coat Second Coat – Macropoxy 646 @ 3 mils DFT Third Coat – Macropoxy 646 @ 3 mils DFT

14	Acrylic Emulsion	Insulation on Piping and Ductwork / Matte	First Coat – Series 1026 @ 200 sfpg Second Coat – Series 1026 @ 200 sfpg	First Coat – DTM Primer/Finish @ 200 sfpg Second Coat – DTM Primer/Finish @ 200 sfpg
20	Polyamide Epoxy Coal Tar	Dissimilar Metal Protection / Semi-Gloss	Scarify the Surface, SP-1 First Coat – Series 46H-413 @ 20 mils DFT	Scarify the Surface, SP-1 First Coat – HiMil Sher-Tar @ 20 mils DFT
21	Polyamine Epoxy – Polyamine Novolac Epoxy	Chemical Containment / Concrete / Interior / Gloss	Filler – Series 218 as needed to fill voids and bugholes First Coat – Series 201 @ 200 sfpg Second Coat – Series 282 @ 200 sfpg, hand broadcast anti-skid aggregate onto floor while still wet Third Coat – Series 282 @ 200 sfpg	Filler – Dura-Plate 2300 as needed to fill voids and bugholes First Coat – Corobond 100 @ 200 sfpg Second Coat – Cor-Cote EN 7000 @ 200 sfpg, hand broadcast anti-skid aggregate onto floor while still wet Third Coat – Cor-Cote EN 7000 @ 200 sfpg

Foot Notes:

1. Series N69 may be substituted for Series 1.

END OF SECTION

DIVISION 10

SPECIALTIES

SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide portable fire extinguishers and mounting brackets for surface mounted fire extinguishers as specified herein, and as needed for a complete and proper installation.

1.02 SUBMITTALS

A. Product data:

1. Manufacturer's information and specifications and other data needed to prove compliance with the specified requirements.
2. Mounting instructions.

B. Shop Drawings: Mounting brackets. Include plans, elevations, section, details and attachments to other work.

C. Maintenance Data: Contractor shall provide manufacturer’s maintenance data and coordinate with the Owner’s existing fire extinguisher service to ensure fire extinguishers submitted are capable of being integrated into the Owner’s current maintenance system.

D. Warranty: Sample of special warranty.

E. Comply with pertinent provisions of Section 01 33 00.

1.03 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10; “Portable Fire Extinguishers”

B. Listed and labeled for type, rating and classification by an independent testing agency acceptable to authorities having jurisdiction.

C. Obtain fire extinguishers through one source from a single manufacturer.

1.04 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Provide six (6) multi-purpose dry chemical fire extinguishers with UL rating of 4A:60B:C; 10 pound capacity, enameled steel tank with flexible hose and pressure gage, completely rechargeable.

B. Provide manufacturer's standard wall-mounting bracket for each fire extinguisher.

C. Service, charge, and tag each fire extinguisher not more than five calendar days prior to the Date of Substantial Completion.

2.02 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Engineer.

C. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

1. Orientation: Vertical.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install in strict accordance with the manufacturer's recommended installation procedures, anchoring all components firmly into position for long life under hard use.

B. Locate and install extinguishers and brackets in accordance with NFPA 10 and where directed by the Fire Department official.

C. Mounting Brackets: Fasten to structure, square and plumb.

D. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

E. Install mounting brackets so that the top of fire extinguishers is 54 inches above finish floor

END OF SECTION

DIVISION 22

PLUMBING

SECTION 22 00 05
PLUMBING SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes plumbing equipment, fixtures, insulation and piping systems, including:

1. Domestic Water Piping System:

a. Domestic cold water piping (W1, W2 and W3).
b. Domestic hot water piping (HW, TW, TWRE, W4).

2. Soil and Waste Piping Systems:

a. Above ground soil, waste and vent piping in buildings including traps and connections to fixtures and drains.

1.02 DEFINITIONS, ABBREVIATIONS AND ACRONYMS

A. Acronyms:

1. ABS: Acrylonitrile Butadiene Styrene
2. CPVC: Chlorinated Polyvinyl Chloride
3. CWP: Cold Working Pressure
4. DR: Dimension Ratio
5. DWV: Drain Waste Vent
6. EPDM: Ethylene Propylene Diene Monomer
7. HDPE: High Density Polyethylene
8. IDR: Inside Dimension Ratio
9. IPS: Iron Pipe Size
10. NPT: National Pipe Thread
11. O.S.&Y.: Outside Stem and Yoke
12. PE: Polyethylene
13. PEX: Crosslinked Polyethylene
14. PLC: Programmable Logic Controller, refer to Division 13 for interface requirements
15. PTFE: Polyetrafluoroethylene (Teflon®)
16. PVC: Polyvinyl Chloride
17. TEFC: Totally Enclosed Fan Cooled
18. TFE: Tetrafluoroethylene

B. Unit Abbreviations:

1. °F: Degrees Fahrenheit
2. Btu/Hr: British Thermal Units per Hour
3. CFM: Cubic Feet per Minute
4. GPH: Gallons per Hour
5. GPM: Gallons per Minute
6. HP: Horsepower
7. kW: Kilowatts
8. PSI: Pounds per Square Inch
9. RPM: Revolutions per Minute

1.03 REFERENCES

A. Code References:

1. ADA: Americans with Disabilities Act

B. Standard References:

1. ANSI: American National Standards Institute
2. ASME: American Society of Mechanical Engineers
3. ASSE: American Society of Sanitary Engineering
4. ASTM: American Society for Testing and Materials
5. AWWA: American Water Works Association
6. CISPI: Cast Iron Soil Pipe Institute
7. CDA: Copper Development Association Incorporated
8. CSA: Canadian Standards Association
9. MSS: Manufacturers Standardization Society
10. PDI: Plumbing and Drainage Institute
11. UL: Underwriters Laboratories Incorporated

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data - Submit manufacturer's technical data for all fixtures, drain, valves and equipment. Include in submittal, specifications, capacity ratings, pump curves showing scheduled operating point clearly identified, dimensions, weights, materials, accessories furnished, and installation instructions.

C. Shop Drawings - Submit assembly-type shop drawings showing unit dimensions, construction details, rough-in elevations, methods of assembly of components, and field connection details.

D. Wiring Diagrams - Submit manufacturer's electrical requirements for power supply wiring to equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

E. Maintenance Data - Submit maintenance data and parts list for piece of scheduled equipment, accessory, and control. Include this data and product data in maintenance manual in accordance with requirements of Division 1.

F. Submit in accordance with Section 01 33 00.

G. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of equipment in service.
3. Submit in accordance with Section 01 78 23.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide plumbing equipment, fixtures, insulation and piping from firms regularly engaged in manufacture of same types and sizes of equipment required, whose

products have been in satisfactory use in similar service for not less then 3 years.

B. Plumbing Code Compliance: Comply with all applicable portions of building codes pertaining to plumbing materials, construction and installation of products.

1. Illinois Department of Public Health:

a. Part 890: Illinois Plumbing Code.

2. All local plumbing codes.

C. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil waste piping systems.

D. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store equipment in clean, dry location.

1.07 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

PART 2 – PRODUCTS

2.01 GENERAL

A. Where more than one type is indicated, selection is Contractor's option or compliance with governing regulations

B. Size system drain piping as shown or, if not shown, as required to properly drain piping systems, including valves and equipment.

C. Manufacturer's equipment used as basis of design for project is name indicated in Specifications for particular type of equipment or application contained in these contract documents. If no manufacturer listed, basis of design is industry standard indicated.

2.02 DOMESTIC WATER PIPING SYSTEMS

A. Size 3 inch or smaller water (W1, HW, TW, TWRE, W4), interior, process areas:

1. Unless specifically indicated on the drawings or elsewhere to be stainless steel, material choice is Contractors option between CPVC and Stainless Steel.

a. Stainless Steel Pipe:

1) ASME B36.19M, Schedule 40, seamless stainless steel, type 304L pipe.
2) Fittings: MSS SP-114, Class 150 threaded fittings.
3) Fittings: MSS SP-114, Class 150 socket-weld fittings.

b. CPVC Pipe:

1) ASTM D2846 CPVC pipe, schedule 80.
2) Fittings: ASTM F439, socket weld joints.
3) All plastic pipe and fittings serving potable water systems shall be third party certified to comply with NSF 61.

B. Size 3 inch or smaller, non-potable water (W2 or W3):

1. Unless specifically indicated on the drawings or elsewhere to be stainless steel, material choice is Contractors option between PVC and Stainless Steel.

a. Stainless Steel Pipe:

1) ASME B36.19M, Schedule 40, seamless stainless steel, type 304L pipe.
2) Fittings: MSS SP-114, Class 150 threaded fittings.
3) Fittings: MSS SP-114, Class 150 socket-weld fittings.

b. Polyvinyl Chloride (PVC) Pipe:

1) Pipe Weight: Schedule 80, ASTM D1785.
2) Fittings: ASTM D2467, socket weld joints.
3) Joints: Solvent cement joints in accordance with ASTM D2855.

C. Size 4 inch or larger, buried or interior:

1. Cement-Lined Ductile Iron:

a. Furnish and install in accordance with Section 40 05 19.

2.03 SOIL, VENT AND STORM SYSTEM PIPING

A. Size 10 inch or smaller:

1. Polyvinyl Chloride (PVC) Pipe:

a. Pipe Weight: Type DWV, ASTM D2665.
b. Fittings: PVC Plastic, Type DWV, socket type.
c. Joints: Solvent cement joints in accordance with ASTM D2855.

2.04 VALVES

A. General:

1. Valves installed in insulated piping systems shall be furnished with extended stem as required to allow operation of valve without damage to or interference with insulation system.
2. All valves used on potable water systems (W1, HW, TW, TWRE) shall be of lead free construction suitable for potable water use, complying with NSF/ANSI 61.
3. Provide valves meeting the requirements of Section 40 05 53 and as indicated below:

a. Ball Valves 3 inch and smaller for stainless steel water service: Type V336.

b. Ball Valves 3 inch and smaller for CPVC water service: Type V360.
c. Ball Valves 3 inch and smaller for PVC water service: Type V355.
d. Ball Check Valves for CPVC water service: Type V260.
e. Gate Valve: Type V416

B. Emergency Wash Station Tempering Valve: (TWV-1)

1. Manufacturers:

a. Lawler Manufacturing Co, Model 911.
b. Or equal.

2. Emergency shower mixing valve with two independent control mechanisms which split flow in half and blend split flow to desired temperature at discharge.
3. Adjustable setpoint range to 70-90°F.
4. Thermometer at two inlets and discharge.
5. Anti-scald protection to disrupt hot water if loss of cold water.
6. Designed to comply with ANSI Z358.1.
7. Rated for 125-psi inlet pressure and 180°F inlet temperature.
8. Bronze body construction.
9. Capacity: 60 gpm at 30 psig. Capable of maintaining setpoint temperature even if hot or cold water temperature changes 30°F, or a supply pressure reduction of 50%.

2.05 FIXTURES

A. Emergency Eyewash and Showers: (EWS-1)

1. Manufacturers

a. Guardian, Model G1993.
b. Haws Drinking Faucet Co.
c. Or Equal.

2. Corrosion resistant, schedule 80 PVC construction.
3. Yellow 10 inch diameter ABS plastic shower head with 20 gpm restrictor orifice.
4. 1 inch PVC coated, brass body stay open shower valve with stainless steel actuating arm and pull rod.
5. 11.5 inch diameter yellow ABS plastic eye/face wash bowl.
6. ½ inch PVC coated, brass body stay open eyewash valve.
7. Twin face wash heads with flip-top dust cover, internal flow control, and water filter.

B. Emergency Eyewash: (EEW-1)

1. Manufacturers

a. Guardian, Model G1782.
b. Haws Drinking Faucet Co.
c. Or Equal.

2. Corrosion resistant, schedule 80 PVC construction.
3. 11.5 inch diameter yellow ABS plastic eye/face wash bowl.
4. ½ inch PVC coated, brass body stay open eyewash valve.
5. Twin face wash heads with flip-top dust cover, internal flow control, and water filter.

C. Emergency Showers: (ES-1)

1. Manufacturers

    a. Guardian, Model G1643.
    b. Haws Drinking Faucet Co.
    c. Or Equal.

2. Corrosion resistant, schedule 80 PVC construction.
3. Yellow 10 inch diameter ABS plastic shower head with 20 gpm restrictor orifice.
4. 1 inch brass body stay open shower valve with stainless steel actuating arm and pull rod.

2.06 EQUIPMENT

A. Gas-Fired Water Heaters: (090-GWH-1, -2)

1. Manufacturers:

    a. A.O. Smith, Model Cyclone Mxi, BTH-300.
    b. Or equal.

2. General: Provide fully condensing gas-fired water heaters rated at 96% thermal efficiency.
3. Heater: Working pressure of 160 psi. 1 inch tapping for relief valve. Tank shall be of seamless glass lined steel tank construction. Glass coating shall be applied on internal surfaces exposed to water after tank has been assembled and welded.
4. Volume: 119 gallon capacity.
5. Safety Controls: Equip with automatic gas shutoff device to shut off entire gas supply in event of excessive temperature in tank and pilot safety shutoff.
6. Heater shall be sealed combustion unit designed to be vented with PVC inlet and exhaust vents in a through the wall orientation.
7. Jacket: Insulate tank with foam insulation. Provide outer steel jacket with baked enamel finish.
8. 300,000 Btu/Hr input with 349 GPH recovery capacity at 100°F temperature rise.
9. Accessories: Provide brass drain valve, CSA certified and ASME rated T&P relief valve, and cold water dip tube.
10. 115 Volt, 1-phase, 60 Hertz power supply.
11. Controls: Integrated solid state temperature and ignition control device with integral diagnostics, LED fault display capability, and a digital display of temperature settings.
12. Natural gas service to water heater will be at 14 inch water column delivery pressure.
13. Provide condensate neutralization kit and concentric vent adapter with termination suitable for horizontal installation.

B. Domestic Water Expansion Tank: (090-EXT-1, -2)

1. Manufacturers:

    a. State Water Heaters, Thermoflex or Waterguard.
    b. Or Equal.

2. Provide expansion tanks with minimum 9 gallon volume with minimum acceptance volume of 3 gallon at 55 psi charge pressure, Amtrol model ST-30VC-DD.
3. Provide expansion tanks approved for potable water supplies by IAPMO.
4. Expansion tank shall be constructed of drawn steel with a bonded polymer liner.
5. Expansion tank shall have Butyl diaphragm separating the air chamber from the water-containing chamber.
6. Expansion tank shall have a field adjustable pre-charge.
7. Maximum working pressure of 150 psi.

C. Tempered Water Recirculation Pump: 090-TWRP-1

1. Manufacturers:

    a. Bell and Gosset NBF-9U/LW.
    b. Grundfos.
    c. Or equal.

2. System lubricated circulator pump.
3. 3 gpm at 6 feet of water column head.
4. 115 Volt/1-phase 41 watt power. Motor shall be non-overloading on any point on pump curve.
5. Lead-free bronze body, approved for potable water use and certified to NSF 372.
6. Union end or flanged connections.
7. Ceramic shaft supported by carbon bearings that are lubricated by circulated fluid.
8. Motor stator shall be isolated from circulating fluid though a stainless steel can and rotor shall be sheathed in stainless steel.
9. Suitable for 225°F up to 150 psig in an open system.
10. Provide with automatic timer control kit.

    a. Timer shall be a daily timer with 15 minute increments. Initially set for 15 minute run every hour.
    b. Suitable for use with 120V single phase pumps up to 16 amps.
    c. Run modes shall include off, on (continuous), and timer run.

2.07 ACCESSORIES

A. Water Hammer Arrestors:

1. Manufacturers:

    a. Precision Plumbing Products.
    b. Or Equal.

2. Provide where required by state codes, where indicated on drawings and Installation portion of this Section and as required for complete installation.
3. For CPVC or PVC piping systems:

    a. CPVC, Schedule 80 construction, conforming to ASTM standard 1784 for materials and F411 for pipe.
    b. Suitable for normal operating pressures of 35-100 psig and spike pressures to 250-psig.

4. For stainless steel piping systems:

    a. 316 stainless steel construction.
    b. Flanged or threaded end connections as dictated by unit size.
    c. Suitable for normal operating pressures of 35-500 psig and spike pressures up to 2,000 psig.

5. Where no size indicated, provide unit one line size smaller than piping system size served.

2.08 INSULATION

A. Insulate in accordance with Section 40 42 13

2.09 PIPING SPECIALTIES

A. Provide piping specialties in accordance with Section 40. Provide piping specialties from manufacturers regularly engaged in manufacture of piping specialties of type and sizes required for not less then 3 years.

B. Pipe Escutcheons: Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter and outside diameter to completely cover pipe penetration and pipe sleeve extensions. Furnish pipe escutcheons with nickel or chrome finish.

C. Pipe Sleeves and Wall Collars: Provide pipe sleeves and wall collars of one of the following:

1. Sheet Metal: Round tube with snap lock joint, welded spiral seams or welded longitudinal joint. Fabricate from galvanized steel of the following gauges, 20 gauge for smaller then 4 inch, 16 gauge up to 6 inch, 14 gauge for all pipe sizes greater then 6 inch
2. Plastic Pipe: Provide sleeves fabricated of schedule 80 PVC pipe.
3. Iron Pipe: Provide ductile iron or cast iron pipe with integrally cast intermediate collar in exterior, water supporting and water retaining walls and slabs.
4. Steel Pipe: Provide seals fabricated of schedule 40 carbon steel pipe with welded center flange. Sleeve shall be hot-dipped galvanized when used for water stoppage.

D. Mechanical Sleeve Seals: Provide modular type sleeve seals consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates designed to cause rubber sealing elements to expand when tightened. Seal shall withstand 40 feet hydrostatic head of water.

E. Sleeve Seals: Provide sleeve seals for sleeves located in exterior walls or slab on grade floors with either elastomeric joint sealant or mechanical sleeve seals as described above.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which piping and equipment is to be installed. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 GENERAL

A. All work to conform to state and local plumbing and backflow prevention codes.

B. Install fixtures and equipment in accordance with manufacturer’s installation instructions.

C. Trench, backfill and compact in accordance with Section 31 23 33.

D. Install pipe hangers, supports and anchors in accordance with local plumbing code and Section 40 05 07.

E. Install pipe insulation in accordance with Section 40 42 13.

F. Provide pipe identification in accordance with Section 40 05 97.

G. Install wall pipes, sleeves and seals in accordance with Section 40 05 09.

H. Install valves in accordance with Section 40 05 53.

I. Paint sanitary piping black after all testing is complete in accordance with Section 09 96 00.

J. Paint vent piping grey after all testing is complete in accordance with Section 09 96 00.

3.03 PIPING INSTALLATION

A. General:

1. Pressfit piping systems shall be installed in accordance with manufacturer's installation instructions including use of manufacturer's recommended crimping device.
2. Install pipe, tube and fittings in accordance with recognized industry practices, local plumbing code and ANSI B31.9 - Building Service Piping.
3. Piping installations shall achieve permanently leakproof piping systems capable of performing each indicated service without piping failure.
4. Install each pipe run with minimum joints and couplings.
5. Provide unions at each valve and equipment connection.
6. Reduce sizes, where indicated, by use of reducing fittings.
7. Align piping accurately at connections, within 1/16 inch misalignment tolerance.
8. Where equipment connections differ from pipe sizes indicated on Drawings, route piping full size as indicated on drawings to unit including isolation valve and provide reducer as required at point of connection.
9. Non-metallic piping systems buried outside of the foundation of a structure shall be installed with tracer wire in accordance with Section 33 05 05.

B. Pipe Locations:

1. Locate piping runs, except otherwise indicated, vertically and horizontally (pitched to drain), and avoid diagonal runs wherever possible.
2. Orient horizontal runs parallel with walls, building column lines and other piping.
3. Locate runs, as shown or described by diagrams, plans, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and equipment.
4. Hold piping close to walls, overhead construction, columns and other structural and permanent enclosure elements of building; limit clearance to 1/2 inch where furring is shown for enclosure for concealment of piping, but allow for insulation thickness, if any.
5. Where possible, locate insulated piping for 1.0 inch clearance outside insulation.
6. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.
7. Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable or indicated to do so.
8. Install drip pan under piping that must be run through electrical spaces.

C. Piping System Joints:

1. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
2. Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of tube fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
3. Weld pipe joints in accordance with ANSI B31.
4. Hubless Cast-Iron Joints - Comply with CISPI 310.
5. Plastic Pipe/Tube Joints - Comply with manufacturer's instructions and recommendations, and with applicable industry standards, ANSI/ASTM D 2235, and ANSI/ASTM F 402.

D. Exterior Water Piping:

1. Install exterior water service piping system in compliance with local governing regulations.
2. Water Service Piping: Extend water service piping of size and in location indicated to water service entrance at building. Provide sleeve in foundation wall for water service entry, make entry watertight. Provide gate valve at water service entry inside building; strainer, pressure gauge, test tee with valve.
3. Copper Tube: Install in accordance with recommended procedures of CDA.
4. Ductile Iron Pipe: Install in accordance with AWWA C600 and Section 40 05 19.

E. Expansion Compensation:

1. Install piping including mains, branches and runouts with sufficient offsets to allow for free expansion and contraction, sufficient to prevent leaks and overstressing of piping system.

F. Water Hammer Arrestors:

1. Install in upright position in locations and of sizes in accordance with PDI-WH-201 and elsewhere as indicated and as noted below:

   a. Provide ¾ inch unit on top of riser serving each hose outlet, hose reel, or high pressure wash system supply connection (upstream of pressure washer).
   b. Provide 2 inch unit at each W2 connection, upstream of unit isolation valve, for each polymer system units in Building 090.
   c. Provide line sized unit upsteam of each solenoid valve.

G. Installation of Soil, Storm and Vent Piping and Products:

1. Install soil and vent products in accordance with manufacturer's written installation instructions and local plumbing code.
2. General: Install underground building drains as indicated and in accordance with local plumbing code. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of piping of dirt and other superfluous material as Work progresses. Maintain swab or drag in line and pull past each joint as completed. Place plugs in ends of uncompleted piping at end of day or whenever Work stops.
3. Install horizontal piping on constant grade, avoiding pockets. Minimum grade of 1/8 inch per foot for mains and 1/4 inch per foot for branches.
4. Install cleanouts where indicated on drawings. In addition to where shown, provide cleanouts at ever 90 degree bend in soil and storm piping at maximum of 50 foot intervals for 3 inch and smaller soil piping and 100 foot intervals for 4 inch and larger soil piping.
5. Test soil and vent piping in accordance with requirement of local plumbing code.
6. Catch basin outlet pipe shall be installed with an elbow down within the basin, extending a minimum of 6 inch below the invert of the outlet pipe.

3.04 WATER SERVICE

A. Schedule any interruption of the existing water service with the Owner.

3.05 FIXTURES

A. General:

1. Install in accordance with manufacturer's written installation instructions and with local

plumbing codes.

2. Install plumbing fixtures of types indicated where shown and at indicated heights, in accordance with fixture manufacturer's written instructions, roughing-in drawings, and recognized industry practices. Ensure plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of Plumbing Code pertaining to installation of plumbing fixtures.
3. Verify locations and coordinate with architectural designs and other devices and equipment, as approved by Engineer before roughing-in connections.
4. Examine floors, substrates, and conditions under which fixture work to be accomplished.
5. Correct incorrect locations of piping and other unsatisfactory conditions for installation of plumbing fixtures.
6. Do not proceed with Work until unsatisfactory conditions corrected
7. Operation of fixtures shall be tested for proper operation and adjusted for field connections and service use, as required.
8. Fasten plumbing fixtures securely to indicated supports or building structure level and plumb. Secure plumbing supplies behind or within wall construction to be rigid and not subject to pull or push movement.
9. Protect installed fixtures from damage during remainder of construction period.
10. Do not use new fixtures during construction unless approved in writing by Owner.
11. Upon completion of installation and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance, or remove and replace with new units and proceed with retesting.
12. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site, or remove fixture and replace with new unit. Feasibility and match to be judged by Engineer. Remove cracked or dented units and replace with new units
13. Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation.

3.06 EQUIPMENT

A. General:

1. Install in accordance with manufacturer's written installation instructions and with local plumbing codes.
2. Verify locations and coordinate with architectural designs and other devices and equipment, as approved by Engineer before roughing-in connections.
3. Operation of fixtures shall be tested for proper operation and adjusted for field connections and service use, as required.

B. Water Heaters:

1. General:

a. Install in accordance with manufacturer's written installation instructions and local plumbing code.
b. Support: Set units on concrete pads, orient so controls and devices needing service and maintenance have adequate access. Level and plumb unit.
c. Pipe discharge from relief valve to 6 inch above floor.
d. Piping: Connect hot and cold water piping to units with shutoff valves and unions. Connect recirculating water line to unit with shutoff valve, check valve, and union.

2. Gas-Fired Water Heaters:

a. Install gas piping in accordance with Section 23 11 23.
b. Gas Supply: Connect to gas line with drip leg, tee, gas cock, and union; full size of

unit inlet connection. Locate piping to not interfere with service of unit.

c. Install vent piping in accordance with manufacturer's written installation instructions and local codes.
d. Install PVC vent and intake air piping through wall in sizes recommended by Manufacturer.
e. Startup: Startup, test, and adjust gas-fired water heaters in accordance with manufacturer's startup instructions, and Utility Company's requirements. Check and calibrate controls, adjust burner for maximum efficiency

3.07 VALVES

A. Install valves in accordance with manufacturer's written installation instructions and local plumbing code.

B. Sectional Valves - Install on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated.

C. Shutoff Valves - Install on inlet of each piece of plumbing equipment, and on inlet of each plumbing fixture, and elsewhere as indicated.

D. Drain Valves - Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each riser or drop in piping system, and elsewhere where indicated or required to completely drain domestic water piping system.

3.08 PIPE INSULATION

A. Insulate all W1, W2, W3, W4, HW, TW, and TWRE piping systems in their entirety.

B. Install pipe insulation in accordance with manufacturer's written installation instructions.

C. Insulation shall not be installed until testing and acceptance of piping systems has been completed.

D. Install insulation for each continuous run of piping with full-length units, do not use scraps or cut pieces abutting each other.

E. Install insulation on domestic hot, cold and horizontal storm water piping.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation, install factory molded or precut on job fabricated units.

3.09 CLEANING AND STERILIZATION

A. Clean and sterilize domestic water piping systems as required by health authorities having jurisdiction and in accordance with Section 01745 and local plumbing code.

B. All water lines 3 inch and larger shall be disinfected, samples from two consecutive days must be taken to an approved lab, and the lab analysis reports must be submitted to the Development Services Department showing that the samples have passed the tests for two consecutive days per ANSI/AWWA C651-92, the AWWA Standard for Disinfecting Water Mains.

C. Plate count must be less than 10 spc/ml.

3.10 TESTING PIPING SYSTEMS

A. Test piping system in accordance with Section 40 05 10 and local plumbing code.

3.11 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

   a. 1 workday for Installation Services.
   b. 1/2 workday for Instructional Services.
   c. 1/2 workday for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

END OF SECTION

DIVISION 23

HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Drawings and General Requirements of contract including General and Supplementary Conditions and Division 1 specification sections apply to work of this Section.

B. Extent of testing, adjusting, and balancing work is indicated by requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to:

1. Air distribution systems and associated equipment.
2. Heating water supply and return systems.

C. The work consists of setting speed and volume (flow) adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required by contract documents.

D. Component types of testing, adjusting, and balancing specified in this section includes the following as applied to mechanical equipment:

1. Odorous Air Fan (M-11-23-2)
2. Relocated hot water unit heater (090-HWUH-7)

1.02 QUALITY ASSURANCE

A. A firm certified by National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) in those testing and balancing disciplines similar to those required for this project.

B. Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated and NEBB "Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems".

1.03 SUBMITTALS

A. Submit certified test reports signed by Test and Balance (TAB) Supervisor who performed TAB work.

B. Reports shall be on NEBB forms unless other forms have been approved by the Engineer prior to the start of testing.

C. Include identification and types of instruments used and their most recent calibration date with submission of final test report.

D. Include copies of certified test reports in maintenance manuals.

1.04 JOB CONDITIONS

A. Do not proceed with testing, adjusting, and balancing work until work has been completed and is operable. Ensure that there is no work still to be completed.

B. Do not proceed until work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt and discarded building materials.

PART 2 - PRODUCTS

2.01 PATCHING MATERIALS

A. Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

B. At Tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Do not proceed with TAB work until unsatisfactory conditions have been corrected in manner acceptable to Tester.

3.02 TEST AND ADJUSTMENT

A. Test, adjust and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards.

B. Prepare report of test results, including instrumentation calibration reports, in format recommended by applicable standards.

C. Air side system balancing shall include but not be limited to the following procedures:

1. Test and record motor full load amperage.
2. Check all fans for correct rotation.
3. Do not drill holes into PVC ductwork.

D. Water side system balancing shall include but not be limited to the following procedures:

1. Adjust water systems to provide required or design quantities.
2. For pumps operating with pressure controlled VFDs, pump speed shall first be set to lowest output that allows design flow to most remote terminal served. Measured minimum required supply water pressure shall be identified to the Temperature Controls Contractor for establishing setpoint in the FMS.
3. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance; where flow metering devices are not installed, base flow balance on temperature difference across heat transfer elements in the system.
4. Adjust systems to provide indicated pressure drops and flows through heat transfer elements prior to thermal testing; perform balancing by measurement of temperature differential in conjunction with air balancing.
5. Balance system with automatic control valves fully open to heat transfer elements.

6. Adjust water distribution systems by means of balancing cocks/valves, valves, and fittings. The system balancer shall not use service or shut-off valves for balancing unless indexed for balance point.
7. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

E. Patch holes in ductwork and housings, which have been cut or drilled for test purposes, in manner recommended by original Installer.

F. Mark equipment settings, including damper control positions, fan speed control levers, and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

G. Balancing contractor shall coordinate damper position settings with temperature control contractor to verify airflows and positions. Include time for this verification. See HVAC controls specification for time included by temperature controls contractor to work with balancing contractor.

H. Balancing contractor to work with temperature control contractor and HVAC contractor to verify correct operation of entire HVAC system, before submitting report.

END OF SECTION

SECTION 23 07 00
HVAC INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Drawings and General Requirements of contract including General and Supplementary Conditions and Division 1 specification sections apply to work of this Section.

B. Extent of mechanical insulation specified in this section includes Piping and Ductwork Systems (where indicated).

1.02 QUALITY ASSURANCE

A. Installation shall meet the requirements Illinois Mechanical and Energy Codes.

B. Manufacturer - Subject to compliance with requirements, provide products of one of the following:

1. Armstrong World Industries, Inc.
2. Certainteed Corp.
3. Knauf Fiberglass
4. Manville Corp.
5. Owens-Corning Fiberglass Corp.
6. Pittsburg Corning Corp.
7. Rubatex Corp.

C. Installer - A firm with at least 3 years successful installation experience on projects with mechanical insulation similar to that required for this project.

D. Flame/Smoke Ratings - Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

1.03 SUBMITTALS

A. Product Data - Submit manufacturer's specifications and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, thickness, and furnished accessories for each mechanical system requiring insulation in accordance with Section 01 33 00.

B. Maintenance Data - Submit maintenance data and replacement material lists for each type of mechanical insulation in accordance with Section 01 78 23.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or level, affixed showing fire hazard ratings of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged insulation; remove from project site.

PART 2 – PRODUCTS

2.01 FIBERGLASS INSULATION MATERIALS

A. Fiberglass Pipe Insulation:

1. Knauf 1000° Pipe Insulation, Johns Manville Micro-lok, or equal. Preformed insulation designed for nominal pipe sizes indicated on the drawings.
2. Meeting requirements of ASTM C547, ASTM C585, and ASTM C795.
3. Rigid, molded, noncombustible construction.
4. Maximum k = 0.23 Btu in./hr sq ft °F at 75°F.
5. Jacketing as specified for intended use.

2.02 JACKETING MATERIALS

A. Colored PVC Piping Jacket Materials:

1. Heavy-duty UV resistant PVC jacketing, ASTM D1784, 30 mil thickness, solid color, Johns Manville Zeston 300 PVC, or equal.
2. Color to be as selected by Owner or Engineer.

PART 3 - EXECUTION

3.01 SYSTEM INSULATION

A. Heating Water Supply and Return Piping (HWS and HWR):

1. Insulate all interior piping:

a. Insulation: Fiberglass pipe insulation, 1-1/2 inch thickness for pipe sizes 3 inch and smaller and 2 inch thickness for pipe sizes 4 inch and larger.
b. Insulation for fittings shall be preformed with PVC jacketing.
c. Jacketing: Colored PVC.

3.02 INSTALLATION OF INSULATION

A. Install insulation products in accordance with manufacturer's written instructions.

B. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

C. Maintain integrity of vapor-barrier jackets on insulation, and protect to prevent puncture or other damage.

D. Cover fittings and similar items in each system with equivalent thickness and composition of insulation as applied to adjoining run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

E. Extend insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

F. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

3.03 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 23 11 23
FACILITIES NATURAL GAS PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. Drawings and General Requirements of Contract including General and Supplementary Conditions and Division 01 specification Sections apply to Work of this Section.

B. Extent of natural gas piping system work, is indicated on drawings and schedules, and by requirements of this Section.

C. Applications for natural gas piping systems include the following:

1. Building distribution system from existing gas service to gas-fired equipment connections.

1.02 QUALITY ASSURANCE

A. National Fuel Gas Code Compliance - Comply with applicable provisions of NFPA 54 (ANSI Z223.1) "National Fuel Gas Code", and ANSI Z223.1a "Supplement to National Fuel Gas Code".

B. International Fuel Gas Code (IFGC) by the International Code Council (ICC), Inc.

C. Local Utility Compliance - Comply with requirements of local natural gas utility.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's data for fuel gas piping systems materials and products.

B. Shop Drawings: For pressure regulating valves indicate selected valve size, orifice, and spring range for each required valve and submit valve capacity charts.

C. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

2.01 NATURAL GAS PIPING MATERIALS AND PRODUCTS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in natural gas piping systems. Where more than one type of material or product are indicated, selection is Installer's option.

2.02 BASIC PIPE, TUBE, AND FITTINGS

A. Building Distribution Piping (5 psi and below)

1. Pipe Size 2-inch and Smaller: Black steel pipe, ASTM A53.

a. Pipe Weight: Schedule 40.
b. Fittings: Malleable iron threaded.

2.03 VALVES

A. Provide valves meeting the requirements of Section 40 05 53 and as follows:

1. Equipment/Building Isolation, 2 inch and larger: Type V025.
2. Equipment Isolation, 1-1/2 inch and smaller: Type V382.
3. Pressure Regulating (up to 12,000 SCFH): Type V708

2.04 BASIC SUPPORTS, ANCHORS, AND SEALS

A. Provide supports, anchors, and seals complying with local Fuel Gas Code, Section 40 05 07, in accordance with the following listing:

1. Clevis hanger or band hangers for horizontal-piping.
2. Two-bolt riser clamps for vertical piping supports.
3. Concrete anchors and clamps for building attachments.
4. Piping indicated to be routed above the roof structure shall be supported with non-penetrating roof supports.

B. Material shall be in accordance with Section 40 05 07 with respect to the “Environment” the piping support systems are installed as indicted on Project Space Environment/Hazardous Rating Schedule found in the 001 series of Drawings.

PART 3 – **EXECUTION**

3.01 INSTALLATION OF NATURAL GAS PIPING

A. Install natural gas distribution piping in accordance with applicable codes and local utility company requirements.

B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly, and apply to only male threads of metal joints.

C. Remove cutting and threading burrs before assembling piping.

D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.

E. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.

F. Ground gas piping electrically and continuously within project, and bond tightly to grounding connection.

G. Install drip-legs in gas piping where indicated, and where required by code or regulation.

H. Install "Tee" fitting with bottom outlet plugged or capped, at bottom of pipe risers.

I. All branch connections shall be made horizontal from or vertically upward from main piping.

J. Install piping with 1" drop in 60' pipe run (0.14%) in direction of flow.

K. Install piping parallel to other piping.

L. All gas piping in concealed locations such as ceiling plenums shall have welded joints.

M. Vent all interior regulators to the building exterior. Vent termination shall be located a minimum of 10'-0" away from any outside air intake and 5'-0" from any combustion exhaust outlet.

N. Paint gas piping Safety Orange after all testing is complete in accordance with Section 09 96 00.

O. Label piping in accordance with Section 40 05 97.

P. Do not install polyethylene gas pipe inside buildings.

3.02 GAS SERVICE

A. Schedule any interruptions of existing gas service with Owner.

3.03 INSTALLATION OF SUPPORTS, ANCHORS, AND SEALS

A. Install supports, anchors, and seals in accordance with Local Fuel Gas Code and Section 40 05 07.

3.04 INSTALLATION OF VALVES

A. Install valves meeting the requirements of Section 40 05 53 and as follows:

1. Provide gas cocks at connection to gas train for each gas-fired equipment item; and on risers and branches where indicated.
2. Locate gas cocks where easily accessible, and where they will be protected from possible injury.

3.05 INSTALLATION OF PRESSURE REGULATORS

A. Install pressure regulators where indicated in accordance with manufacturer's instructions.

B. Regulators installed indoors shall be vented to outdoors.

3.06 EQUIPMENT CONNECTION

A. Connect gas piping to each gas-fired equipment item, with drip leg, union or flange, pressure regulating valve (where required), and shutoff gas cock. Comply with equipment Manufacturer's instructions.

B. All connections to outdoor, concrete pad mounted equipment and other locations where specifically indicated, shall include a flexible pipe connector.

1. This connector shall be located downstream of isolation valve.
2. For equipment fed by buried gas piping, flexible connector shall be installed between point of existing ground and first pipe support on concrete equipment pad.
3. For equipment fed by building supported above-grade gas piping, flexible connector shall be installed between last building support and first pipe support on concrete equipment pad.

C. Building and Site gas distribution systems will be at 10 psi. Any natural gas fueled component that is not suitable for stated distribution pressure shall be provided with pressure reducing valve, sized for equipment flow rate and selected to reduce pressure from distribution pressure to maximum allowable pressure of equipment served.

3.07 PIPING TESTS

A. Test natural gas piping in accordance with ANSI B31.2 or other recognized testing procedure.

END OF SECTION

SECTION 23 21 13
HYDRONIC PIPING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of hydronic piping systems work, is indicated on drawings and by requirements of this Section.

B. Applications for hydronic piping systems include the following:

1. Heating water piping systems. (HWR and HWS)
2. Heating water system manual valves

1.02 SUBMITTALS

A. Product Data; Manufacturer's specifications, catalog cuts, and literature for all items specified herein.

B. Submit all product data and coating system information specified above in one complete submittal.

C. Submit data for proposed glycol solution. Glycol solution shall match Owner’s existing supplier.

D. Shop drawings showing layout for piping systems shall be submitted in accordance with and transmitted under appropriate piping system Specification section.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of components in service.
3. Submit in accordance with Section 01 78 23.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of hydronic piping products of types, materials, and sizes required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years successful installation experience on projects with hydronic piping work similar to that required for Project.

C. Comply with applicable standards:

1. ANSI/ASME B31.9 Building Services Piping
2. Local Mechanical and HVAC Codes

PART 2 – PRODUCTS

2.01 WATER PIPING MATERIALS AND PRODUCTS

A. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated.

B. Where more than one type of materials or products are indicated, selection is Installer's option.

2.02 BASIC PIPE, TUBE, VALVES, AND FITTINGS

A. Provide pipe, tube, and fittings in accordance with the following listing. Pipe material shall be field verified and matched.

1. Pipe Size 2" and Smaller.

a. Black Steel Pipe - ANSI/ASTM A 53, A 106 or A 120.
b. Pipe Weight: Schedule 40.
c. Pipe Weight: Schedule 80 for ½" pipe.
d. Fittings: Class 125 cast-iron threaded, ANSI B16.4.

2. Pipe Size 2" and Smaller.

a. Type L Copper with soldered joints.

2.01 Valves:

A. Provide valves meeting the requirements of Section 40 05 53 and as indicated below:

1. Ball Valves: Type V305.
2. Balancing Valves, 2-in and smaller: Type V680.

2.02 BASIC SUPPORTS AND ANCHORS

A. Provide supports, anchors, and seals complying with Section 40 05 07, in accordance with the following listing:

1. Steel clevises for horizontal piping hangers and supports.
2. Two-bolt riser clamps, for vertical-piping clamps.
3. Concrete anchors, C-clamps, beam clamps, and steel brackets for building attachment.
4. Protection saddles, for saddles and shields.
5. Materials in accordance with Section 40 05 07.

PART 3 – EXECUTION

3.01 INSTALLATION OF HYDRONIC PIPING

A. Insulate piping systems in accordance with Section 23 07 00.

B. Provide adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment.

C. Expansion, Contraction, and Bending: Install piping with provisions for expansion and contraction using expansion loops, swing or expansion joints where required. Provide for expansion and contraction in mains, risers, and runouts. Do not spring or force piping during installation. Do not bend piping without use of bending machine.

D. Reduce sizes (where indicated) by use of reducing fittings. Align accurately at connection, within 1/16" misalignment tolerance.

E. Comply with ANSI B31 Code for Pressure Piping.

F. Locating piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams or details.

G. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of building; limit clearance to ½ inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. When possible, locate insulated piping for 1 inch clearance outside of insulation.

H. All vertical piping shall be installed plumb.

I. Avoid routing piping over electrical equipment. Where piping must pass over electrical equipment, provide galvanized steel drip pan below piping, minimum 1-inch deep with soldered joints.

J. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.

K. Unless indicated otherwise on Drawings, install piping level with no pitch.

L. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

M. Equipment Connections:

1. Connect piping to equipment as indicated on drawings and equipment Manufacturer's written instructions.
2. All piping serving equipment without flanged connections shall be installed with a union located between equipment isolation valve and equipment connection.
3. Where equipment connection size differs from pipe size indicated on Drawings, provide transition as required between equipment isolation valve and equipment connection.

N. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

O. Weld pipe joints in accordance with ANSI B31.

P. Provide pipe, valve, and equipment identification in accordance with Section 40 05 97. Banding colors shall be selected by Owner.

Q. Install fire seals in each fire rated wall and floor penetration installing detailed components and applying putty or caulking in accordance with Manufacturer’s instructions.

R. Install dielectric adapters between dissimilar metals within piping systems.

3.02 EXPANSION LOOPS, GUIDES, AND ANCHORS

A. Expansion: Calculate expansion from 0 degrees F to maximum operation temperature of system.

B. Guides: Provide guides to properly direct pipe movement into expansion loops and offsets.

C. Anchors: Provide anchors of an approved design to control movement in piping. Weld anchors to ferrous piping and braze anchors to nonferrous piping.

3.03 INSTALLATION OF SUPPORTS AND ANCHORS

A. Install supports, anchors, and seals in accordance with Section 40 05 07.

3.04 INSTALLATION OF VALVES

A. Install valves in accordance with manufacturer's installation instructions and Section 40 05 53.

B. Shutoff Valves: Install on inlet and outlet of each mechanical equipment item, and on inlet of heating/cooling terminal, and elsewhere as indicated.

C. Drain Valves: Provide ½ inch V305 drain at all low points in piping system.

D. Vent Valves: Provide ¼ inch V305 or manual vent valve in accordance with Section 23 21 16 at all high points in piping system.

3.05 INSTALLATION OF HYDRONIC SPECIALTIES

A. Install hydronic specialties in accordance with Section 23 21 16.

3.06 LEAK TESTING

A. Provide temporary equipment for testing, including pump and gauges.

B. Test piping system before insulation is installed, wherever feasible, and remove control devices before testing.

C. Subject entire piping system to leak tests, either as a whole, or in sections; but leave no part untested.

D. Provide temporary blind flanges or caps at boiler connections, boilers not to be subjected to test pressure.

E. Fill piping systems with clear water, vent all air, and pressurize at to 75-psig for 2 hours. Test fails if leakage is observed, or pressure drop exceeds 5% of test pressure.

F. Test must be witnessed by Owner's representative.

G. Repair piping systems which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

H. Retest system as required to show system is leak free.

3.07 CLEANING, FLUSHING, AND INSPECTING

A. Clean and flush system, with clear water, of all dirt, metal chips, sand, and foreign matter. Flushing must be witnessed by Owner's representative.

B. All control valves, pumps, equipment, and side tapped instrumentation shall be removed from or isolated from the flushing and cleaning procedures. These components shall be individually cleaned.

C. Initial flushing shall be accomplished by recirculation and 50 micron filtration of clean water through piping system for a minimum duration or 1 hour while maintaining a minimum velocity of 6 feet per second. Drain system, disposing of liquid as directed by Owner.

D. Clean and passivate piping with clean water and Owner's existing water treatment system supplier, recommended cleaning solution. Cleaning solution shall be recirculated through the system for a minimum 4 hours, unless shorter period acceptable to water treatment system supplier, while maintaining a minimum velocity of 6 feet per second. Drain system, disposing of liquid as directed by Owner. Cost of chemicals to be paid by Contractor.

E. Final flushing shall be accomplished by recirculation and 5 micron filtration of clean water through piping system for a minimum duration or 1 hour while maintaining a minimum velocity of 6 feet per second. Drain system, disposing of liquid as directed by Owner.

F. After flushing remove, clean, and reinstall all strainer baskets and screens.

G. Inspect each run of each system for completion of joints, supports, accessory items, and obvious leaks.

H. Obtain the services or Owner's existing water treatment system supplier to analyze system make-up water and existing water chemistry. Provide chemical additions to each water system as recommended by Owner's existing supplier. Fill HWR/HWS systems with concentration of 50% propylene glycol solution and inhibitor chemicals recommended by Owner's supplier. Cost of chemicals to be paid by Contractor.

3.08 SYSTEM BALANCING

A. All equipment and components connected to hydronic piping systems with a scheduled or specified liquid flow rate shall be balanced in accordance with Section 23 05 93.

END OF SECTION

SECTION 23 21 16
HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Applicable provisions of Division 1 and the General and Supplemental Conditions govern the Work of this Section.

B. Extent of hydronic specialties required by this Section is indicated on drawings, and/or specified in other Division 23 hydronic piping system sections.

C. Types of hydronic specialties specified in this Section include the following:

1. Vent Valves.

1.02 SUBMITTALS

A. Product Data - Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type manufactured hydronic specialty. Include pressure drop curb or chart for each type and size of hydronic specialty. Submit schedule showing manufacturer's figure number, size, location, rated capacities, and features for each required hydronic specialty.

B. Maintenance Data - Submit maintenance data and spare parts list for each type of manufactured hydronic specialty. Submit these data in Maintenance Manual in accordance with Section 01 78 23.

C. Hydronic Specialty Types - Provide hydronic specialties of same type by same manufacturer.

PART 2 - PRODUCTS

2.01 VENT VALVES

A. Provide manual stainless steel vent valves designed to be operated manually with screwdriver or thumbscrew, 1/8" N.P.T. connection.

PART 3 - EXECUTION

3.01 GENERAL

A. Install hydronic specialties where shown and as required in accordance with manufacturer's installation instructions and local codes.

3.02 INSTALLATION OF VENT VALVES:

A. Install manual vent valves on each hydronic terminal at highest point, and on each hydronic piping drop in direction of flow for mains, branches, runouts, all system high points, and elsewhere as indicated.

END OF SECTION

SECTION 23 31 16
NONMETAL DUCTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Polyvinyl chloride (PVC) ductwork and accessories.
2. PVC manual volume dampers.

1.02 SUBMITTALS

A. Submittal information is identified below:

1. Product Data: Manufacturer's specifications for duct system materials showing dimensions, wall thicknesses, weights, materials of construction, corrosion resistance characteristics, flame and smoke spread and method of construction.

B. Submit in accordance with Section 01 33 00

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:

1. SMACNA Thermoplastic Duct Construction Manual.
2. ULC S 102.2
3. ASTM E84 / UL 723.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect ductwork, accessories, and purchased products from damage during shipping, storage, and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade protected from wind.

PART 2 – PRODUCTS

2.01 PVC DUCTWORK

A. Polyvinyl Chloride (PVC) Pipe:

1. Pipe Weight: Schedule 40, ASTM D1785.
2. Fittings: ASTM D2467, socket weld joints.
3. Joints: Solvent cement joints in accordance with ASTM D2855.

A. Design Conditions:

1. Service:

a. Odorous air collection: Suitable for H2S exposure.

2. Design System Maximum Pressure: 2-In. W.C.
3. Design System Maximum Vacuum: 2-In. W.C.
4. Ambient Temperature: 0 to 115°F.

B. Joints:

1. Field joints shall flanged or socket welded.

C. Flanges:

1. Flanges shall be constructed of PVC.
2. Flanges shall be perpendicular to axis of duct to within ½˚ and flat to within 1/32-in for 18-in and smaller flanges and to within 1/16-in for 20-in and larger flanges.
3. Coordinate flange requirements with equipment connections and provide ANSI sized and drilled flanges where required. All bolting hardware shall be of 304 stainless steel construction.

D. Ducting Deflection:

1. The duct shall be designed to limit duct sag of horizontal installed round duct to less than 1% of the dia. based on the below identified support spacing.

E. Supports:

1. Duct supports shall be designed to meet the general requirements of Manufacturer's recommendations, SMACNA's Thermoplastic Duct Construction Manual., and as follows.
2. Spacing:

   a. Vertical ducts shall be supported at the base of the riser and provided with lateral support at the top of the riser.
   b. Horizontal Spacing:

      1) 6-12-in duct: 10-ft maximum.
      2) 14-24-in duct: 12-ft maximum.

   c. Where flexible connectors shown on drawings, or expansion joints recommended by ductwork Manufacturer, supports shall be provided on each side of joint.
   d. Supports shall be provided on each side of a horizontally installed valve and at the point of connection to equipment.

3. All support saddles and duct attachment components shall be of stainless steel construction.
4. All threaded rods and miscellaneous support materials (not in direct contact with duct) shall be of stainless steel construction.

F. Workmanship:

1. The finished ductwork shall be free from visual imperfections

G. Accessories:

1. Bolts, washers, and nuts: stainless steel construction.
2. Gaskets: Gaskets shall be full-faced, EPDM, minimum 1/8 inch thick and 40 – 60 durometer.

2.02 PVC DAMPERS

A. Manufacturer:

1. Harvel.
2. Or Equal.

B. General:

1. Damper manufacturer must match ductwork manufacturer.
2. PVC Round butterfly dampers or blast gate dampers shall be provided at the locations shown on Drawings. The dampers will be used to isolate and balance airflows.
3. Leakage rate shall not exceed 3 cfm/sq ft at 10-in w.c..

C. Hand Operators:

1. Heavy-duty, having a locking quadrant suitable for positioning the blade at any intermediate position.

D. Accessories:

1. Bolts, washers, and nuts: stainless steel construction.
2. Gaskets: Gaskets shall be full-faced, EPDM, minimum 3/16 inch thick and 40 – 60 durometer.

PART 3 – INSTALLATION

3.01 INSPECTION

A. General: Examine areas and conditions under which CPVC ductwork, dampers, and expansion joints/flexible connections are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. General:

1. Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight and noiseless (no objectionable noise) systems, capable of performing each indicated service.
2. Install each run with minimum number of joints.
3. Align ductwork accurately at connections, within 1/8-in. misalignment tolerance and with internal surfaces smooth.
4. Support ducts as dictated by ductwork manufacturer.
5. Support vertical ducts at every floor.
6. PVC ductwork shall not be solvent cement welded in temperatures below 40F or above 90F. Joints shall not be made in hot direct sunlight.
7. Remove all burrs and chips from any duct that has been cut. Wipe away all surface contamination on surfaces that are to be joined. The surface must be free of all moisture and condensation.
8. Apply primer to PVC surfaces as recommended by PVC manufacturer.

B. Field Fabrication:

1. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

C. Duct Routing:

1. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible.
2. Located runs as indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment.
3. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
4. Limit clearance to ½-in. where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.
5. Coordinate layout with other piping and lighting layouts.

D. Where ducts pass through interior partitions, exterior walls, floor, or roof, refer to Drawings for detail.

E. Coordinate duct installations with installation of accessories, dampers, equipment, controls, and other work associated with duct system.

3.03 FIELD QUALITY CONTROL

A. Any duct found to be improperly installed shall be removed and replaced with ductwork or fittings meeting these specifications. This shall include the following:

1. Pipe smaller than specified.
2. Construction joints not properly sealed.

3.04 EQUIPMENT CONNECTIONS

A. General:

1. Connect ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, equipment containing rotating machinery, and/or where indicated on Drawings.

3.05 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances.

B. Temporary Closure:

1. At ends of duct which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

C. Airflow testing:

1. Refer to Section 23 05 93, not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION

DIVISION 26

ELECTRICAL

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.

1.02 DEFINITIONS

A. Underfloor Conduits.

1. Conduits run underground within perimeter of building walls under building floor. This may consist of 1 conduit, or several conduits grouped together.

1.03 QUALITY ASSURANCE

A. Items provided under this Section shall be listed or labeled by Underwriters Laboratories, Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire and cable according to National Electrical Manufacturers Association (NEMA) WC 26.

PART 2 – PRODUCTS

2.01 BUILDING WIRES AND CABLES

A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as required to meet application and NEC requirements.

B. Wire and cable for 600 volts and below: Soft drawn, copper wire with 600 volt insulation.

1. Conductors:

a. Annealed, copper in accordance with American Society for Testing and Materials (ASTM) B33.
b. Stranding: Class B in accordance with ASTM B8.

2. Insulations and Coverings:

a. Rubber: Conform to NEMA WC 3.

b. Thermoplastic: Conform to NEMA WC 5.
c. Cross-Linked Polyethylene: Conform to NEMA WC 7.
d. Ethylene Propylene Rubber: Conform to NEMA WC 8.

C. Feeders, service conductors, and motor feeders: Single conductor Type XHHW-2.

D. Branch Circuits:

1. Single Conductor Type THHN/THWN (90 degrees Celsius): Above ground and underfloor conduits.
2. Single Conductor Type XHHW-2: Duct bank conduit.
3. No. 12 American Wire Gauge (AWG) minimum size (unless otherwise noted) for branch circuit wiring, including motor circuits.
4. Size 120 volt branch circuits for length of run on following basis.

a. 0 to 50 feet Run From Panelboard to first outlet: No. 12 AWG minimum.
b. 51 to 100 feet Run: Increase one wire size, i.e., No. 12 AWG becomes No. 10 AWG.
c. 101 to 150 feet Run: Increase two wire sizes, i.e., No. 12 AWG becomes No. 8 AWG.
d. 151 feet and above: Wiring sized for 3% maximum voltage drop.

5. For other branch circuits, voltage drop for branch circuits and feeder circuit combined shall not exceed requirements of the NEC 215.

E. Control Circuits:

1. Single conductor Type THHN/THWN (90 degrees Celsius): Above ground and underfloor conduits.
2. No. 14 AWG minimum size (unless otherwise noted).
3. Multi-wire cable assembly: Duct bank conduits.

F. Non-shielded Instrumentation, Graphic Indication, and Other Control Wiring Operating at Less Than 120 volt: No. 14 AWG except as otherwise indicated with same insulation as control circuits.

1. Single conductor Type THHW/THWN (90 degrees Celsius), above ground and underfloor conduits.
2. Multi-wire cable assembly: Duct bank conduits.

G. Shielded instrumentation wiring, above ground and underfloor conduits:

1. Polyvinyl Chloride (PVC) insulation, tinned copper (19 by 29) stranded, No. 16 AWG, twisted pair or triplet cabled with aluminum mylar shielding, stranded, tinned, No. 18 AWG copper drain wire, and overall black FR-PVC, 90 degrees C, 600 volt jacket.
2. Multi-wire cable assembly: duct bank conduits.

H. Multi-Wire Control and Instrumentation Cable Assemblies:

1. Multi-conductor, color-coded cable with number and size of conductors indicated.
2. Where spare conductors are not indicated provide 10% spare conductors. One pair minimum.
3. Control and non-shielded instrumentation.

a. Bare soft stranded No. 14 or 12 AWG copper in accordance with ASTM B3.
b. Class B stranded in accordance with ASTM B8.
c. Type THWN insulation also meeting requirements of NEMA WC-5 with armor-nylon in accordance with UL 83-THHN/THWN (90 degrees Celsius).
d. Color coded in accordance with NEMA WC-5 Method I Table K-2.
e. Cabled with suitable fillers.

f. Overall black FR-PVC, 90 degrees Celsius, 600 volt sunlight resistant jacket.
g. UL listed for installation in cable trays in accordance with NEC Art. 318, Class I, Division 2 hazardous areas and in accordance with NEC 340 and for direct burial.

4. Shielded Instrumentation:

a. Bare soft stranded No. 16 AWG copper in accordance with ASTM B3.
b. Class B stranded tinned copper in accordance with ASTM B8.
c. PVC with nylon armor insulation.
d. Twisted pairs color coded in accordance with NEMA WC-5 Method I Table K-2, and numbered.
e. Individual and overall aluminum mylar shields and seven strand tinned copper drain wires.
f. Overall black FR-PVC 90 degrees C 600 volt sunlight resistant jacket.
g. UL listed for installation in cable trays in accordance with NEC 318, Class I, Division 2 hazardous areas in accordance with NEC 340 and for direct burial.

2.02 CONNECTORS

A. UL-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated.

B. Select to comply with Project's installation requirements and as required to meet application.

C. Conductors No. 10 AWG and Smaller: 3M Electric Products, Skotchlok, or equal pre insulated spring connector. Comply with manufacturer's packaging requirements for number, size, and combination of conductors.

D. Conductors No. 8 AWG and Larger: Bronze 2-bolt type connectors with spacer.

2.03 TERMINATIONS

A. Power Conductors: Compression crimp type lugs.

B. Control and Instrumentation Conductors: Compression crimp type fork tongue, insulated support type lugs on terminal strips. Do not splice.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and National Electrical Contractors Association (NECA) "Standard of Installation".

B. Install permanent wire marker tags at terminations for branch, feeder, motor and control circuits.

C. Remove existing wire from raceway before pulling in new wire and cable.

D. Run wire and cable in conduit unless otherwise indicated on Drawings. Pull conductors into raceway simultaneously where more than 1 is being installed in same raceway.

1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
3. Do not draw conductor into conduits until building is enclosed, watertight, and work causing cable damage has been completed.

E. Install cable supports for vertical feeders in accordance with NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

F. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie cables in individual circuits.

G. Seal cable and wire entering building from underground between wire and conduit, where cable exits conduit, with non-hardening approved compound.

H. Install wire and cables in separate raceway systems as follows:

1. ac Control.
2. Shielded instrumentation.
3. Network Cables.
4. Fiber Optic Cables.
5. As required by NEC.

I. Where control or instrumentation cables are run in underground conduit and ducts provide multi-wire cable assemblies.

J. Where power cables and instrument/signal cables enter and pass through same distribution box, steel barrier or separate raceways shall continue through box to avoid magnetic interaction between power cables and instrumentation conductors.

K. Do not run instrumentation cables into control cabinets or Motor Control Center (MCC) unless cables are terminated in cabinet or MCC.

L. Wiring at Outlets: Install with at least 12 inch (300 millimeter) of slack conductor at each outlet.

M. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

N. Drawings do not designate number of conductors in conduit nor does location of branch circuits and switch legs indicated on Drawings designate location or routing. Route branch circuits and switch legs as dictated by construction and these Specifications.

3.02 TERMINATIONS AND SPLICES

A. Terminate control, instrumentation, and communication cables on terminal strips in separate terminal cabinets located near conduit entrances of buildings or as shown on Drawings.

B. No splices in cables unless approved by Engineer.

C. Power Cable Terminations:

1. Termination of wires with full compression type lugs installed with appropriate hand or hydraulic tool. Use proper dies to achieve the desired compression.
2. For screw type terminal blocks, terminations for stranded conductors shall be made with T & B lock-on fork connector with insulated sleeves.
3. Motor lead conductor terminations shall be made with a T & B or approved equal, full compression lug, full ring type, bolted, and taped as required. For connecting motor lead to service wiring fasten full ring lugs together with cadmium plated steel cap screws, and cover with a minimum of 2 layers 1/2 lap, 3M Scotch No. 33 tape; option: T & B "Motor Stub Splice Insulator".

3.03 CONTROL CIRCUITS

A. Control circuit home runs from same area for the same system returning to same panel, (e.g., Local Controls Panel (LCP), Control Station (CS), etc.,) may be combined provided signal and voltage types are not mixed.

B. Following types of home runs shall not be combined with other types:

1. 4-20 milliamp direct current analog; Type 2 shielded cable.
2. 24 volts direct current discrete (e.g., field or LCP powered dry contacts).

3.04 BRANCH CIRCUITS

A. Motor branch circuits and branch circuits for 3 phase circuits shall not be combined.

B. Branch circuits for single phase equipment devices from same Lighting Panel (LP) or Power Panel (PP) may be combined provided that such combining does not result in having to derate ampacity of conductors.

3.05 FEEDERS:

A. Extend feeders at full capacity from origin to termination.

B. Each conduit raceway shall contain only those conductors constituting single feeder circuit.

C. Where multiple raceways are used for single feeder, each raceway shall contain conductor of each phase and neutral if used.

D. Where feeder conductors run in parallel, conductors shall be of same length, material, circular-mil area, insulation type, and terminated in same manner.

E. Where parallel feeder conductors run in separate raceways, raceways shall have same physical characteristics.

F. Confine feeders to insulated portions of building unless otherwise shown.

G. On network systems, neutral shall be run with phase wires. Unbalanced neutral current shall not exceed normal or derated conductor capacity.

3.06 MOTORS AND EQUIPMENT WIRING

A. Provide motor circuits in accordance with diagrams and schedules on Drawings and code requirements, from source of supply to associated motor starter and starter to motor terminal box, including necessary and required intermediate connections.

B. Do not include associated control conductors in same conduit with power conductors.

C. Provide branch circuits to conform with NEC requirements and nameplate ratings. CONTRACTOR responsible for verification of ratings of motors and installing proper branch circuits.

3.07 COLOR CODING

A. Conductors for Lighting and Power Wiring:

Phase	208/120 volts	480/277 volts
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Travelers	Pink	Purple
Neutral	White	White with non-green stripe
Ground	Green	Green

B. Colored pressure-sensitive plastic tape.

1. Apply in half overlapping turns for minimum of three inches at terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes.
2. 3/4 inch wide with colors as specified.
3. Apply last two laps of tape with no tension to prevent possible unwinding.
4. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.

C. For modifications and additions to existing wiring systems, color coding shall conform to existing wiring system.

D. Color code for insulated power system wiring shall be in accordance with NEC.

E. Color code for intrinsically safe systems shall be light blue.

3.08 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

A. Install permanent wire marker at termination.

B. Identifying numbers and letters on wire markers shall correspond to those on terminal blocks or wiring diagrams used for installing systems.

C. Plastic sleeve or self adhesive vinyl cloth.
D. Comply with Section 26 05 53.

3.09 FEEDER IDENTIFICATION

A. Pullboxes and junction boxes install metal tags on circuit cables and wires to clearly designate circuit identification and voltage.

B. Comply with Section 26 05 53.

3.10 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection:

1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
2. Test cable mechanical connections to manufacturer's recommended values using calibrated torque wrench.
3. Check cable color coding with specifications and NEC standards.

B. Electrical Tests:

1. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts direct current for 1 minute.
2. Perform continuity test to insure proper cable connection.

C. Test Values:

1. Evaluation results by comparison with cables of same length and type. Investigate any value less than 50 megohms.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1– GENERAL

1.01 SUMMARY

A. Section Includes:

1. Grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems.
2. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.

1.02 SUBMITTALS

A. Report of Field Tests and Observations: Certified by Contractor.

B. Test Results:

1. Certified field tests and observation reports indicating and interpreting test reports for compliance with performance requirements.

C. Submit in accordance with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. Comply with Underwriters Laboratories, Inc (UL) 467.

B. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. Regulatory Requirements:

1. NEC: Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2– PRODUCTS

2.01 GROUNDING AND BONDING PRODUCTS

A. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, more stringent requirements and greater size, rating, and quantity indications govern.

2.02 WIRE AND CABLE GROUNDING CONDUCTORS

A. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

1. Material: Copper.

B. Equipment Grounding Conductors: Insulated with green color insulation.

C. Grounding-Electrode Conductors: Stranded cable.

D. Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.

E. Bare Copper Conductors:

1. Solid Conductors: American Society for Testing and Materials (ASTM) B3.
2. Assembly of Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.

2.03 MISCELLANEOUS CONDUCTORS

A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section.

B. Braided Bonding Jumpers: Copper tape, braided No. 3/0 American Wire Gauge (AWG) bare copper wire, terminated with copper ferrules.

C. Bonding Straps: Soft copper, 0.05 inch (1 millimeter) thick and 2 inches (50 millimeters) wide, except as indicated.

2.04 CONNECTOR PRODUCTS

A. Pressure Connectors: High-conductivity-plated units.

B. Bolted Clamps: Heavy-duty type.

C. Exothermic-Welded Connections: Provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

PART 3– EXECUTION

3.01 APPLICATION

A. Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.

1. Install equipment grounding conductor with circuit conductors for items below in addition to those required by Code:

a. Feeders and branch circuits.
b. Single-phase motor or appliance branch circuits.
c. Three-phase motor or appliance branch circuits.
d. Flexible raceway runs.
e. Armored and metal-clad cable runs.

2. Busway Supply Circuits: Install separate equipment grounding conductor from grounding bus in switchgear, switchboard, or distribution panel to equipment grounding-bar terminal on busway.
3. Nonmetallic Raceways: Install equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
4. Water Heater, Heat-Tracing, and Antifrost Heater Circuits: Install separate equipment grounding conductor to each electric water heater, heat-tracing assembly, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

B. Piping Systems and Other Equipment: Comply with NEC Article 250 for bonding requirements.

3.02 INSTALLATION

A. Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.

B. Grounding Conductors: Route along shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

D. Concrete-Encased Grounding Electrode (grounding building/structure footing): Fabricate according to NEC Article 250 using minimum of 20 feet (6 meters) of bare tinned copper conductor not smaller than No. 4 AWG or minimum 20 feet (6 meters) rebar 1/2 inch or larger in diameter. Bond grounding conductor to reinforcing steel to at least 4 locations, and to anchor bolts. Extend grounding conductor up in foundation wall.

3.03 CONNECTIONS

A. Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make visible indication that connector has been adequately compressed on grounding conductor.

G. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.04 FIELD QUALITY CONTROL

A. Testing:

1. Subject completed grounding system to megger test at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.

    a. Measure ground resistance not less than 2 full days after last trace of precipitation, and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by 2 point method according to Section 9.03 of Institute of Electrical And Electronics Engineers (IEEE) 81.

2. Maximum grounding to resistance values are as follows:

    a. Equipment Rated 500 kilovolt amps (kVA) and Less: 10 ohms.
    b. Equipment Rated 500 to 1000 kVA: 5 ohms.
    c. Equipment Rated More than 1000 kVA: 3 ohms.
    d. Unfenced Substations and Pad-Mounted Equipment: 5 ohms.
    e. Manhole Grounds: 10 ohms.

3. Excessive Ground Resistance: Where resistance to ground exceeds specified values, notify ENGINEER promptly and include recommendations to reduce ground resistance and to accomplish recommended work.

4. Report: Prepare certified test reports, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.05 RESTORATION

A. Restore disturbed surfaces in accordance with Section 32 92 00.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Supports from building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.02 QUALITY ASSURANCE

A. Items provided under this section shall be listed and labeled by Underwriters Laboratories, Inc. (UL) or other Nationally Recognized Testing laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

B. Regulatory requirements:

1. NEC: Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Indoor locations – stainless steel.

1. Where GRS conduit is used provide a dissimilar metal separation.

B. Outdoor, corrosive, wet or damp locations – 316 stainless steel.

2.02 COATINGS

A. Products for use outdoors.

B. Use Polyvinyl Chloride (PVC) coating where indicated on Drawings.

2.03 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Stainless steel wedge type or drop in type.
2. Toggle Bolts: All stainless steel springhead type.
3. Powder-Driven Threaded Studs: Heat-treated stainless steel, designed specifically for intended service.
4. Nuts, Washers, and Bolts: Stainless steel.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers.

E. U-Channel Systems: Channels, with 9/16-inch diameter holes, at minimum of 8 inch on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of same manufacture.

2.04 FABRICATED SUPPORTING DEVICES

A. Shop- or field-fabricate supports or manufacture supports assembled from U-channel components.

B. Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports. Comply with Section 05 50 00.

C. Pipe Sleeves: Provide pipe sleeves of one of following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from following gage metal for sleeve diameter noted:

   a. 3 inch and smaller: 20 gauge
   b. 4 inch to 6 inch: 16 gauge
   c. Over 6 inch: 14 gauge

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

2.05 FIRE RESISTANT JOINT SEALERS

A. Manufacturers:

1. "Dow Corning Fire Stop Foam," Dow Corning Corp.
2. "Pensil 851," General Electric Co.
3. Or equal.

B. Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.

C. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with American Society for Testing and Materials (ASTM) E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with structural system and with other electrical installation. Coordinate with light fixtures to ensure hangers and supports are not mounted lower or below light fixtures causing shadows.

C. Raceway Supports: Comply with NEC and following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by safety factor of at least four. Where this determination results in safety allowance of less than 200 pounds, provide additional strength until there is minimum of 200 pounds safety allowance in strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
6. In vertical runs, arrange support so load produced by weight of raceway and enclosed conductors is carried entirely by conduit supports with no weight load on raceway terminals.

D. Vertical Conductor Supports: Install simultaneously with installation of conductors.

E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

F. Sleeves: Install in concrete slabs and walls and other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.

G. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
2. Holes cut in concrete shall not cut main reinforcing bars. Fill holes that are not used.
3. Load applied to any fastener shall not exceed 25% of proof test load. Use vibration- and shock- resistant fasteners for attachments to concrete slabs.

END OF SECTION

SECTION 26 05 33.13
CABINETS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Outlet and device boxes.
2. Pull and junction boxes.
3. Cabinets.
4. Hinged door enclosures.

B. Conduit-body-type electrical enclosures and wiring fittings are specified in Section 26 05 33.16.

1.02 DEFINITIONS

A. Cabinets: Enclosure designed either for surface or for flush mounting and having frame, or trim in which door or doors may be mounted.

B. Device Box: Outlet box designed to house receptacle device or wiring box designed to house switch.

C. Enclosure: Box, case, cabinet, or housing for electrical wiring or components.

D. Hinged Door Enclosure: Enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with walls of box.

E. Outlet Box: Wiring enclosure where current is taken from wiring system to supply utilization equipment.

F. Wiring Box: Enclosure designed to provide access to wiring systems or for mounting of indicating devices or of switches for controlling electrical circuits.

1.03 SUBMITTALS

A. Product Data: Submit for cabinets and enclosures with classification higher than National Electrical Manufacturers Association (NEMA) 1.

B. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories, Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

B. Regulatory Requirements:

1. NEC: Components and installation shall comply with National Fire Protection Association (NFPA 70).

PART 2 – PRODUCTS

2.01 CABINETS, BOXES, AND FITTINGS, GENERAL

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for use and location. Provide items complete with covers and accessories required for intended use. Provide gaskets for units in damp or wet locations.

2.02 MISCELLANEOUS MATERIALS AND FINISHES

A. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

B. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

C. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connectors.

D. Finishes:

1. Exterior Finish: Galvanized or Gray baked enamel for items exposed in finished locations except as otherwise indicated.
2. Interior Finish: Where indicated, white baked enamel.

2.03 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

A. General:

1. Conform to UL 514A and UL 514B.
2. Boxes shall be of type, shape, size, and depth to suit each location and application.

B. Steel Boxes: Conform to NEMA OS 1. Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

C. Galvanized Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

2.04 PULL AND JUNCTION BOXES

A. General: Comply with UL 50 for boxes over 100 cubic inch volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. Galvanized Steel Boxes: Flat rolled, code gauge, sheet steel with welded seams. Where necessary to provide rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.

C. Stainless-Steel Boxes: Fabricate of stainless steel conforming to Type 304 of American Society for Testing and Materials (ASTM) A167. Where necessary to provide rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.

D. Galvanized Cast-Iron Boxes: Molded of cast iron alloy with gasketed cover and integral threaded conduit entrances.

2.05 CABINETS

A. Comply with UL 50.

B. Construction: Flat rolled, code gauge, galvanized, sheet steel, NEMA 1 class except as otherwise indicated. Cabinet shall consist of box and front consisting of 1 piece frame and hinged door. Arrange door to close against rabbet placed around inside edge of frame, with uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inch apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inch apart and not over 6 inch from top and bottom of door. For flush cabinets, make front approximately 3/4 inch larger in each dimension. For surface mounted cabinets make front same height and width as box.

C. Doors: Double doors for cabinets wider than 24 inch Telephone cabinets wider than 48 inch may have sliding or removable doors.

D. Locks: Combination spring catch and key lock, with each lock for cabinets of same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical-electrical rooms. Locks shall be of type to permit doors to latch closed without locking.

2.06 STEEL ENCLOSURES WITH HINGED DOORS

A. Comply with UL 50 and NEMA ICS 6.

B. Construction:

1. Sheet steel, 16 gauge, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.
2. Galvanized in indoor dry locations.
3. 316 stainless steel in wet indoor locations and in outdoor locations.

C. Doors: Hinged directly to cabinet and removable, with approximately 3/4 inch flange around each edge, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24 inch. Provide multiple doors where required.

D. Mounting Panel: Provide painted removable internal mounting panel for component installation.

E. Enclosure: NEMA 12 except as indicated. Where door gasketing is required, provide neoprene gasket attached with oil-resistant adhesive, and held in place with steel retaining strips. For enclosures of class higher than NEMA 1, use hubbed raceway entrances.

2.07 TERMINAL STRIPS

A. Manufacturers:

1. Square D.
2. Buchanan.
3. Or equal.

B. Channel mount snap-on type.

C. Individual gangable with nylon bases.

D. Solderless box lug type rated at 600 volts to accommodate No. 22 to 8 American Wire Gauge (AWG) wire or as otherwise indicated.

E. Provide 50% spare terminals.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Support and fasten items in accordance with Section 26 05 29.

D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

E. Remove sharp edges where they may come in contact with wiring or personnel.

3.02 APPLICATIONS

A. Cabinets: Flush mounted, NEMA Type 1 enclosure except as otherwise indicated.

B. Hinged Door Enclosures: Sheet steel, baked enamel finish, NEMA type 12 enclosure except as indicated.

C. Hinged Door Enclosures Outdoors: Galvanized sheet steel with baked enamel finish, NEMA type 12. Install drip hood, factory tailored to individual units.

D. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types for each location in conformance with following requirements unless otherwise noted:

1. Interior Dry Locations: Sheet steel, NEMA type 1 for flush mounting and feraloy Type FS or FD cast boxes with threaded conduit hubs for surface mounting.
2. Locations Exposed to Weather or Dampness: Galvanized, cast metal, NEMA Type 3R.
3. Wet Locations: 316 Stainless Steel, NEMA type 4X enclosures.
4. Corrosive Locations: 316 Stainless Steel, NEMA type 4X enclosures.
5. Metal Door Jambs: Narrow partition boxes with internal ears.

E. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types for each location in conformance with following requirements unless otherwise noted:

1. Interior Dry Locations: Sheet steel, NEMA type 1 for flush mounting and feraloy Type FS or FD cast boxes with threaded conduit hubs for surface mounting.
2. Locations Exposed to Weather or Dampness: Galvanized, cast metal, NEMA Type 3R.
3. Wet Locations: 316 Stainless Steel, NEMA type 4X enclosures.
4. Corrosive Locations: 316 Stainless Steel, NEMA type 4X enclosures.

3.03 INSTALLATION OF OUTLET BOXES

A. Outlets at Windows and Doors: Locate close to window or door trim.

B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so centers of columns are clear for future installation of partitions.

C. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install boxes without plaster rings. Saw cut recesses for outlet boxes in exposed masonry walls.

D. Gasketed Boxes: At following locations use cast metal, threaded hub type boxes with gasketed weatherproof covers:

1. Exterior locations.
2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations).
3. Where exposed to moisture laden atmosphere.
4. Where indicated.

E. Mounting: Mount outlet boxes for switches with long axis vertical or as indicated. Mount boxes for receptacles vertically. Gang boxes shall be mounted with long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on side opposite hinges and close to door trim, even though electrical floor plans may show them on hinge side.

F. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

G. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

H. Concrete Boxes: Use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6 inch depth.

I. Secure boxes rigidly to substrate upon which being mounted or solidly embed boxes in concrete or masonry. Do not support from conduit, mechanical ductwork or piping.

J. Set boxes in concealed conduit runs, flush with wall surfaces, with or without covers as required.

K. Do not install boxes back to back or through wall. Offset outlet boxes on opposite sides of wall minimum 12 inch

L. Set outlet boxes parallel to construction, securely mounted and adjusted to set true and flush with finished surface.

M. Do not burn holes, use knockout punches or saw.

N. Use handy boxes only where specifically indicated.

O. Provide outlet box divider barriers between 277/480 volt and 120/240 volt devices as required per NEC.

3.04 OUTLET BOX LOCATIONS

A. Locate flush mounted wall boxes in corner of nearest brick or block to keep cutting to minimum.

B. Location of outlets and equipment as shown on Drawings is approximate and exact location to be verified and shall be determined by:

1. Construction or code requirements.
2. Conflict with equipment or other trades.
3. Equipment manufacturer's drawings.

C. Minor modification in location of outlets and equipment considered incidental up to distance of 10 feet with no additional compensation, provided necessary instructions given prior to roughing in of outlet.

D. Mounting heights for devices and equipment to be measured from finished floor to centerline of device and unless otherwise noted on Drawings as follows.

1. Switches: 48 inch above floor.
2. Alternating Current Receptacles: 15 inch above floor or 6 inch above counters, counter backsplashes, and baseboard radiators in finished areas; 48 inch above floor in unfinished areas.
3. Pushbuttons: 48 inch above floor.
4. Motor Starters and Disconnect Switches: 60 inch above floor
5. Thermostats: 60 inch above floor.

3.05 INSTALLATION OF PULL AND JUNCTION BOXES

A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 inch sq by 4 inch deep. Do not exceed 6 entering and 6 leaving raceways in single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed following:

Size of Largest Conductors in Box	Maximum No. of Conductors in Box
No. 4/0 AWG	30
250 Kcmil	20
500 Kcmil	15
Over 500 Kcmil	10

1. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inch inside boxes.
2. Mount pull boxes in inaccessible ceilings with covers flush with finished ceiling.
3. Size: Provide pull and junction boxes for telephone, signal, instrumentation, control, and other systems at least 50% larger than would be required by the NEC for boxes smaller than 24 inch by 24 inch, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.06 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

A. Mount with fronts straight and plumb.

B. Install with tops 78 inch above floor.

C. Set cabinets in finished spaces flush with walls. For cabinets install outside caulk top and sides of cabinet to prevent water build up behind cabinet.

D. Terminate wires and cables on terminal strips.

3.07 GROUNDING

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes grounding conductor, provide grounding terminal in interior of cabinet, box or enclosure.

3.08 CLEANING AND FINISH REPAIR

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using zinc-rich paint recommended by manufacturer.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION

SECTION 26 05 33.16
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Raceways:

a. Galvanized rigid steel conduit (GRS).
b. Polyvinyl chloride (PVC) externally coated galvanized rigid steel conduit (CGRS).
c. Flexible metal conduit (FMC).
d. Liquidtight flexible metal conduit (LFMC).
e. Rigid nonmetallic polyvinyl chloride conduit (PVC).
f. Wireway (WW).

1.02 DEFINITIONS

A. Underfloor Conduits.

1. Conduits which run underground within perimeter of building walls under building floor. This may consist of one conduit, or several conduits grouped together.

B. Duct Bank Conduits

1. Conduits which run under ground outside perimeter of building walls. This may consist of one conduit, or several conduits grouped together.

C. Underground Conduits

1. Underground conduits are both underfloor conduits and duct bank conduits.

1.03 SUBMITTALS

A. Submittals are not required if Contractor supplies materials or equipment as specified. If Contractor proposes substitutions to material or equipment submittals identified below are required.

1. Product data.
2. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories, Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

B. Regulatory Requirements:

1. NEC: Components and installation shall comply with National Fire Protection Association (NFPA) 70.

C. Comply with National Electrical Contractors Association (NECA) "Standard of Installation."

PART 2 – PRODUCTS

2.01 METAL CONDUIT

A. Galvanized Rigid Steel Conduit: American National Standards Institute (ANSI) C80.1.

B. Plastic-Coated Steel Conduit and Fittings: National Electrical Manufacturers Association (NEMA) RN 1 and ETL Verified Polyvinyl Chloride-001 Labeled.

C. Flexible Metal Conduit: Zinc-coated steel.

D. Liquidtight Flexible Metal Conduit: Flexible steel conduit with Polyvinyl Chloride jacket.

2.02 NONMETALLIC CONDUIT

A. Rigid Nonmetallic Polyvinyl Chloride (PVC) Conduit: NEMA TC 2, PVC Chloride

1. Concrete Encased: Schedule 40.
2. Direct Buried: Schedule 80.

B. PVC Conduit Fittings: NEMA TC 3; match to conduit type and material.

2.03 FITTINGS

A. Fittings and conduit bodies for steel conduits:

1. Steel or malleable iron, zinc galvanized or cadmium plated.
2. Do not use set screw or indentor type fittings.
3. Do not use aluminum or die cast fittings.
4. GRS Connectors and Couplings:

a. Threaded.
b. Insulated throat.
c. Gland compression type.
d. Rain and concrete type.

5. Comply with NEMA FB 1, compatible with conduit materials.

B. Fittings for flexible metal conduit.

1. Insulated throat type.
2. Threaded.
3. Grounding type.
4. Liquidtight: 1 piece sealing "O" rings with connectors when entering boxes or enclosures.
5. Hazardous Locations: Stainless steel.

C. Expansion Joints:

1. Conduit expansion fittings complete with copper bonding jumper, Crouse-Hinds Type XJ.
2. Conduit expansion/deflection fittings with copper bonding jumper, Crouse-Hinds Type XD.

D. Seals:

1. Wall entrance, OZ/Gedney Type FSK or FSC.

E. Drain Fittings:

1. Automatic Drain Breather:

    a. Explosionproof.

        1) Safe for Class I Division 1, Groups C and D.

    b. Capable of passing minimum 25 cubic centimeters of water per minute and minimum 0.05 cubic feet of air per minute at atmospheric pressure.

2. Condensate Drain:

    a. Conduit outlet body, Type T.
    b. Threaded, galvanized plug with 3/16 inch drilled holed through plug.

2.04 WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireway as required for complete system.

C. Select features where not otherwise indicated, as required to complete wiring system and to comply with NEC.

D. Wireway Covers:

1. Hinged type for dry locations.
2. Bolted cover with gasket for wet locations.

E. Finish: Manufacturer's standard enamel finish unless otherwise noted.

2.05 RACEWAY/DUCT SEALING COMPOUND

A. Nonhardening, putty-like consistency workable at temperatures as low as 35^{o}F.

B. Compound shall not slump at temperature of 300 ^{o}F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

PART 3– EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive raceways, wireways, and fittings for compliance with installation tolerances and other conditions affecting performance of raceway system.

B. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access. Coordinate layout and installation of raceway and boxes with light fixtures to ensure raceway and boxes are not mounted lower or below light fixtures causing shadows.

3.02 WIRING METHODS

A. Outdoors, Damp or Wet Locations: Use following wiring methods unless otherwise noted on Drawings:

1. Exposed: Galvanized rigid steel

2. Concealed: Galvanized rigid steel
3. Underground Power and Control, Single Run: Galvanized rigid steel

    a. Concrete encased except for area lighting branch circuits or as otherwise noted on Drawings.

4. Underground Power and Control, Grouped: Rigid nonmetallic PVC conduit.

    a. Concrete encased.

5. Underground Shielded Instrumentation Cables and Shielded Instrumentation Cables run in concrete slabs, Single Run or Grouped: Galvanized rigid steel

    a. Concrete encased.

6. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.

B. Indoor Dry Locations: Use following wiring methods unless otherwise noted.

1. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Flexible metal conduit.
2. Exposed: galvanized rigid steel conduit
3. Concealed: galvanized rigid steel conduit

C. Indoor Wet Locations: Use following wiring methods unless otherwise noted.

1. Conduit in wash down areas (Polymer Room): PVC coated galvanized rigid steel conduit

D. Use 3/4 inch minimum size unless otherwise noted except conduit runs to room light switches may be 1/2 inch.

E. Unless specifically indicated otherwise, use galvanized rigid steel conduit for general wiring.

F. Underground conduits:

1. Encase galvanized rigid steel conduits installed underground in at least 3 inch of concrete.
2. Underground conduit shall be minimum of 1 inch, buried at depth of not less than 24 inch below grade.
3. Provide conduits or ducts terminating below grade with means to prevent entry of dirt and moisture.

G. In precast areas, run conduits in insulation space or in floor topping without crossing conduits, using 3/4 inch maximum conduit size.

H. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1 inch (25 millimeter) concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1 inch trade size parallel to or at right angles to main reinforcement and spaced on center of at least 3 times conduit trade diameter with minimum 2 inch concrete covering. Conduits over 1 inch may not be installed in slab without approval of Engineer.
4. When at right angles to reinforcement, place conduit close to slab support.
5. Conduits embedded in concrete frame shall comply with applicable provisions of American Concrete Institute (ACI) 318.

3.03 WIREWAYS

A. Use wireways only where indicated on drawings.

B. Do not use wireways without prior approval from Engineer.

C. Do not install wireways through walls or floors.

3.04 INSTALLATION

A. Paint conduits to match color of existing conduits in room or surface. In cases where wall and ceiling color don't match, paint conduit to match surface it is run along.

B. Conceal raceways by enclosing within finished walls, ceilings, and floors, unless otherwise indicated.

C. Provide watertight conduit system where installed in wet places, underground or where buried in masonry or concrete.

1. Use threaded hubs when entering top of enclosures.
2. Use sealing type locknuts when entering sides or bottom of enclosures.

D. Keep raceways at least 6 inch (150 millimeter) away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

E. Install raceways level and square and at proper elevations. Provide adequate headroom.

F. Complete raceway installation before starting conductor installation.

G. Support raceway as specified in Section 26 05 09.

H. Use temporary closures to prevent foreign matter from entering raceway.

I. Run concealed raceways with minimum of bends in shortest practical distance considering type of building construction and obstructions, except as otherwise indicated.

J. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow surface contours as much as practical.

1. Mount exposed horizontal runs as high above floor as possible, and in no case lower than 7 foot above floors, walkways, or platforms in passage areas.
2. Run parallel or banked raceways together, on common supports where practical.
3. Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

K. Join raceways with fittings designed and approved for purpose and make joints tight.

1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
2. Use insulating bushings to protect conductors.

L. Terminations: Where raceways are terminated with locknuts and bushings, align raceway to enter squarely, and install the locknuts with dished part against the box. Use two locknuts, one inside and one outside the box. Use insulating bushings. Provide insulated grounding bushings to terminate ground wire.

M. Where terminating in threaded hubs, screw raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to box, and tighten chase nipple so no threads are exposed.

N. Install pull wires in empty raceways. Use monofilament plastic line having not less than 200 pound (90 kilogram) tensile strength. Leave not less than 12 inch (300 millimeter) of slack at each end of pull wire.

O. Signal System Raceways 2 inch Trade Size and Smaller: In addition to above requirements, install in maximum lengths of 150 foot (45 meters) and with maximum of two 90 degree bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.

P. PVC Externally Coated Galvanized Rigid Steel Conduit: Use only fittings approved for use with that material. Patch nicks and scrapes in PVC coating after installing conduit.

Q. Conduit runs extending through areas of different temperature or atmospheric conditions or partly indoors and partly outdoors shall be sealed, drained, and installed in manner preventing drainage of condensed or entrapped moisture into cabinets, motors or equipment enclosures.

3.05 CONDUIT STUB-UPS

A. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above finished slab.

B. Transition under floor conduit to PVC coated galvanized rigid steel conduit before rising above floor. Under floor conduit elbows shall be PVC coated galvanized rigid steel conduit. Extend the PVC coated galvanized rigid steel conduit portion of the stub-up minimum 12 inch above floor or slab.

3.06 CONDUIT BENDS

A. Make bends and offsets so inside diameter is not reduced. Unless otherwise indicated, keep legs of bend in same plane and straight legs of offsets parallel.

B. Provide NEMA standard conduit bends, except for conduits containing medium voltage cable, fiber optic cable, or conductors requiring large radius bends.

C. Provide large radius conduit bends for conduits containing 5 kilovolt and 15 kilovolt cables as follows:

Conduit Trade Size	Bend Radius
2 inch - 2-1/2 inch	24 inch
3 inch - 4 inch	36 inch
5 inch	48 inch

1. Where physical limitations do not permit use of above, conduit bends with radius of at 8 times diameter of largest cable passing through conduit may be used.

3.07 FLEXIBLE CONNECTIONS

A. Terminate conduits at motor terminal boxes, motor operated valve stations or pipe-mounted instruments and other equipment subject to vibration with maximum of 3 foot (915 millimeter) liquidtight flexible metal conduit unless other wise indicated.

B. Use liquidtight flexible conduit in wet or damp locations.

C. Install separate ground conductor inside flexible conduit connections.

3.08 FITTINGS

A. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at following points and elsewhere as indicated:

1. Where conduits enter or leave hazardous locations.
2. Where conduits pass from warm locations to cold locations, such as boundaries of refrigerated spaces and air-conditioned spaces.
3. Where otherwise required by NEC.

B. Use raceway fittings compatible with raceway and suitable for use and location. For GRS use threaded conduit fittings, except as otherwise indicated.

C. Install automatic breather drain fittings according to manufacturers written instructions. Locate fittings to drain conduit system and prevent condensate from entering device enclosures. Install automatic breather drain fittings at following points and elsewhere as indicated.

1. Where vertical seals are installed.
2. Low points in conduit system.
3. Below field instruments at junction of flexible and rigid conduit.
4. Where otherwise required by NEC.

D. Install wall entrance seal as dictated by application where conduits pass through foundation walls below grade.

E. Install conduit expansion fittings complete with bonding jumper in following locations.

1. Conduit runs crossing structural expansion joint.
2. Conduit runs attached to 2 separate structures.
3. Conduit runs where movement perpendicular to axis of conduit may be encountered.

F. Where conduit passes from inside of building to outdoors, it shall be firmly packed at fitting nearest wall line with Johns-Manville Duxseal to depth of at least 1 inch after wires and cables are pulled in; or, if conduit enters directly into equipment, it shall be fitted with seal and drain fitting to prevent water entering equipment.

3.09 GROUNDING

A. Ground in accordance with Section 26 05 26.

B. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

3.10 PROTECTION

A. Provide final protection and maintain conditions, in manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

3.11 CLEANING

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1– GENERAL

1.01 SUMMARY

A. Section Includes:

1. Identification of electrical materials, equipment, and installations.

1.02 SUBMITTALS

A. Product Data:

1. Submit for each type of product specified.

B. Miscellaneous:

1. Schedule of identification nomenclature to be used for identification signs and labels.

C. Submit in accordance with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2– PRODUCTS

2.01 RACEWAY AND CONDUCTOR LABELS

A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide a single type for each application category. Use colors prescribed by American National Standards Institute (ANSI) A13.1, NFPA 70, or as specified elsewhere.

B. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Color: Black legend on orange field.
2. Legend: Indicates voltage.

C. Adhesive Labels: Preprinted, flexible, self adhesive vinyl. Legend is over-laminated with clear, wear and chemical resistant coating.

D. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color coded, acrylic or latex bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

E. Colored Adhesive Tape: Self adhesive vinyl tape not less than 3 mils thick by 1 to 2 inch wide (0.08 millimeter thick by 25 to 51 millimeter wide).

F. Underground Line Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with following features:

1. Size: Not less than 6 inch wide by 4 mils thick (152 millimeter wide by 0.102 millimeter thick).
2. Compounded for permanent direct burial service.
3. Embedded continuous metallic strip or core.
4. Printed Legend: Indicates type of underground line.

G. Aluminum, Wraparound Marker Bands: Bands cut from 0.014 inch (0.4 millimeter) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

H. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.

I. Aluminum Faced Card Stock Tags: Wear resistant, 18 point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch (0.05 millimeter) thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application.

J. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 inch (51 by 51 millimeter) by 0.05 inch (1.3 millimeter).

2.02 ENGRAVED NAMEPLATES AND SIGNS

A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

B. Engraving stock, melamine plastic laminate, 1/16 inch (1.6 millimeter) minimum thick for signs up to 20 square inch (129 square cm), 1/8 inch (3.2 millimeter) thick for larger sizes.

1. Engraved Legend: Black letters on white face.
2. Punched for mechanical fasteners.

C. Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4 inch (6.4 millimeter) grommets in corners for mounting.

D. Exterior, Metal Backed, Signs: Wear resistant, non-fading, UV resistant ink, with reinforced UV, chemical, abrasion, and moisture resistant laminate layer. Aluminum substrate 0.04 inch (1 millimeter), with colors, legend, and size appropriate to application. 1/4 inch (6.4 millimeter) grommets in corners for mounting.

E. Fasteners for Plastic Laminated and Metal Signs: Self tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts, flat washers and lock washers.

2.03 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self extinguishing, 1 piece, self locking, Type 6/6 nylon cable ties with following features:

1. Minimum Width: 3/16 inch (5 millimeter).
2. Tensile Strength: 50 pound (22.3 kilograms) minimum.
3. Temperature Range: Minus 40 to 185 degrees Fahrenheit (Minus 4 to 85 degrees Celsius).
4. Color: As indicated where used for color coding.

B. Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer.

PART 3– EXECUTION

3.01 INSTALLATION

A. Install identification devices according to manufacturer's written instructions.

B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project.

D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

E. Self Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

F. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer.
3. Apply one intermediate and one finish coat of silicone alkyd enamel.
4. Apply primer and finish materials according to manufacturer's instructions.

G. Install Circuit Identification Labels on Boxes: Label externally as follows:

1. Exposed Boxes: Pressure sensitive, self adhesive plastic label on cover.
2. Concealed Boxes: Plasticized card stock tags.
3. Labeling Legend: Permanent, water proof listing of panel and circuit number or equivalent.

H. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 inch (150 to 200 millimeter) below finished grade. Where multiple lines installed in common trench or concrete envelope provide multiple underground line warning tapes, one for each 16 inches of width of lines. If lines do not exceed an overall width of 16 inch (400 millimeter), use single line marker.

1. Install line marker for underground wiring, both direct buried and in raceway.

I. Color Code Conductors: Feeder and branch circuit conductors throughout secondary electrical system.

1. Field applied, color coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG.

a. Colored, pressure sensitive plastic tape in half lapped turns for distance of 6 inch (150 millimeter) from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible unwinding. Use 1 inch (25 millimeter) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
b. Colored cable ties applied in groups of 3 ties of specified color to each wire at each terminal or splice point starting 3 inch (76 millimeter) from terminal and spaced 3 inch (76 millimeter) apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length.

2. 208/120 Volt System: As follows:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Neutral: White.
    e. Ground: Green.

3. 480/277 Volt System: As follows:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Neutral: White with non-green stripe.
    e. Ground: Green.

J. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in pull boxes, junction boxes, and switchboard rooms.

1. Legend: 1/4 inch (6.4 millimeter) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Fasten tags with nylon cable ties; fasten bands using integral ears.

K. Apply identification to conductors as follows:

1. At all terminations in electrical cabinets, control cabinets and devices, junction boxes, pull boxes. Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
2. Control and Communications Circuits: Identify each conductor by its system and circuit designation. Use consistent system of tags, color coding, or cable marking tape.

L. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8 inch (9 millimeter) high lettering for emergency instructions on power transfer, load shedding, and or emergency operations.

M. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide single line of text with 1/2 inch (13 millimeter) high lettering on 1-1/2 inch (38 millimeter) high label; where 2 lines of text are required, use lettering 2 inch (51 millimeter) high. Use black lettering on white field. Apply labels for each unit of following categories of equipment.

    a. Panelboards, electrical cabinets, and enclosures.
    b. Access doors and panels for concealed electrical items.
    c. Motor control centers.
    d. Motor starters and variable frequency devices.
    e. Push button stations.

f. Remote controlled switches.
g. Control devices.

2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

END OF SECTION

SECTION 26 05 84
ELECTRIC MOTORS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Electric motors for use on ac power systems up to 600 Volts.
2. Motors that are factory-installed as part of equipment.
3. Field-installed motors.

B. Motors furnished under other sections of these Specifications as part of equipment items shall conform to requirements of this section except as noted otherwise in that section or indicated otherwise on Drawings or schedules.

C. Section does not include manufacturer’s definite purpose, direct current, synchronous or wound rotor motors.

1.02 SUBMITTALS

A. General:

1. Include motor submittal as part of equipment submittal for equipment specified in other sections.
2. Include identification of equipment by name and tag number as indicated in Specifications or on Drawings.

B. Product Data:

1. Complete nameplate data in accordance with National Electrical Manufacturers Association (NEMA) standards.
2. Full load power factor and maximum recommended power factor correction capacitor kilovolt amperes reactive (kVAr) rating for motors 5 horsepower and larger.
3. Nominal efficiency in accordance with Institute of Electrical and Electronics Engineers (IEEE) 112.
4. Motor dimensions and frame size.
5. Manufacturer's printed data on each motor type being provided to indicate compliance with specified performance and construction.
6. Service manual to include storage and alignment instructions.

C. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions, maintenance requirements and parts list.
2. Submit with specification section of equipment of which motor is a part.
3. Submit in accordance with Section 01 78 23.

1.03 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories, Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Terms "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Comply with National Electrical Manufacturers Association (NEMA) MG 1, "Motors and Generators."

C. Comply with UL 1004, "Motors, Electric".

PART 2 – PRODUCTS

2.02 MANUFACTURERS

A. Siemens

B. General Electric

C. U.S. Motors

D. Toshiba

E. WEG

2.03 GENERAL

A. Requirements below apply to motors covered by this Section except as otherwise indicated.

B. Motors 1/2 horsepower and Larger: Polyphase.

C. Motors Smaller Than 1/2 horsepower: Single-phase.

D. Frequency Rating: 60 Hertz.

E. Voltage Rating: Determined by voltage of circuit to which motor is connected for following motor voltage ratings (utilization voltages):

1. 120 volt Circuit: 115 volt - motor rating.
2. 208 volt Circuit: 200 volt - motor rating.
3. 240 volt Circuit: 230 volt - motor rating.
4. 480 volt Circuit: 460 volt - motor rating.

F. Service factors indicated for motors are minimum values and apply at frequency and utilization voltage at which motor is connected. Provide motors which will not operate in service factor range when supply voltage is within 10% of motor voltage rating.

G. Capacity: Sufficient to start and operate connected loads at designated speeds in indicated environment, and with indicated operating sequence, without exceeding nameplate ratings. Provide motors rated for continuous duty at 100% of rated capacity.

H. Temperature Rise: Based on 40 degrees Celsius ambient except as otherwise indicated.

I. Enclosure: Totally Enclosed Fan Cooled (TEFC) unless otherwise indicated in other sections and as required by NEC.

1. Explosion proof motors approved for specific hazard classifications covered by NEC.
2. Weather proof motors designed for outdoors and in wet areas.
3. Chemical resistant motors designed for severe duty applications, including high humidity, corrosive, dirty or salty atmospheres.

J. Copper Windings.

2.04 POLYPHASE MOTORS

A. Squirrel-cage induction-type conforming to following requirements except as otherwise indicated.

B. NEMA Design Letter Designation: "B"

C. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading for application.

D. Motor Efficiencies:

1. General purpose motors (not inverter duty/vector duty or explosion proof): NEMA Premium Energy Efficient Motors with nominal efficiency equal to or greater than that stated in NEMA MG 1 for NEMA Premium Energy Efficient Motors for that type and rating of motor.
2. Inverter Duty and/or Vector Duty Motors: NEMA Premium Energy Efficient Motors with nominal efficiency equal to or greater than that stated in NEMA MG 1 for NEMA Premium Energy Efficient Motors for that type and rating of motor.
3. Explosion proof motors: NEMA Premium Energy Efficient Motors with nominal efficiency equal to or greater than that stated in NEMA MG 1 for NEMA Premium Energy Efficient Motors for that type and rating of motor.

E. Multi-Speed Motors: Separate winding for each speed.

F. Inverter Duty and/or Vector Duty Motors with Manufacturer's Premium Insulation System that is Specifically for Use with Solid-State Drives/ Variable Frequency Drives (VFD): Squirrel-cage induction, NEMA Design B units with ratings, characteristics, and features coordinated with and approved by drive manufacturer conforming to or exceeding the requirements of NEMA MG 1, Part 31.

1. Include adequate thermal capacity for continuous operation under worst case temperature conditions with motor operating at rated torque, without reduction in insulation life of motor, under the range of conditions specified.
2. Suitable for operation with inverters specified in Section 26 29 23.
3. Motors operating on VFD shall be protected from circulating shaft currents with either a grounding ring or insulated bearings:

    a. Provide factory installed motor shaft grounding ring:

        1) AEGIS SGR grounding ring or equal bolted to motor frame
        2) Sized for motor shaft.

G. Motors for Reduced Inrush Starting: Coordinate with indicated reduced inrush controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

H. Torque:

1. Breakdown torque shall be 200% or more of maximum torque load placed on motor shaft.
2. Provide necessary WK2 curves for special loads to coordinate with motors.
3. Supply special motors where load requirements exceed standard design.

I. Open Drip Proof (ODP).

1. Energy Efficient.
2. Protected Openings.
3. Class B Insulation.
4. 1.15 Service Factor.
5. Cast iron construction.

J. Totally Enclosed Fan Cooled (TEFC) and Totally Enclosed Non Ventilated (TENV).

1. Energy Efficient.
2. 1.15 service factor, Class "F" insulation.
3. Cast iron construction; frame, conduit box, end shields, fan cover, inner caps for 182T frames and larger.
4. Positive lubrication systems.
5. Removable eyebolt.
6. Suitable for indoor and outdoor installations.
7. Diagonally split, neoprene gasketed, rotatable oversized conduit box with NPT threaded lead hole.
8. Conduit box mounted, UL approved clamp type grounding lug.
9. Permanently numbered non-wicking leads.
10. Rust inhibitive non-washing lubricant.
11. Stainless steel nameplate with.

    a. NEMA nominal efficiency.
    b. Anti Friction Bearing Manufacturers Association (AFBMA) bearing numbers.
    c. Lubrication instructions.

K. Corrosion Resistant (Mill and Chemical Duty).

1. Same features as TEFC, except as noted below.
2. Neoprene lead seal separator gasket mounted between motor frame and conduit box.
3. Anti-static corrosion resistant fan.
4. Zinc plated hex head hardware.
5. Stainless steel T drains and breather fittings.
6. Stator and rotor completely epoxy coated for corrosion protection.
7. Non-metallic V-ring shaft slinger.
8. Double shielded bearings.
9. Double-coated epoxy enamel exterior finish.
10. Stainless steel nameplate.

L. Mixer motors.

1. As specified in equipment specification sections.
2. 1.10 service factor, unless otherwise indicated in equipment specification sections.

2.05 SOURCE QUALITY CONTROL

A. Testing:

1. Perform individual motor test on motors over 1 horsepower.
2. Test shall be standard NEMA routine production test in accordance with NEMA MG 1.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Field install motors in accordance with manufacturer's instructions and following:

1. Direct Connected Motors: Mount securely in accurate alignment.
2. Belt Drive Motors: Use adjustable motor mounting bases. Align pulleys and install belts. Use belts furnished by manufacturer and tension belts in accordance with manufacturer recommendations.

3.02 COMMISSIONING

A. Check operating motors, both factory and field-installed, for unusual conditions during normal operation. Coordinate with commissioning of equipment for which motor is part.

B. Report unusual conditions.

C. Correct deficiencies of field-installed units.

3.03 ALIGNMENT

A. Installer of motor is responsible for alignment.

B. Check alignment of motors prior to startup.

C. Motors over 50 horsepower: Laser alignment and balance check using test equipment specially designed for this purpose.

3.04 FIELD QUALITY CONTROL

A. Inspect wire and connections for physical damage and proper connection.

B. Conduct insulation resistance (megger) test on each motor 25 horsepower and larger before energizing. Conduct test with 500 or 1,000 volts direct current megger. Test each phase separately and follow procedures listed below.

1. Disconnect voltage sources, lightning arrestors, capacitors, and other potential low insulation sources from motor before connecting megger to motor.
2. When testing phase, connect phases not under test to ground.
3. Apply test voltage, phase to ground on each phase being tested. Record resistance reading at 30 sec and at 1 min after test voltage is applied. Divide 1 minute reading by 30 second reading to obtain dielectric absorption ratio (DAR). DAR shall be 1.25 or greater for phase to pass test.
4. If phases have DAR of 1.25 or greater, attach tag to motor and mark tag "Insulation Resistance Test OK" and sign.
5. If phases have DAR of less than 1.25, attach tag to motor and mark tag “Insulation Resistance Test Failed” and sign. Provide new motor and retest. Notify Engineer of failure and actions taken to correct.
6. Connect equipment removed in Item 1 above.

C. Before energizing motor, record motor's nameplate current on record drawing line diagrams. Size motor starter overload heaters with starter manufacturer's recommendation for given motor nameplate current, service factor, and power factor correcting capacitors, if provided.

D. Check rotation of motor before connecting to driven equipment; before couplings are bolted or belts installed. Before motor is started to check rotation, determine that motor is lubricated. When rotation is correct, mark insulation resistance test tag "Rotation OK". Sign or initial test tag by person who checked motor rotation.

E. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.

F. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

END OF SECTION

SECTION 26 08 00
ELECTRICAL SYSTEM DEMONSTRATION

PART 1- GENERAL

1.01 SUMMARY

A. Demonstrate proper operation of electrical systems and equipment in presence of Engineer.

1.02 SUBMITTALS

A. Demonstration log.

B. Submit in accordance with Section 01 33 00.

PART 2- PRODUCTS

(Not Used)

PART 3- EXECUTION

3.01 PERFORMANCE

A. Demonstrations:

1. Each piece of equipment.
2. Each integrated system.

B. Demonstration Log:

1. Keep log of individual demonstrations.
2. Data:

a. Date and time of demonstration.
b. Owner's representative.
c. Equipment or system demonstrated.
d. Result of demonstration.

1) Success or fail.
2) If failure, description of failure.
3) Corrective action taken.
4) Redemonstration result.

END OF SECTION

SECTION 26 24 19
MOTOR-CONTROL CENTERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Modifications to existing Westinghouse Freedom 2100 Series motor-control centers for use on ac circuits rated 600 Volts and less. New branch circuit breaker buckets will be added to existing motor control centers “90-MCC-1” and “90-MCC-2”. New circuit breakers shall match fault current ratings of existing motor control centers. See one-line diagrams for existing MCC voltage and phase configuration, bus ratings, and fault current ratings.

1.02 SUBMITTALS

A. Product Data:

1. Include dimensions, ratings, and data on features and components.

B. Shop Drawings: For each motor-control center specified in this Section. Include dimensioned plans, elevations, and component lists. Show ratings, including short-time and short-circuit ratings, and horizontal and vertical bus ampacities.

1. Schedule of features, characteristics, ratings, and factory settings of individual motor-control center units.
2. Wiring Diagrams: Interconnecting wiring diagrams pertinent to class and type specified for motor-control center. Schematic diagram of each type of controller unit indicated.

C. Test Results:

1. Certified reports of field tests and observations.

D. Operation and Maintenance Data (O&M):

1. Maintenance data for Motor Control Center (MCC).
2. Submit in accordance with Section 01 78 23.

E. Miscellaneous:

1. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

F. Submit in accordance with Section 01 33 00.

G. Approval of equipment specified in this section is contingent upon approval of coordination study specified in Section 26 05 73.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain similar motor-control devices through one source from single manufacturer.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories, Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. Regulatory Requirements:

1. NEC: Components and installation shall comply with National Fire Protection Association (NFPA) 70.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store so condensation will not occur on or in motor-control centers. Provide temporary heaters as required to prevent condensation.

B. Handle motor-control centers according to NEMA ICS 2.3. Use factory-installed lifting devices.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Eaton/Cutler-Hammer/Westinghouse – Circuit breaker feeder buckers as depicted on 007 series drawings.

2.02 MOTOR-CONTROL CENTERS

A. Wiring: NEMA ICS 3, Class I, Type B. Factory wiring shall be labeled at each end with markers which correspond to the approved shop drawing wiring diagrams.

B. Enclosures: Surface-mounted cabinets as indicated. NEMA 250, Type 1 gasketed, unless otherwise indicated to meet environmental conditions at installed location.

1. Compartments: Modular; individual doors have concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units require disconnect means in off position before door can be opened or closed, except by consciously operating permissive release device.
2. Interchangeability: Compartments are constructed to remove units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in control center. Units requiring same size compartment are interchangeable, and compartments are constructed to permit ready rearrangement of units, such as replacing 3 single units with unit requiring 3 spaces, without cutting or welding.
3. Wiring Spaces: Each vertical section of structure with horizontal and vertical wiring has spaces for wiring to each unit compartment in each section, with supports holding wiring in place.

C. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location.

2.03 FUNCTIONAL FEATURES

A. Description: Modular arrangement of motor controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center as indicated.

B. Overcurrent Protective Devices: Types of devices with features, ratings, and circuit assignments indicated. Individual feeder-tap units through 225-Amp rating shall be installed on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

C. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

D. Spare Units: Type, sizes, and ratings as indicated, and installed in compartments indicated "spare."

2.04 FEEDER OVERCURRENT PROTECTION

A. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.

1. Characteristics: Frame size, trip rating, number of poles, auxiliary devices, and interrupting capacity rating to meet available fault current as indicated on drawings.
2. Application Listing: Appropriate for application, including Type HACR for heating, air-conditioning, and refrigeration equipment.
3. Circuit Breakers, 200 Amp and Larger: Trip units interchangeable within frame size.
4. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
5. Series rated circuit breakers not acceptable.

PART 3- EXECUTION

3.01 INSTALLATION

A. Install motor-control centers according to NEMA ICS 2.3 and manufacturer's written instructions.

3.02 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs according to Section 26 05 53.

3.03 CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Section 26 05 19.

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices according to indicated wiring diagram or one that is manufacturer approved, where available.

1. Connect selector switches to bypass only manual and automatic control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.04 CONNECTIONS

A. Tighten motor-control center bus joint, electrical connector, and terminal bolts according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.05 FIELD QUALITY CONTROL

A. Testing:

1. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include record of repairs and adjustments made.
2. Perform following tests:

a. Test insulation resistance of new MCC components and of new connecting feeder, and control circuits.
b. Make continuity tests of new circuits.
c. Inspect MCCs for defects and physical damage, testing laboratory labels, circuit connections, and nameplate compliance with up-to-date system drawings.
d. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
e. Perform visual and mechanical inspection and related work for protective devices as specified in Section 26 28 00 and 26 29 00.
f. Device Ratings and Settings: Verify ratings and settings new overcurrent protective devices. Make final adjustments of devices in accordance with Sections 26 28 00 and 26 29 00.

3. Quality Control Testing Program: Assure MCC component installation meets specified requirements, is operational within specified tolerances, and provides appropriate protection for systems and equipment.

a. Reports: Prepare written reports of test results and observations. Report defective materials and workmanship. Include complete records of adjustments and corrective action taken.
b. Labeling: On satisfactory completion of tests and related effort, apply label to tested components indicating results, person responsible, and date.
c. Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformers and control power wiring.
d. Test overcurrent protective devices as specified in Section 26 28 00.

4. Retesting: Correct deficiencies and retest. Verify by retests that specified requirements are met.

3.06 ADJUSTMENTS

A. Set field-adjustable pick-up and time-sensitivity ranges as indicated.

3.07 CLEANING

A. Inspect interior and exterior of motor-control centers. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

END OF SECTION

SECTION 26 28 00
LOW-VOLTAGE CIRCUIT PROTECTION DEVICES

PART 1- GENERAL

1.01 SUMMARY

A. Section Includes:

1. Feeder and equipment disconnects.

1.02 SUBMITTALS

A. Product Data:

1. Submit for switches and accessories.

B. Test Results:

1. Report of Field Tests and Observations certified by Contractor.

C. Operating and Maintenance Data (O&M):

1. Maintenance data for tripping devices.
2. Submit in accordance with Section 01 78 23.

D. Submit in accordance with Section 01 33 00.

E. Approval of equipment specified in this section is contingent upon approval of coordination study specified in Section 26 05 73.

1.03 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

B. Regulatory Requirements:

1. NEC: Components and installation shall comply with National Fire Protection Association (NFPA) 70.

C. Single-Source Responsibility: Enclosed switches, fuses and circuit breakers shall be product of single manufacturer.

PART 2- PRODUCTS

2.01 MANUFACTURERS

A. Non-Fusible Switches:

1. Eaton (Cutler-Hammer)
2. Schneider Electric (Square D Co.)

2.02 ENCLOSED SWITCHES

A. Enclosed Nonfusible Switch: National Electrical Manufacturers Association (NEMA) KS 1, Type HD handle lockable with 2 padlocks.

B. Enclosure: NEMA KS 1, Type 1, unless specified or required otherwise to meet environmental conditions of installed location.

1. Outdoor or Other Wet or Damp Indoor Locations: NEMA Type 4X 316 stainless steel

PART 3- EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions to verify proper locations, sizes, and characteristics.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install enclosed switches in locations as indicated, according to manufacturer's written instructions.

B. Install enclosed switches level and plumb.

C. Install wiring between enclosed switches and control/indication devices.

D. Connect enclosed switches and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.03 IDENTIFICATION

A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

3.04 FIELD QUALITY CONTROL

A. Testing:

1. Reports: Prepare certified written reports on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made.
2. Labeling: Upon satisfactory completion of tests and related effort, apply label to tested components indicating test results, date, and responsible person.
3. Schedule visual and mechanical inspections and electrical tests with at least 1 week's advance notification.
4. Upon completing installation of system, perform following preparations for tests:

a. Make insulation resistance tests components, and connecting supply, feeder, and control circuits.
b. Make continuity tests of circuits.
c. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
d. Comply with manufacturer's instructions for installation and testing of circuit breaker.

5. Visual and mechanical inspection: Include following inspections and related work.

    a. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
    b. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
    c. Check tightness of electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

6. Retest: Correct deficiencies identified by tests and observations and retest. Verify by system tests that specified requirements are met.

3.05 CLEANING

A. Upon completion of installation, inspect over current protection devices. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION

SECTION 26 29 00
LOW-VOLTAGE CONTROLLERS

PART 1- GENERAL

1.01 SUMMARY

A. Section Includes:

1. Alternating Current (AC) motor-control devices rated 600 Volts and less that are supplied as enclosed units.

1.02 SUBMITTALS

A. Product Data:

1. Include dimensions, ratings, and data on features and components.

B. Shop Drawings: For each controller center specified in this Section. Include dimensioned plans, elevations, and component lists. Show ratings, including short-time and short-circuit ratings.

1. Schedule of features, characteristics, ratings, and factory settings of individual units.
2. Wiring Diagrams: Interconnecting wiring diagrams pertinent to class and type specified for and schematic diagram of each type of controller unit indicated.

C. Test Results:

1. Certified reports of field tests and observations.

D. Operation and Maintenance Data (O&M):

1. Maintenance data for motor controllers.
2. Submit in accordance with Section 01 78 23.

E. Miscellaneous:

1. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

F. Submit in accordance with Section 01 33 00.

G. Approval of equipment specified in this section is contingent upon approval of coordination study specified in Section 26 05 73.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain similar motor-control devices through one source from single manufacturer.

B. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

C. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2- PRODUCTS

2.01 MANUFACTURERS

A. Allen-Bradley Co.

B. Cutler-Hammer/Westinghouse.

C. Square D Co.

2.02 ENCLOSURE

A. Meet environmental conditions of installed location.

1. Provide National Electrical Manufacturers Association (NEMA)-250 Type 1 enclosure in electrical equipment rooms and NEMA-250 Type 12 enclosure for other indoor switches locations unless otherwise indicated.
2. Provide NEMA-250 Type 4X for outdoor and wet location switches with watertight hubs and stainless steel Type 316 enclosure.

2.03 MAGNETIC MOTOR CONTROLLERS

A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across line, unless otherwise indicated.

B. Control Circuit: 120 Volt; obtained from integral control power transformer, unless otherwise indicated. Include control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100% spare capacity.

C. Combination Controller: Factory-assembled combination controller and disconnect switch with or without overcurrent protection as indicated.

1. Circuit-Breaker Disconnect: NEMA AB 1, motor-circuit protector with field-adjustable short-circuit trip coordinated with motor locked-rotor amperes.

D. Overload Relay:

1. Electronic solid state type with inverse-time-current characteristic, phase loss and phase unbalance protection for size 2 and larger.
2. Provide NEMA Class 20 heaters or sensors in each phase matched to nameplate full load current of specific motor to which connected with appropriate adjustment for duty cycle.
3. Enhanced Protection Overload Relay: Provide overload relays with NEMA Class 10 or better tripping characteristics for submersible equipment or where indicated. Select to protect motor against voltage unbalance and single phasing.

E. When power factor correction capacitors are indicated provide termination lugs on line side of overload relays.

F. Time Delay Restart Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection.

1. Provide in starter enclosure for Size 2 and larger starters.
2. Delay initial motor start.

3. Delay motor restart due to starter dropout caused by undervoltage or starter coil circuit interruption for maintained control circuits.
4. Adjustable on delay from 0.15 to 30.0 seconds set at 10.0 seconds.
5. Connect control relay in motor starter coil circuit.
6. Coordinate control relay section with motor starter to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out.

2.04 ENCLOSURES

A. Description: Flush or surface-mounted cabinets. NEMA 250, Type 1, unless otherwise indicated to meet environmental conditions at installed location.

1. Wet or Damp Indoor and Outdoor Locations: NEMA 250, Type 4X, 316 stainless steel.

2.05 ACCESSORIES

A. Provide devices when indicated. Factory install in controller enclosure, where indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

1. Provide front of panel devices as specified in Section 40 78 00 and P&ID drawings.

C. Stop and Lockout Push-Button Station: Momentary-break push-button station with factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Elapsed Time Meters: Heavy duty with digital readout in hours.

F. Transient Voltage Surge Suppressors: IEEE C62.41, selected to meet requirements for medium-exposure category. Impulse sparkover voltage coordinated with system circuit voltage. Factory mounted with Nationally Recognized Testing Laboratory listed and labeled mounting device.

PART 3- EXECUTION

3.01 INSTALLATION

A. Install independently mounted motor-control devices according to manufacturer's written instructions.

B. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

C. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Section 26 05 29.

D. Install freestanding equipment on concrete housekeeping bases conforming to Section 03 30 00.

E. Motor-Controller Fuses: Install indicated fuses in each fusible switch.

3.02 IDENTIFICATION

A. Identify motor-control components and control wiring according to Section 26 05 53

3.03 CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Section 26 05 19.

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices.

1. Connect selector switches to bypass only manual and automatic control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.04 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.05 FIELD QUALITY CONTROL

A. Testing:

1. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.
2. On completing installation of system, perform following tests.

a. Test insulation resistance of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by manufacturer.
b. Make continuity tests of circuits.
c. Review updating of final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
d. Review manufacturer's written instructions for installation and testing of motor control devices.

3. Visual and Mechanical Inspection: Include following inspections and related work.

a. Motor Control Device Ratings and Settings: Verify ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective device ratings and settings where differences found. Use accepted revised ratings or settings to make final system adjustments.
b. Inspect for defects and physical damage and nameplate compliance with Drawings.
c. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's written instructions.
d. Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturer's recommended torque values.
e. Clean devices using manufacturer's approved methods and materials.
f. Verify proper fuse types and ratings in fusible devices.

4. Electrical Tests: Perform following in accordance with manufacturer's written instructions.

a. Insulation resistance test of motor control devices conducting parts to extent permitted by manufacturer's written instructions. Insulation resistance less than 100 megohms not acceptable.
b. Make adjustments for final settings of adjustable trip devices.

c. Test auxiliary protective features such as loss of phase, phase unbalance, and undervoltage to verify operation.
d. Check for improper voltages at terminals in controllers having external control wiring when controller disconnect opened. Voltage over 30 volts unacceptable.

5. Correct deficiencies and retest motor control devices. Verify by system tests that specified requirements are met.

B. Retesting:

1. Correct deficiencies identified by tests and completely retest equipment.
2. Verify by system test that total system meets specification requirements.

3.06 ADJUSTING

A. Time Delay Restart Relay:

1. Adjust control relay to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out.

B. Set field-adjustable pick-up and time-sensitivity ranges as indicated.

3.07 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

END OF SECTION

SECTION 26 29 23
VARIABLE FREQUENCY DRIVE EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Specifications for Variable Frequency Drive Equipment including Schedule 1 attached to this section.

B. Variable Frequency Drive Equipment for project shall be from the same manufacturer and shall be the same model and type.

1.02 REFERENCES

A. ANSI: American National Standards Institute

B. IEEE: Institute of Electrical and Electronics Engineers

C. UL: Underwriters Laboratory

1.03 SYSTEM DESCRIPTION

A. Unless otherwise specified, run signals shall be derived from motor starter normally open auxiliary contacts or from variable frequency drive.

B. References to “selector switch” refer to maintained contact type switch functions. Loss and return of control power to circuit does not change control mode or requirement as per switch position.

C. References to “push-button” refer to momentary contact type switch functions.

1.04 SUBMITTALS

A. Shop Drawings:

1. Panel fabrication and dimensions drawings.
2. Front of panel layout drawings.
3. Interior panel layout drawings.
4. Nameplate legend.
5. Component specification sheets.
6. Instruction manuals.
7. Parts list.
8. Recommended spare parts list.
9. Include Engineer’s tag number or description when available on each drawing, specification sheet, and manufacturer’s catalog cut in submittal for each component included in system.

B. Operation and Maintenance (O&M) Data:spade

1. Submit manufacturer’s standard O&M data indicating safety and periodic maintenance data.

C. Submit shop drawings and operation and maintenance data in accordance with the requirements of Section 01 33 00 and Section 01 78 23.

1.05 QUALITY ASSURANCE

A. Review equipment motor submittal for compatibility with drive system and to assure 20-year motor insulation design life and drive sizing.

B. Drive equipment shall conform to requirements of IEEE 519.

C. VFDs and options shall be UL listed as a complete assembly. The VFD package shall have a UL listed short circuit current rating (SCCR) of 65,000 amps and this rating shall be indicated on the UL data label

PART 2 – PRODUCTS

2.01 PULSE WIDTH MODULATED (PWM) VARIABLE FREQUENCY DRIVE (VFD)

A. Manufacturers.

1. Cutler-Hammer/Eaton PowerXL DG1

a. No Substitutes

B. General:

1. Ambient temperature 0 TO 40 ^{o}C.
2. Humidity: 5 to 95%, non-condensing.
3. cUL/UL approved or CSA certified and UL listed.
4. Factory wiring shall be labeled at each end with markers which correspond to the approved shop drawing wiring diagrams.

C. Input Power.

1. 460 Volts Alternating Current (VAC) (+8%, -10%).
2. 3-phase, 3-wire, any phase sequence.
3. 60 Hertz (+/-5%).
4. Drive shall include surge protection. The surge protective device shall be listed per UL 1449 Third Edition (Sept 2009), Type 1 SPD (In=10kA), 42 kiloAmps (kA) short circuit current rating (SCCR) and have a voltage protection rating (VPR) of 3000Volts per UL 1449.
5. Capable of withstanding line voltage transients up to 3000 volts in accordance with ANSI 37.90.1 and ANSI C62.41.
6. Drive shall be constructed to limit line noise generated due to voltage distortion and line notch. Include as required to meet IEEE 519:

a. Insulated Gate Bipolar Transistor (IGBT) switching.
b. Direct Current (DC) Link Inductor.
c. 3% Line Reactor. Coordinate with separate harmonic filter ahead of drive to assure that the operation of the drive is not impacted due to excessive impedance ahead of drive.

D. Output Power.

1. Match to motor.
2. 3-phase, 3-wire.
3. Sinusoidal wave, pulse width modulated wave form.
4. Maximum output: 460 VAC.
5. 6 to 60 Hertz, adjustable.

6. Frequency accuracy: +/- 1% of setting.
7. Rate full load output current in excess of motor nameplate current and increase motor current due to harmonics.
8. Output open and short circuit protection.
9. Power transistors shall be IGBT's with Peak Inverse Voltage (PIV) ratings of 1200 volts minimum.

E. Motor Performance.

1. 0.5% speed regulation in manual or automatic speed control mode.
2. 150% starting torque.
3. 100% rated torque from 60 Hertz to specified turndown over 10:1 speed range.

F. Drive features.

1. Selectable library of routines for 4-20 milliamps direct current (mAdc) follower circuitry to include output proportional to current, offset, slope, minimum clamp, and separate acceleration and deceleration adjustments.
2. Design circuit to accept 4-20 mAdc positive or negative signal, grounded or un-grounded.
3. Automatic restart on nuisance shutdown for up to 5 successive attempts.
4. Minimum Efficiency for constant torque applications.

    a. 100% rated speed and load – 95% or better.
    b. 70% rated speed and 100% load – 94% or better.
    c. 50% rated speed and 100% load – 93% or better.
    d. 30% rated speed and 100% load – 91% or better.
    e. 20% rated speed and 100% load – 87% or better.

5. Include PI (proportional, integral) control function integral to drive.
6. 110% overload capacity for 60 seconds.

G. Short Circuit and Drive Input Protection:

1. Instantaneous over-current trip shutdown set at 180% and 150% overload capacity for 60 seconds.
2. Under-voltage protection with automatic restart.
3. Input power circuit breaker with 42,000 amps interrupting capacity (AIC), labeled in accordance with UL Standard 489 with through the door operator.

    a. Provisions to lock in "OFF" position.
    b. Mechanical interlock to prevent opening cabinet door with disconnect in the "ON" position, or moving disconnect to the "ON" position with the door open.
    c. Auxiliary contact on main disconnect to isolate control power when control power fed from an external source.
    d. Barriers and warning signs on terminals that are energized with power disconnect "OFF".

H. Internal Protective Features:

1. Output phase sequence independent of input phase sequence.
2. Phase loss protection.
3. High or low sustained voltage shutdown.
4. 120 vac or 24 volts direct current (vdc) grounded control circuits.
5. Anti-regenerative circuit to protect inverter during deceleration.
6. Transistor over-current and over-temperature protection.
7. Electrically isolated low voltage logic.

8. DC bus fuse protection.
9. MOV (metal oxide varistor) surge protection.

I. Inverter Adjustments

1. Maximum Speed: 50 to 100% rated.
2. Minimum Speed: 6 to 70% rated.
3. Current limit: 10% to 150%.
4. Linear Acceleration: 3 to 300 seconds.
5. Linear Deceleration: 3 to 300 seconds.
6. Torque boost.
7. Maximum voltage level.
8. Electronic thermal overload: 10 to 100% of drive current.
9. Carrier frequency: 2.2 to 8.0 kilohertz (kHz) adjustable.
10. Up to three adjustable skip frequencies.
11. Selectable volts/Hertz patterns to include general purpose, variable torque, constant torque, constant horsepower, and programmable.
12. Fault Recovery: Auto Restart.
13. Loss of Power: Auto Restart.
14. I/O Assignments: Field Adjustable.

J. Inverter Diagnostic and Shutdown Protective Features:

1. External fault.
2. Low line voltage.
3. High line voltage.
4. Instantaneous current overload.
5. Internal over-temperature.
6. Over-current stall.
7. Over-voltage stall.
8. Ground fault.
9. Blown input fuse.
10. Control power supply failure.

K. Inverter construction:

1. Modular construction for ease of maintenance.
2. Easily accessible from front.
3. Construct boards of fire retardant materials in accordance with NEMA Grade FR4 specifications.

L. External Signals.

1. Provide communications module with EtherNet/IP protocol for data communications with plant supervisory control and data acquisition (SCADA) system.
2. Capable of accepting two-wire or three-wire start/stop control contacts in the automatic mode.
3. Accept 4-20 mAdc input speed reference with adjustable bias and gain.
4. Accept 0-10,000 ohm potentiometer input speed reference.
5. Accept external safety shutdown signals as specified or shown on drawings.
6. Provide dry contact for remote indication of drive run status.
7. Provide dry contact for remote indication of common equipment fail alarm.
8. Provide isolated 4-20 mAdc powered signal for remote indication of drive speed.

M. Operator interface:

1. Provide front of panel multifunction display/keypad, capable of controlling drive and setting drive parameters. Provide as a minimum with the following functions:

    a. Start
    b. Stop
    c. Reset
    d. Increase/Decrease Speed Control
    e. Manual or Remote Mode.

2. Display shall indicate following parameters:

    a. Control mode – manual or automatic.
    b. Output frequency.
    c. Output voltage.
    d. Output current.
    e. Motor RPM.
    f. Alarms and Faults.

3. Keypad functions shall include:

    a. Menu driven.
    b. Parameters stored in non-volatile memory.
    c. Password or code protected.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at job site or classroom designated by Owner for minimum workdays indicated, travel time excluded, to supervise final adjustment of system after installation is complete, system startup, and training of Owner's personnel for system operation. Include minimum of:

    a. 1 workday for Installation Services.
    b. 1/2 workday for Instructional Services.
    c. 1/2 workday for Post Startup Services.

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system related areas. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 00.

D. Installation and wiring of drive shall be by construction contractor.

SCHEDULE 1 TO SECTION 26 29 23

VARIABLE FREQUENCY DRIVES (VFD)

Enclosure Tag Number	Associated Equipment Description and Tag Number		Encl. Rating	Hp*	Equip. Spec.	Mode	Torque
90-VFD-8-9-1	Polymer Feed Pump 1	P-8-9-1	NEMA 1	7.5**	43 23 57	Volt/ Hertz	Constant
90-VFD-8-9-2	Polymer Feed Pump 2	P-8-9-2	NEMA 1	7.5**	43 23 57	Volt/ Hertz	Constant
90-VFD-8-9-3	Polymer Feed Pump 3	P-8-9-3	NEMA 1	7.5**	43 23 57	Volt/ Hertz	Constant
90-VFD-8-9-4	Polymer Feed Pump 4	P-8-9-4	NEMA 1	7.5**	43 23 57	Volt/ Hertz	Constant

* Verify Motor Horsepower and Full Load Current with Equipment Supplied.
** Equipment sized for 12 FLA.

END OF SECTION

SECTION 26 44 00
PROCESS PIPING HEAT TRACING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Self-regulating heat tapes and control equipment.
2. Provide electrical heat trace system as part of piping and insulation system furnished under other sections.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide pipe tracing cable system capable of maintaining pipe contents at temperature of 40°F when outside ambient temperature is -20°F with 20 miles per hour wind.

1.03 SUBMITTALS

A. Product Data:

1. Manufacturer's product data sheets.

B. Shop Drawings:

1. Show isometric layout of pipe tracing cables over piping layout.
2. Include installation details and connection diagrams sufficient to install pipe tracing cable system.

C. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories, Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Chromalox

2.02 CABLE DESIGN

A. Basis of design: Chromalox SRL Series

B. Voltage: 120 volts, 60 Hertz, 1-phase as shown on Drawings for electrical connection.

C. Parallel design, current flow across cable.

D. Heat output/foot constant, independent of length.

E. Capable of overlapping without creation of hot spots.

F. Capable of being cut to any length in field.

G. Self-regulating heat output.

H. Braided metallic shield.

I. Outer plastic jacket.

J. Provide manufacturers standard power connections, end seals, splice and tee kit components.

K. Provide red lighted end seal on each individual heat trace line with capability of being rack/wall mounted.

L. Provide proper fittings and appurtenances for field connection of system to conduit and wiring without need for procurement of special fittings or wiring devices.

2.03 HEAT TRACE CONTROL SYSTEM

A. Basis of Design: Chromalox DTS Series

B. Thermostatic sensing control:

1. Provide pipe sensing thermostat to operate pipe heating systems when ambient temperature drops to 40 degrees Fahrenheit.

a. Provide minimum 50 foot lead for device RTD.

2. Provide solid state alarm relay for wiring to facility SCADA system. Provide general alarm status for conditions listed below:

a. Pipe temperature drops below 35 degrees Fahrenheit.
b. RTD failure.
c. Power loss.

C. Enclosure:

1. NEMA 4X enclosure, rack/wall mounted.
2. LED display on enclosure front for observing digital display of controller.

PART 3– EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which pipe tracing cables to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of Work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Coordinate circuit connection points and voltages with Drawings.

C. Apply "electrical traced" signs to outside of thermal insulation.

D. Provide Class B Ground Fault Circuit Interrupting (GFCI) protection for each heat trace line.

3.03 FIELD QUALITY CONTROL

A. Examine material for defects prior to installation.

B. Examine final installation for damage and defects in workmanship prior to startup and installation of insulation.

C. Prior to and after installation of insulation, each pipe tracing system shall be megger tested. Minimum insulation resistance shall be 20 megohms regardless of circuit length. Both bus wires shall be tested to verify the connection of all splices and tees. Megger test pipe tracing system in accordance with manufacturers written instructions.

END OF SECTION

DIVISION 31

EARTHWORK

SECTION 31 10 00
SITE CLEARING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Protection of existing surface features
2. Removal of miscellaneous surface features.
3. Clearing and grubbing of site.
4. Stripping topsoil.
5. Locating existing pipes and electrical conduits.
6. Removal from site and disposal of stockpiled landfill material.

1.02 SUBMITTALS

A. Submit coordinates and elevation of each located underground pipe.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 PREPARATION

A. Provide a minimum of 3 working days notice, prior to construction, to owners of existing utilities and surface features.

B. Protect existing utilities and surface features indicated to remain. Restore damaged existing utilities and surface features to condition equal to condition prior to construction.

C. Protect trees, shrubs, and other land resources, where indicated to remain. Provide fencing no closer than “drip line” of trees and shrubs and of sufficient height so features will not be damaged.

D. Do not remove or cut down trees unless identified for removal on drawings, or located within limits of excavation, proposed structures or paving as indicated on Drawings.

E. Do not trim trees unless shown on Drawings.

F. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

G. Maintain access to site.

H. Install erosion control measures prior to start of any earth-disturbing activities.

3.02 REMOVALS

A. Remove obstructions such as mounds of dirt, stones, or debris located within construction limits.

B. Remove surface features including pavements, curb and gutter, posts, fences, shrubs, landscaping features, and other miscellaneous items within construction limits.

C. Full depth saw cut all pavement, sidewalk and curbing to be removed.

D. Conform to requirements of Section 01 35 16.

3.03 CLEARING AND GRUBBING

A. Clearing and grubbing shall include cutting and disposal of trees, shrubs, brush, windfalls, logs, and other vegetation, and removal and disposal of roots, stumps, stubs, grubs, logs and other timber, and other perishable or objectionable matter.

B. Clear and grub within limits of excavations for structures and utility trenches, including the adjacent areas need for equipment access. Contractor shall make every effort to minimize limits of disturbance.

C. Grub stumps and roots to a depth of at least 12 inches below existing ground surface or subgrade, whichever is lower.

D. Cut interfering tree roots and branches 1 inch or greater in diameter perpendicular to direction of growth on tree side of trench.

E. Remove cleared and grubbed material from site and dispose of in accordance with applicable regulations.

3.04 STRIPPING TOPSOIL

A. After area has been cleared of vegetation, remove existing topsoil to entire depth in areas where grade is to be adjusted and in areas to be covered by structures or paving.

B. Stripped topsoil shall be free of clay lumps, sand and gravel, stones, vegetation, and debris.

C. Stockpile on site in an area clear of new construction. Strip stockpile areas of vegetation prior to stockpiling.

D. Maintain the stockpile in a manner which will not obstruct the natural flow of drainage.

1. Protect from erosion.
2. Maintain stockpile free from debris and trash.
3. Immediately stabilize stockpiles and surround stockpiles as needed with silt fence or other perimeter control if stockpiles will remain inactive for 7 days or longer.

E. Owner has first right to excess topsoil not used in Work. Obtain Owners approval before removing any topsoil not required for work. Remove excess topsoil not required by Owner from site.

3.05 DISPOSAL

A. Remove brush, grass, roots, trash, and other material from site preparation operations from site.

B. Do not store or permit debris to accumulate on the job site.

C. Do not burn debris at the site.

D. Dispose of materials removed by clearing and grubbing in accordance with applicable regulations.

3.06 DEMOLITION

A. Conform to Section 01 35 16.

3.07 EXPLORATION FOR EXISTING UNDERGROUND PIPING AND ELECTRICAL CONDUITS (POTHOLING)

A. Prior to initiating work, Contractor shall determine exact location and elevation of underground piping and conduits at locations specified.

1. Excavate and expose top and sides of piping or conduit.
2. Locate top and outer edges of piping or conduit by surveying with equipment capable of locating each point to within 0.1 ft. accuracy.
3. Tie survey coordinate information to state plane coordinate system shown on drawings.
4. Probing to locate outer edges of piping may be permissible if exposing sides of piping would compromise the structural integrity of the piping, provided the size and invert elevation can be determined from the information available.
5. Each point to be surveyed shall consist of a set of three (3) survey points. One set of points shall consist of coordinates on each side of the pipe or conduit and the top center elevation of pipe or conduit.

B. The Contractor shall pothole all utility crossings along proposed piping and duct bank routes, and additional locations as indicated on the Drawings. Should additional location information be needed, contact the Engineer.

C. Submit location survey information in hard copy and electronic form to Engineer. Engineer will evaluate information for its impact on proposed structures and will revise the design as required to avoid impacting the existing piping and conduits.

D. Contractor shall backfill and compact the backfill over the exposed piping and conduits in accordance with the requirements of Section 31 23 33 - Trenching and Backfill.

E. Disposal of excess soil material shall be in accordance with applicable regulations. Refer to Section 01 57 19.

3.08 PRELIMINARY SITE SURVEY

A. When required on the Drawings or specified in this or other sections, Contractor shall perform a preliminary site survey of surface features to ascertain their locations and elevations to an accuracy of 0.01 ft in all axis.

B. In areas where pavements, driveways or sidewalks are removed and no adjoining fixed features are available to reference (curb gutter, sidewalks, remaining pavement, etc) the Contractor shall provide a survey for the entire area to be disturbed which will establish the grades and locations of the existing features which can be staked for restoration efforts. Grades shall be determined at no more than 25 ft intervals. It is the intent of the contract documents to restore the project area to existing conditions or better.

C. In all areas where road or driveway centerlines or edges are removed the Contractor shall survey the centerline and edges to allow them to be accurately restored. Survey will not be required if existing curbing is present and is not disturbed on the pavement edge.

D. Inlets or other structures which are removed for construction and are to be replaced shall have their rim elevation and all inverts surveyed prior to removal.

E. Contractor shall photograph all landscape restoration areas including, but not limited to retaining walls, fences, flower beds, garden areas, shrubs and trees.

END OF SECTION

SECTION 31 23 33
TRENCHING AND BACKFILL

PART 1 – GENERAL

1.01 SUMMARY

A. Trenching and backfilling to elevations shown on Drawings and as needed for installation of underground piping and utilities associated with Work and to meet requirements of Contract Documents.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. D1556: Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
   2. D2167: Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
   3. D2937: Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
   4. D6938: Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. Illinois Department of Transportation (IDOT):

   1. Standard Specifications for Road and Bridge Construction, Current Edition

1.03 DEFINITIONS

A. Influence Zone Under Foundations, Pavements, or Sidewalks: Area below foundation or pavement or sidewalk subbase bounded by 1 horizontal to 2 vertical slope extending outward from 1-foot beyond outer edge of foundation or pavement or sidewalk subbase.

B. Influence Zone Under Piping or Electrical Ducts: Area below limits bounded by line 6 in. below pipe or electrical duct and by 1 horizontal to 2 vertical slope extending outward from that line 1-foot beyond outer edge of pipe or duct.

C. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by Engineer.

1.04 SUBMITTALS

A. Test Results.

   1. Compaction test results.
   2. Proctor test results.

B. Miscellaneous Submittals.

   1. Test results to verify fill materials and bedding and cover materials meet Specifications.

C. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Testing shall be provided by Contactor in accordance with Section 01 45 29 and this Section.

B. Where IDOT aggregate gradations are specified, aggregates shall be from IDOT approved sources.

C. Sheeting, shoring, and bracing shall conform to safety requirements of federal, state, and local agencies.

1.06 PROJECT / SITE CONDITIONS

A. Notify owners of above or below ground utilities encountered during trenching operations.

B. Cap and remove or relocate services in accordance with instructions of owners of such utilities.

C. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of owners of such utilities.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

PART 2 – PRODUCTS

2.01 SUBGRADE STABILIZING AGGREGATE

A. Subgrade stabilizing aggregate, if required, shall be IDOT CA-3.

2.02 BEDDING MATERIALS

1. Plastic, Copper, Fiberglass or Reinforced Plastic Pipe, and Electrical Conduit or Ducts: IDOT gradation FA-1, FA-2, FA-5, FA-6, FA-10, or FA-21.
2. Other Pipe 18-inch diameter or less: IDOT gradation CA-11 or CA-13.
3. Other Pipe over 18-inch diameter: IDOT gradation CA-7.

2.03 COVER MATERIALS

A. Copper, Fiberglass or Reinforced Plastic Pipe and Electrical Conduit: IDOT gradation FA-1, FA-2, FA-5, FA-6, FA-10, or FA-21.

B. Other Piping: IDOT CA-6 or CA-10.

C. Electrical Ducts: Structural Fill or Excavated Trench Material.

D. Bedding material may be substituted for cover material.

2.04 FILL MATERIALS

A. Structural Fill: IDOT CA-6.

B. Excavated Trench Material:

1. Natural soils resulting from excavation of project trenches.

2. Free of topsoil, wood, peat, cinders, organic and deleterious matter or other rubbish.

C. Flowable Fill (Controlled Low Strength Material): Said material, when used, shall meet IDOT Standard Specifications, Section 1019, Mix 1 per Article 1019.05.

2.05 FILTER FABRIC

A. Porous non-woven fabric with multiple layers of randomly arranged fibers, min 4.0 ounce per square yard (typical).

B. Manufacturers:

1. Mirafi 140N by Mirafi, Inc.
2. Typar 340I by DuPont.
3. Supac 5P by Phillips Fibers Corp.
4. Propex 4545 by Amoco Fabrics Co.
5. Or Equal.

2.06 SHEETING, SHORING, AND BRACING

A. Type, design, detail, and installation of sheeting, shoring, and bracing shall be determined by and sole responsibility of Contractor.

2.07 SOURCE QUALITY CONTROL

A. Testing:

1. One sieve analysis, plasticity index, and uniformity coefficient for each source of structural fill.
2. One sieve analysis for each source of bedding material and cover material.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work such as areas loosened by frost action or softened by flooding or weather, or existence of unsuitable material. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Natural soils or fill softened by frost, flooding or weather shall be removed and replaced.

B. Remove unsuitable material from within trenches.

C. Stabilize trench bottom and replace unsuitable materials with subgrade stabilizing aggregate, if required.

D. If unsuitable materials or soft soils are encountered at the bottom of the trench, remove and replace with a foundation consisting of subgrade stabilizing aggregate. Unsuitable material removal and replacement shall extend the depth of the unsuitable material or 18 inches beneath the bedding layer, whichever is less.

E. Where placement of subgrade stabilizing aggregate will not provide an adequate foundation for laying pipe due to instability of existing materials and where ordered by Engineer, place

geotextile fabric on top of unstable subgrade prior to placing subgrade stabilizing aggregate foundation. Geotextile fabric shall completely enclose foundation, bedding, and cover materials, and pipe.

3.03 SHEETING, SHORING, AND BRACING

A. Whenever necessary to prevent caving during excavation and to protect adjacent piping, structures, property, workers, and public, trenches shall be sheeted, shored, and braced.

B. When sheeting, shoring, and bracing is required, install to prevent soil from entering excavation below or through sheeting.

C. Remove sheeting, shoring, and bracing after backfilling, or when approved by Engineer as backfill is being placed.

D. Remove sheeting, shoring, and bracing in manner not damaging to facility or permitting voids within backfill.

E. Fill settled areas after sheeting, shoring, and bracing has been removed.

3.04 DEWATERING

A. Dewater excavation site prior to starting trenching and maintain groundwater minimum of 12 inches below bottom of trench. Dewatering system shall be of a sufficient size and capacity as required to control hydrostatic pressure on trench sides and bottom to allow material to be excavated, pipe installed and backfill placed, all in a dry condition.

B. Contactor is responsible for choosing method of groundwater control.

C. If Contactor chooses to use deep wells or well points, wells and well points shall be designed, installed, and operated to prevent removal of in-situ materials.

D. Drill, maintain, and abandon dewatering wells in accordance with federal, state, and local ordinances.

E. Keep construction site free-draining. Keep trenches free of water.

F. Remove soil disturbed by pressure or flow of groundwater.

G. Maintain dewatering system to prevent uplifting of or damage to facilities.

H. Protect adjacent utilities, structures, and properties from damage resulting from dewatering operations.

I. Direct discharge of trench dewatering pumps to sediment traps before conveying to natural drainage channels or storm water drains.

3.05 EXCAVATION

A. Excavate to the lines, grades, and elevations indicated and necessary to complete construction.

B. Method of excavation shall be consistent with soil types encountered and result in undisturbed subgrade. Loosened soils shall be recompacted or removed and replaced.

C. Where possible, excavated materials shall be placed in areas that will not block existing vehicle and pedestrian traffic and drainageways.

D. Conduct excavating operations to carefully expose all in-place underground structures without damage. Wherever excavation extends under or approaches close to an existing structure, precautions and protective measures shall be taken as necessary to preserve the structure and provide temporary support. Use hand excavation methods to probe for and expose such critical or hazardous installations as gas pipe and power or communication cables.

E. Excavation of Rock:

1. Where rock, boulders, or similar material is encountered, and where such material cannot be removed or excavated by conventional earth moving or ripping equipment, remove or excavate such material by means which will neither cause additional cost to the Owner nor endanger buildings or structures on or off site.
2. Do not use explosives without written permission from Engineer.

F. Trench Tolerances:

1. Maximum width of trench at top of pipe shall be outside diameter of pipe plus 24 inches. When sheeting, shoring, and bracing required, width of trench may be increased to allow for their use, provided provisions for excess width of trench are met.
2. Where trench width below top of pipe exceeds specified limit, Contactor, at its expense, shall furnish pipe with strength adequate for actual trench width.
3. Minimum trench width shall be outside diameter of pipe plus 18 inches
4. Top of concrete encasement for electrical duct or top of conduit shall be minimum of 24-inches below final grade or as shown on Drawings.
5. Trench width at ground surface shall be the minimum allowable based on OSHA standards and soil types.

G. Do not advance excavation of trenches more than 300 feet ahead of completed pipe installation.

H. Do not excavate within influence zone of existing footings or foundations without prior approval of Engineer.

I. Excavation through Rigid Pavement:

1. Remove pavement a minimum of 1 foot beyond anticipated edge of excavation.
2. Saw cut pavement to ensure straight joint.
3. Pavement replacement shall match existing.

J. Excavation, backfill, and pavement replacement of roadways shall conform to requirements of the local highway authority. In no case shall the replacement pavement edges bear on less than 12 inches of undisturbed soil.

D. If unsuitable material is encountered within the excavated trench, remove and dispose of unsuitable material and replace with structural fill. Conform to the requirements of Section 01 57 19 for disposal of unsuitable materials.

3.06 FILL USAGE

A. Bedding Material Limits:

1. Electrical Ducts:

a. Hand grade bottom of trench to established uniform grade of not less than 4 inches / 100 feet.
b. Use bedding material to bring grade to desired elevation.

2. Bedding material shall be placed over entire width of trench bottom such that after pipe has been placed thereon, imbedded to grade and aligned, there remains a 6 inch minimum depth of material below pipe barrel and a minimum of 5 inches below the bell.
3. Bell holes shall be excavated so that entire pipe barrel rests on bedding.

B. Cover Material Limits:

1. Electrical Conduit: Minimum 6 inches above and 9 inches each side.
2. Piping: Minimum of 12 inches above top of pipe and 12 inches each side.

C. Structural Fill: Within trenches under pavements and sidewalks and within piping, electrical duct or structure influence zone.

D. Excavated Trench Material: Other areas not previously specified.

E. Flowable Fill: Where noted.

3.07 PLACING FILL

A. Notify Engineer before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Place filter fabric where indicated in accordance with manufacturer's recommendations.

D. Do not backfill until concrete is properly cured and has reached design strength, coatings approved, and required tests accepted.

E. Place fill simultaneously on both sides of freestanding structures.

F. Where pipes leave structures, protect by backfilling pipe influence zone down to undisturbed soil with bedding material.

G. Where pipes or electrical ducts cross, protect piping or ducts at higher elevation by backfilling trench within influence zone of higher pipe or duct with structural fill.

H. Where pipes or electrical ducts leave structures, protect by backfilling within influence zone of pipe or duct with structural fill.

I. Provide mechanical compaction. Jetting, flooding, puddling, or vibroflotaion methods shall not be used for compaction.

J. Place and compact bedding, cover and fill materials in lift thickness and to densities listed below:

1. Degree of compaction: ASTM D1557, Modified Proctor.
2. Moisture Content: Within 3% of optimum.

Location	Maximum Lift Thickness	Modified Proctor (%)
Bedding Material or Cover Material	6 inches	90 minimum
Fill material under Footing, Foundation Slab, or Floor Slab Influence Zone	8 inches	95 minimum
Fill material under Sidewalk, Pavement, Crushed Aggregate Base Course, Piping, or Electrical Duct Influence Zone	6 inches	90 minimum
Fill material under Lawn and Landscaped Areas	12 inches	80 minimum, 90 maximum

K. Backfill to 4 inches below finished grade in areas to receive topsoil.

L. Backfill to bottom of base course in areas to receive sidewalk or paving.

M. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.08 FIELD QUALITY CONTROL

A. Testing:

1. Bedding and cover material – Take one field density test per lift per 75 feet of trench.
2. Trench Backfill Material – Depth of Cover Less than 14 feet: Take two tests every 75 feet of trench. Test when trench has been backfilled halfway and when trench has been completely backfilled.
3. Trench Backfill Material – Depth of Cover Equal to or Greater than 14 feet: Take three tests every 100 feet of trench. Test when trench 1/3 and 2/3 backfilled and when completely backfilled.
4. Determine in-place density of fill at maximum intervals specified in accordance with ASTM D1556, D2167, D2937, or D6938.
5. Recompact and retest areas of backfill tested that did not meet minimum requirements.

3.10 ADJUSTMENT AND CLEANING

A. Stockpile material suitable for backfill where designated by Engineer. Place no fill where trenches for sewers, water line, or other utilities will be located.

B. Remove and dispose of all unsuitable excavated material.

C. Owner has first right to excess material suitable for backfilling or site grading not used in Work.

E. Remove excess material not required by Owner, material not suitable for backfilling or site grading, and unsuitable materials from site. Conform to the requirements of Section 01 57 19 for disposal of excess excavated materials.

END OF SECTION

SECTION 31 25 00
EROSION CONTROL AND SITE STABILIZATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section describes requirements for control of erosion on construction sites. Contractor shall provide necessary materials, equipment, and labor to control erosion by methods specified herein. If no specific quantities are shown on Plans, Contractor shall use whatever quantities are necessary to prevent sediment transport into adjacent storm water conveyance systems or water bodies.

B. Section includes:

1. Silt Fence
2. Storm Sewer Inlet Protection
3. Mulching
4. Erosion Control Blanket
5. Temporary Seeding

1.02 REFERENCES

A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, Current Edition

B. Illinois Urban Manual (IUM), Current Edition

1.03 REGULATORY REQUIREMENTS

A. Contractor shall comply with Lake County Stormwater Management Commission regulations.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

2.01 TOPSOIL

A. Friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and free from subsoil, roots, heavy or stiff clay, sand and gravel, stones larger than two inches in any dimension, noxious weeds, sticks, brush, litter, and other deleterious matter.

B. Acidity Range: pH 5.0 minimum, 7.0 maximum.

C. Reference IUM Material Specification 804.

2.02 FERTILIZER

A. Reference Section 32 92 00.

2.03 TEMPORARY SEEDING

A. Temporary seed shall conform to the requirements of Article 1081.15(g) of the IDOT Standard Specifications.

2.04 EROSION CONTROL MAT

A. Excelsior blanket conforming to the requirements of Article 1081.10(a) of the IDOT Standard Specifications.

2.05 STORM INLET PROTECTION

A. Inlet protection shall be a manufactured storm sewer insert such as Catch All by Marathon Materials, Dandy Bag by Dandy Products, or approved equal.

2.06 SILT FENCE

A. Geotextile fabric: meet the requirements of IUM Material Specification 592 – Geotextile, Table 1, Class 2.

B. Silt fence stakes and posts:

1. Use either wooden stakes or steel posts for fence construction.
2. Minimum length: 5 feet.
3. Wooden posts: 2-inch x 2-inch nominal cross-sectional area.
4. Steel posts: Standard U or T-section, minimum weight of 1.33 pounds per linear foot.
5. Fasteners: staples, zip ties, or wire ties.

2.07 Water: Furnished in accordance with Section 01 52 00.

2.08 All other products shall be as specified in current version of Illinois Urban Manual.

PART 3 – **EXECUTION**

3.01 EROSION CONTROL REQUIREMENTS

A. All erosion control measures shall be implemented in accordance with IUM Practice Standards:

1. Practice Standard 813: Dewatering
2. Practice Standard 830: Erosion Control Blanket
3. Practice Standard 861: Inlet Protection – Impervious Areas
4. Practice Standard 862: Inlet Protection – Pervious Areas
5. Practice Standard 875: Mulching for Seeding and Soil Stabilization
6. Practice Standard 920: Silt Fence
7. Practice Standard 927: Soil Stockpile
8. Practice Standard 965: Temporary Seeding

B. Keep a copy of the current erosion control plan on site throughout the duration of the project. Any revisions of to the erosion control plan shall be kept on site at all times.

C. Erosion control devices, disturbed areas of the site that have not achieved final stabilization,

and locations where vehicles enter and exit the site shall be inspected by a qualified person at least once every seven (7) calendar days and following a storm event resulting in 0.5 inches or more of rain. Post-rain event inspections shall be completed within 24 hours of the end of the rain event, or by the end of the following work day.

D. Make needed repairs and document findings of inspections in a site erosion control log that includes the date of inspection, name of person conducting inspection, scope of the inspection, major observations relating to sediment and erosion control, and any actions taken.

E. Install perimeter erosion controls and stabilized construction entrance(s) prior to any land-disturbing activities, including clearing and grubbing.

F. Contractor shall not begin work until after initial erosion and sediment control devices are in place and approved by Engineer.

G. Contractor shall take all possible precautions to prevent sediment from being tracked onto public or private roadways. Any sediment reaching a public or private road shall be removed by street cleaning (not flushing) before end of each workday.

H. All activities on site shall be conducted in a logical sequence to minimize area of bare soil exposed at any one time.

I. Site stabilization measures shall be initiated whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site, or have temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days. Stabilization measures shall be initiated no later than one (1) working day after cessation of construction activities, except when stabilization is precluded by snow cover. Once initiated, stabilization measures shall be completed as soon as practicable, but no more than 14 days from the initiation of stabilization work in an area.

J. Immediately stabilize stockpiles and surround stockpiles as needed with silt fence or other perimeter control if stockpiles will remain inactive for 7 days or longer.

3.02 TEMPORARY SEEDING

A. All disturbed ground left inactive for 14 days or longer shall be stabilized by seeding or sodding (only prior to October 15) or by mulching or covering, or other equivalent control measure.

Between September 15 and October 15 stabilize with mulch, tackifier, and a perennial seed mixed with winter wheat, annual oats, or annual rye, as appropriate for region and soil type.

After October 15th, stabilize with a polymer and dormant seed mix, as appropriate for region and soil type.

B. Temporarily seed all areas of exposed soil that will not be brought to final grade or on which land-disturbing activities will not be performed for a period greater than 14 days.

C. Temporarily seed in accordance with IUM Practice Standard 965.

3.03 MULCHING

A. In accordance with IUM Practice Standard 875.

3.04 EROSION CONTROL BLANKET

A. Provide in accordance with IUM Practice Standard 830.

3.05 SILT FENCE

A. Silt fences shall be placed along all sideslope and downslope sides of site. If a channel or area of concentrated runoff passes through site, sediment control fences shall be placed along channel edges to reduce sediment reaching channel.

B. Install in accordance with IUM Practice Standard 920 and detail drawings.

C. Attach geotextile fabric to each post with a minimum of three (3) fasteners per post.

D. Remove sediment from behind silt fences and sediment barriers before sediment reaches a depth that is equal to one-third of the fence and/or barrier height.

3.06 STORM DRAIN INLET PROTECTION

A. Install inlet protection prior to land-disturbing activities in the contributing drainage area and/or immediately upon inlet installation.

B. Install device according to manufacturer's instructions.

C. The contributing drainage area to inlet protection device shall be one acre or less. In instances where a larger contributing drainage area exists, runoff shall be routed through a sediment trap or settling device upstream of inlet.

3.07 TEMPORARY SOIL STOKPILES

A. Erosion and sediment control measures are required for soil stockpiles to remain in place for more than 24 hours.

B. Soil stockpiles shall be located a minimum of 25 feet from any wetland, stream, creek, ditch, swale, water conveyance system, lake, pond, etc.

C. Perimeter sediment control, such as a silt fence, shall be installed on the down slope side of the stockpile prior to its creation. Perimeter protection shall be placed a minimum of 8 feet from the toe of the stockpile slope.

D. Provide erosion and sediment control measures in accordance with IUM Practice Standard 927.

3.08 DEWATERING

A. The Contractor shall make their own calculations and shall plan their work accordingly. Dewatering, surface water control, and temporary diversions shall be used to facilitate work "in the dry." Work shall not be allowed in wetlands, flowing water, or in standing water that can discharge directly to Waters of the U.S. or Isolated Waters of Lake County.

B. Contact owner or operator of municipal separate stormwater system if discharge is to municipal storm water conveyance system.

C. Select best management practice for sediment removal based on predominant soil texture encountered at dewatering site with consideration given to pumping or flow rates to prevent discharge of sediment to the maximum extent practical. General categories include:

1. Geotextile Bags
2. Gravity Based Settling Systems
3. Passive Filtration Systems

4. Pressurized Filtration Systems

D. Water pumped from site shall be treated by temporary sedimentation basins, grit chambers, sand filters, upslope chambers, hydro-cyclones, swirl concentrators, or other appropriate controls designed and used to remove particles of 100 microns or greater for highest dewatering pumping rate. If water is demonstrated to have no particles greater than 100 microns during dewatering operations, then no control is needed before discharge. Water may not be discharged in a manner that causes erosion of site or receiving channels.

E. In accordance with IUM Practice Standard 813.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 92 00
TURF AND GRASSES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Preparing ground surface.
2. Seed.
3. Fertilizer.
4. Maintenance.

B. Except for paved, riprapped, or built-up areas, all areas of site which are disturbed and areas noted on Drawings shall be seeded or sodded.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.
2. Mix analysis and names of seed mixes.

B. Test Results:

1. Topsoil test results including fertilizer and lime requirements.

C. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Meet or exceed specifications of Federal, State, and local laws requiring inspection for plant disease and insect control.

B. Seed shall conform to U.S. Department of Agriculture Rules and Regulations under Federal Seed Act and requirements of state seed laws.

C. Contractor shall engage certified soils testing laboratory to perform a soils evaluation of existing and/or imported topsoil to determine fertilizer and lime requirements.Provide a minimum of 1 composite soil sample, consisting of 5 test borings, for every 5 acres to be seeded or sodded.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide seed mixture in sealed containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

B. Deliver fertilizer to site in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.06 WARRANTY

A. Warranty lawn areas for period of 1 year after acceptance of seeding and sodding to be alive and in satisfactory growth at end of warranty period.

1. For purpose of establishing acceptable standard, scattered bare spots, none larger than 1 square foot, will be allowed up to a maximum of 3% of lawn area.

PART 2 – PRODUCTS

2.01 TOPSOIL

A. Friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and free from subsoil, roots, heavy or stiff clay, sand and gravel, stones larger than two inches in any dimension, noxious weeds, sticks, brush, litter, and other deleterious matter.

B. Acidity Range: pH 5.0 minimum, 7.0 maximum.

C. Obtain topsoil from source stockpiled under Section 31 10 00, or provide imported topsoil obtained from sources outside the project limits, or from both sources. Stockpiled topsoil shall be screened to meet specified requirements.

2.01 SEED

A. Fresh, recleaned, new crop seed in specified varieties and proportions indicated.

B. Weed content shall not exceed 0.25%.

Common Name	Weight (%)	Minimum Germination (%)
Kentucky Bluegrass	50	85
Perennial Ryegrass	30	85
Creeping Red Fescue	20	95

2.02 FERTILIZER

A. Commercial balanced, uniform in composition, free flowing, conforming to state and federal laws.

B. Contain percentage by weight as follows, or as modified by topsoil test recommendations.

1. Prior to seeding or sodding: 6-24-24.
2. After seeding or sodding: 18-5-9.

C. 50% of elements shall be derived from organic sources.

2.04 ACCESSORIES

A. Mulch: Dry oat or wheat straw or wood cellulose fiber free of weeds and foreign matter detrimental to plant life. Hay or chopped corn stacks are not acceptable.

B. Water: Furnished by Owner from existing on-site source. Provide pumps, tankage, hose, piping, and attachments as required to bring water to point of use.

C. Erosion Control Blanket:

1. Short term duration, light duty, organic Erosion Control Revegetative Mat
2. Non-organic photodegradable or biodegradable netting allowed.
3. Manufacturers:

a. Curlex I, by American Excelsior
b. S75, DS75, or DS150, by North American Green
c. Excel SR-1, by Western Excelsior
d. ECS1, by East Coast Erosion Blankets
e. Or Equal

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PLANTING SEASONS

A. Spring Planting Season: From time soil can be satisfactorily worked until following dates.

1. Seed: April 1st to June 15th.
2. Sod: June 15th.

B. Fall Planting Season:

1. Seed: August 1st to November 1st
2. Sod: September 1st to October 20th.

C. Dormant Seeding: October 21st to November 15th (Soil at 1"<50 degrees Fahrenheit), seed with cover crop of winter wheat at 100 pounds per acre.

D. Perform planting of seed or placement of sod only when weather conditions and soil conditions are acceptable.

E. Planting season limits may be changed when approved by Engineer.

3.03 PREPARATION

A. Uniformly grade areas disturbed by construction, including adjacent transition areas, with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades. Where proposed elevations are not shown on the Drawings, match pre-construction elevations and drainage patterns.

B. Where a change of slope is indicated on the Drawings, construct a rolled transition section having a minimum radius of approximately 8 ft, unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.

C. Grade areas adjacent to buildings or structures to achieve drainage away from the structures, and to prevent ponding.

D. Maximum allowable variation from design elevation is 1 inch in 10 feet.

E. Do not plant seed or place sod until trees, shrubs, and other landscaping completed.

F. Scarify existing topsoil where grade is not being raised, or where topsoil is over compacted, to depth of 2 inches.

G. For topsoil with high acidity, add lime as recommended in topsoil test report.

H. Grade, rake, and roll with roller weighing not more than 100 pounds per foot or less than 25 pounds per foot.

I. Protection of Newly Graded Areas:

1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances.

3.04 FERTILIZING

A. Before seeding or sodding, apply 6-24-24 fertilizer at uniform rate of 20 pounds/1000 square feet; make 2 passes at right angles. Incorporate fertilizer into soil to depth of at least 2 inches by discing, harrowing, or other approved method.

B. After completion of required interim mowings, apply 18-5-9 fertilizer at rate of 15 pounds per 1000 square feet; make 2 passes at right angles.

C. Adjust rate of application and type of fertilizer as recommended in topsoil test report.

D. Lightly water to aid dissipation of fertilizer.

3.05 SEEDING

A. Apply seed at a total rate of not less than 5 pounds/1000 square feet; make 2 passes at right angles.

B. Seeding method shall establish smooth, uniform turf.

C. Cover seed with 1/8 inches of soil by light raking.

D. Do not seed following rain, if soil has been compacted by rain, or if ground is too dry.

E. Do not seed when wind velocity exceeds 6 miles per hour.

F. Do not seed areas in excess of that which can be mulched on same day.

G. Immediately after seeding, apply mulch to flat areas and erosion control blanket to areas with greater than 3H to 1V slopes.

H. Place mulch loose to allow some sunlight to penetrate and air to circulate, but thick enough to shade ground, conserve soil moisture, and prevent erosion.

I. Butt ends and edges of erosion control blanket snugly and staple to ground surface with 6 inch staples.

J. Apply water with fine spray immediately after area has been mulched or application of erosion control blanket. Leave area thoroughly soaked at close of each working day.

3.06 PROTECTION

A. Protect turf areas by erecting temporary fences, barriers, signs, and similar protection as necessary to prevent trampling until acceptance by Owner.

B. Replace, repair, restake, or replant damaged seeding or sod.

C. Protect slopes and embankments against erosion until Work is accepted. Repair eroded areas by refilling, resodding, reseeding, and remulching as required.

3.07 FIELD QUALITY CONTROL

A. Acceptance:

1. Notify Engineer when lawn areas are ready for final inspection.
2. Substantial completion will be granted upon conformance with following;

    a. Turf reasonable free from weeds, diseases or other visible imperfections.
    b. Turf displays uniform color, quality and coverage.
    c. Minimum 3 mowings performed.
    d. Fertilizer application performed after mowing.

3. After substantial completion, Owner will be responsible for maintenance.

3.10 MAINTENANCE

A. Maintenance shall begin immediately following installation of each portion of lawn. Continue until substantial completion.

B. Maintain lawns by watering, mowing, and repairing or replanting as may be necessary to produce uniform stand of grass until Work accepted.

C. Perform first mowing when average height of grass reaches 3 inches. Perform interim mowings, 2 minimum, as needed to maintain grass height at 2 to 2-1/2 inches. Do not remove more than 1/3 of leaf blade by mowing.

D. After completion of required interim mowings, apply 18-5-9 fertilizer as specified herein.

E. Control weed growth; apply herbicide in accordance with manufacturer’s instructions.

F. Top dress or resod excessive cracks appearing upon soil shrinkage.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33 05 05
SITE UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes Site Piping for:

1. Process piping (alum)

1.02 DEFINITIONS

A. HDPE: High Density Polyethylene

B. PVC: PolyVinyl Chloride

1.03 SYSTEM DESCRIPTION

A. Systems include yard piping between buildings or structures.

B. Systems are further described and specified in:

1. Exposed Piping Installation: Section 40 05 05

1.04 SUBMITTALS

A. Manufacturer's specifications, data sheets, and installation instructions for piping, equipment, and accessories.

B. Include other data as necessary to show compliance with these Specifications.

C. Submit in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.01 PROCESS MECHANICAL PIPING

1. Alum
   a. Pipe: Schedule 80 PolyVinyl Chloride (PVC), socket joint type. Comply with Section 40 05 31.13.
   b. Transition couplings:

      i. From double wall HDPE Poly-Flo pipe to single wall HDPE Poly-Flow pipe: Poly-Flo end termination.
      ii. From HDPE to PVC: Fabricated HDPE to PVC transition union.
   c. Valve vault: Comply with Section 33 05 61.

   d. Valves: PVC socket-weld ball valve (Type V355) per Section 40 05 53. Valves shall be furnished with 2-inch square operating nut, opening to the left. Provide valve stem extension if depth of valve is such that an 8-foot long valve key will extend less than 3 feet above finished grade.

2.02 BACKFILL, COVER AND BEDDING MATERIALS

A. Comply with Section 31 23 33.

2.03 UNDERGROUND PIPE TRACER WIRE AND TEST STATIONS

A. Tracer Wire Type: 12 gauge AWG solid copper wire or copper-clad steel wire with 30 mil HDPE jacketing for underground installation. Jacket color to conform to standard utility marking convention. Stranded copper wire, THHN electrical wiring, stainless steel wire, and bare copper wire are all prohibited.

B. Connectors: Buried tracer wire connections and splices shall be via moisture displacement connectors, such as SnakeBite Locking Connector by Copperhead Industries, Direct Bury Splice Kit by 3M, or equal. Connections made by twisting wires together and taping them is not acceptable.

C. Tracer Wire Test Stations: SnakePit Roadway Access Point by Copperhead Industries. Lid color to be determined by Owner.

2.04 HEAT TRACING, INSULATION AND JACKETING FOR PROCESS MECHANICAL PIPING

A. Comply with Section 40 42 13.

PART 3 - EXECUTION

3.01 BURIED PIPING INSTALLATION

A. Comply with Section 31 23 33 and material and system specifications for piping being installed.

B. When new pipe is to be connected to existing pipe not terminating in manhole, uncover end of existing pipe to allow adjustments in line and grade before any pipe is laid.

C. Lay pipe to line and grade shown on Drawings.

D. For gravity piping, begin laying pipe from lowest point in proposed pipe line.

E. For pressure piping, lay pipe at continuous slope between invert elevations shown at building faces, unless otherwise noted.

F. Lay pipe with bell end of bell and spigot pipe pointing upgrade.

G. Lay gravity pipe uniformly to line and grade so finished pipe presents uniform bore.

H. Noticeable variations from true alignment and grade shall be considered sufficient cause for rejection of Work.

I. Record North, Easting and Elevation of all bends and fittings. Provide data to Owner and Engineer as work progresses.

J. Take precautions to prevent foreign material from entering pipe during or after laying operations. If foreign material enters pipe, remove it completely before continuing.

K. Provide watertight plugs for open ends of pipe when laying not in progress.

L. Laying of Pipe in Cold Weather:

1. Heat pipe and jointing materials to prevent freezing of joints.
2. Do not lay pipe on frozen ground.
3. Pipes with rubber gaskets or resilient type joints: Warm gasket or joint material to facilitate making proper joint.
4. With solvent cemented joint: Remove ice and snow from jointed area prior to applying of solvent cement.

M. Connect dissimilar pipe materials using factory fabricated connecting pieces.

3.02 TRACER WIRE INSTALLATION

A. Install for all pipe except ductile iron and reinforced concrete.

B. Secure tracer wire to pipe, including stubs and dead ends, at top of pipe and tape at 10 ft intervals.

C. Terminate tracer wire at tracer wire test stations. Test stations shall be located as indicated on the Drawings.

3.03 HEAT TRACING, INSULATION, AND JACKETING INSTALLATION FOR PROCESS MECHANICAL PIPING

A. Where indicated, provide heat tracing and/or insulation and jacketing per Section 40 42 13.

3.04 VALVE VAULT INSTALLATION

A. Comply with Section 33 05 61 and Section 31 23 33.

B. Construct at locations and elevations shown on Drawings.

3.05 FIELD QUALITY CONTROL

A. Testing:

1. Test piping systems in accordance with Section 40 05 10 and requirements of applicable systems specifications.
2. Electrical Continuity: Test tracer wire for electrical continuity prior to acceptance of piping.

END OF SECTION

SECTION 33 05 61
MANHOLES, CATCH BASINS, AND INLETS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Precast concrete structures for sewer and water utilities.

1.02 REFERENCES

A. IDOT: Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Current Edition

B. ASTM: American Society for Testing and Materials

1.03 SUBMITTALS

A. Product data:

1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
2. Manufacturers recommended installation procedures.

B. Provide certification reports attesting that materials supplied meet referenced specifications.

C. Shop drawings for manholes showing all components to be installed.

D. If manufacturer’s test data is inadequate or unavailable, Engineer reserves right to require cores drilled for compressive strength tests.

E. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer shall conform to requirements of ASTM C478 for round structures, and ASTM C913 for rectangular structures.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE SECTIONS

A. Rectangular Precast Structures

1. Provide rectangular reinforced precast concrete structure complying with ASTM C913.
2. Size: 2 feet x 3 feet
3. Provide integral anti-floatation collars (extended bases) with a minimum width of 6 inches around bottom of all structures. Provide larger collars for manholes that calculations indicate have buoyancy safety factors less than 1.2 so that required factor of safety is achieved. Other methods of buoyancy control may also be acceptable upon Engineer’s approval.
4. Provide flat top slab with cast-in access hatch as shown on Drawings.

5. All lift holes shall be thoroughly wetted and completely filled with non-shrink mortar or epoxy grout; then smoothed and covered on the outside, with a trowelable grade butyl rubber base backplaster material to minimize leakage.

B. Joints:

1. Tongue and groove with butyl-rubber gaskets meeting requirements of ASTM C443.
2. Joints shall be watertight.

.

C. Pipe to Structure Connections: All connections shall provide for a watertight seal between pipe and manhole.

1. Connect alum piping to structure by means of boot-type connector, meeting the requirements of ASTM C923.

a. Z-Lok Cast in Boots, by A-Lok products, Inc.
b. Or equal.

D. Mark each precast section with name or trademark of manufacturer and date of manufacture. Marking shall be indented into precast section or shall be painted thereon with waterproof paint.

E. Source Quality Control:

1. Test risers and tops in accordance with ASTM C497 for compressive strength compliance by compression tests on cores drilled from 5% of lot.
2. Number of compression tests may be reduced to 1% of lot, with minimum of two cores per lot, for manhole sections fabricated on sewer pipe machine.
3. Manufacturer's core drilling machine shall conform to ASTM C497. Operator shall take test cores as directed by testing laboratory.
4. Stamp base sections, risers and tops, meeting strength requirements, with appropriate monogram.

2.02 MORTAR

A. Comply with ASTM C270, type M.

2.03 FRAMES AND COVERS

A. ASTM A48, gray iron, Class 30-B minimum.

B. Free from cracks, holes, swells, and cold shuts.

C. Provide standard finish, supplied as a total unit.

D. Alum valve vault cover:

1. Neenah R-6660-GH

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.03 INSTALLATION

A. Trench, backfill, and compact for work of this Section in accordance with pertinent provisions of Section 31 23 33.

B. Standard Precast Structure with Integral Base:

1. Excavate deep enough so base section rests on 6 inches minimum of bedding material.
2. Bedding material shall conform to requirements of adjacent pipe, or as indicated on the Drawings.
3. Set structure plumb with orientation of cast-in items as shown on Drawings.

3.04 BACKFILL

A. Backfill with pipe bedding and cover material to spring line of incoming pipe in accordance with Section 31 23 33.

3.06 PIPE TO MANHOLE CONNECTION

A. Support pipe entering manhole above manhole base from wall of manhole back to face of first pipe joint bell with wall of backfill concrete, brick or solid concrete block columns.

B. Connect by means of an approved flexible watertight pipe to manhole seal.

3.07 CASTINGS

A. Set at elevation shown on Drawings.

B. Provide cast-in frame and cover as shown on drawings.

3.08 TESTING AND INSPECTING

A. Do not allow or cause any of Work of this Section to be covered up or enclosed until after it has been inspected.

B. Precast reinforced concrete manholes, inlets, catch basins, risers and tops shall be subject to rejection on account of failure to conform to any specification requirements. In addition, individual sections may be rejected because of any of the following reasons:

1. Fractures or cracks passing through shell, except for single end crack not exceeding depth of joint.
2. Defects indicating imperfect proportioning, mixing, and molding.
3. Surface defects indicating honeycombed or open texture.
4. Damaged ends where such damage would prevent making satisfactory joint.
7. Internal diameter/dimensions of section varying more than 1% from nominal diameter.

8. Any continuous crack having surface width of 0.01 in. or more and extending for length of 12 in or more, regardless of position.

C. Structure seals shall be approved by inspecting Engineer after application and prior to backfilling.

END OF SECTION

DIVISION 40

PROCESS INTERCONNECTIONS

SECTION 40 05 05
EXPOSED PIPING INSTALLATION

PART 1 – GENERAL

1.01 SUMMARY

A. This section identifies process-mechanical piping systems to be provided, specifies unique requirements for each system identified, and references other sections where detailed requirements of piping components are specified.

B. Process-mechanical piping systems are shown on Process-Mechanical Drawings and on Civil Site Piping Drawings. Civil Site Piping Drawings may also show site utility, plumbing, fire protection, and HVAC piping systems that are specified in other sections.

C. Process-Mechanical Piping Schedule included with this section identifies process-mechanical piping systems to be provided. Schedule includes application information and specifies unique system requirements.

1.02 SUBMITTALS

A. Shop Drawings:

1. Layout drawings for each process-mechanical piping system drawn to scale. Identify each piping system with same flow stream identifier as shown on Drawings.

a. Double-line layout for each piping system 3-inch pipe size and larger. Minimum scale of ¼-inch = 1 foot.
b. Single-line or double-line layout for each piping system smaller than 3-inch pipe size. Minimum scale of ¼-inch = 1 foot.
c. For each piping system include:

1) Size for each pipe and fitting.
2) Material, lining type, and system number for coating to be provided for each pipe and fitting.
3) Pipe class, thickness or schedule for each pipe and fitting.
4) Pipe end connections (joint type) and couplings.
5) Location and type of supports, hangers, anchors, and expansion joints.
6) Pipe couplings, saddles, sleeves, clamps, adapters, and other piping products.
7) Pipe mounted equipment and instrumentation identified by tag number assigned on Drawings.
8) Insulation to be provided.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

2.01 PIPE AND FITTINGS

A. Provide pipe and fittings as shown on Drawings and as specified in sections identified in Process-Mechanical Piping Schedule presented at end of this section.

2.02 PRODUCTS FOR PIPING SUPPORT, FLEXIBILITY, THERMAL EXPANSION, ANCHORAGE, AND VIBRATION ISOLATION

A. Provide support system for each non-buried process-mechanical piping system in accordance with Section 40 05 07.

B. Provide anchors, restraints, and concrete blocks as required to resist hydraulic thrust and forces due to thermal expansion.

C. Piping system, including support and anchorage system, shall allow for thermal expansion and contraction due to differences in operating temperature and temperature piping is exposed to during construction. Provide piping system products to allow for and control movement of piping due to thermal expansion and contraction.

D. No attempt has been made to show all pipe supports, hangers, anchors, expansion joints, and other piping products required for piping support, thermal expansion, and anchorage. Absence of these products on Drawings does not relieve Contractor of his responsibility for providing them in accordance with these Specifications.

E. Provide joints, couplings, and expansion joints as shown on Drawings and as required for piping flexibility and vibration isolation. No attempt has been made to show all joints, couplings, expansion joints, and other piping products required for piping flexibility and vibration isolation.

2.03 OTHER PIPING PRODUCTS

A. For buried piping, furnish fill material and install piping in accordance with Section 31 23 33.

B. Provide insulation for piping systems identified to be insulated in REMARKS column of Process-Mechanical Piping Schedule. Provide piping insulation in accordance with Section 40 42 13.

C. Provide products for pipe penetrations in accordance with Section 40 05 09.

D. Provide couplings, flanged coupling adapters, and service saddles in accordance with Section 40 05 06.

E. Provide rubber expansion joints in accordance with Section 40 05 06.

F. Provide stainless steel expansion joints in accordance with Section 40 05 06.

2.04 COATINGS

A. Coat exterior surfaces of non-insulated piping products with coating system numbers specified in Specifications sections identified in Part 3 of this section and in accordance with Section 09 96 00.

PART 3 – EXECUTION

3.01 PREPARATION

A. Use implements, tools, and facilities for handling and protection of piping products to avoid damage prior to installation.

B. Inspect piping products before installation. Provide new or repair or recondition damaged piping products. Repair or reconditioning is subject to Engineer's approval. Patch damaged interior linings and exterior coatings or replace damaged product with new product. Patching is subject to Engineer's approval.

C. Clean ends of piping products before installation. Remove foreign matter and dirt from inside of piping products and keep products clean until Work has been accepted.

3.02 INSTALLATION

A. Location:

1. Install piping parallel to structure lines unless shown otherwise on Drawings.
2. Do not install piping through beams, columns, or other structural members unless shown on Drawings.
3. Locate valves in piping system in accordance with manufacturer's instructions. In horizontal piping runs, do not orient valves so operating stem is below horizontal centerline.

B. Assembly:

1. Install piping without springing or forcing in manner which would cause stress in piping, valves, or connected equipment.
2. Set pipe flanges level, plumb, and aligned. Set flanged fittings so flange is true and perpendicular to pipe axis. Set flanges so bolt holes straddle vertical centerline of pipes.
3. For flanged connections, match bolt holes and obtain uniform contact over entire flange area prior to installation of flange bolts. Tighten bolts to uniformly compress gaskets and minimize flange stress. Tighten bolts to torque recommended by gasket manufacturer. Coat nuts and bolts with anti-seize thread compound.
4. Machine off raised-face of steel flange when mating with flat-faced flange.

C. Pump, Blower and Equipment Connections:

1. Align pipe, equipment, pumps, and blowers so stresses are not transmitted to connections. Support piping independently from pumps, blowers, and equipment. Do not support piping from equipment, blowers, and pumps. Anchor piping to prevent transmission of hydraulic thrust load to pumps, blowers, and equipment.
2. Install couplings, adapters, expansion joints, flanges, and unions so pumps, equipment, valves, and in-line instruments can be removed from service without disruption to other portions of piping system.
3. Install couplings, expansion joints and other vibration isolation components to isolate piping from pump, blower, and equipment vibration.
4. For welded nozzle connections, allow for shrinkage during welding to prevent excessive stresses on pumps and equipment.
5. Provide drain piping from pump and equipment drains and overflows to floor drain system.
6. Provide control lines such as air and bubbler level system piping necessary for operation of pumps, equipment, valves, and in-line instruments.

D. Install insulating flange, insulating coupling or dielectric union at each connection between ferrous and non-ferrous metal piping.

3.03 FIELD QUALITY CONTROL

A. Inspect installed piping products for dents, kinks, abrupt changes of curvature, damage to lining, and other damage. Repair or recondition damaged products as approved by Engineer or replace damaged products with new products.

B. Inspect installed, unlined piping products for corrosion and scale on interior surfaces. Clean products to remove corrosion and scale or replace with new products.

C. Test system in accordance with Section 40 05 10 and as specified in Process-Mechanical Piping Schedule.

3.04 CLEANING

A. After installation and before testing, remove dirt, rocks, debris and other foreign matter from interior of each piping system.

B. Water flush each hydrostatically tested piping system unless specified otherwise.

1. Flushing velocities of 2.5 feet per second shall be maintained until accumulated debris has been removed.
2. Insert cone strainers at equipment connections prior to flushing. Remove cone strainers after flushing is complete.
3. Remove accumulated debris through drains not less than 2 inch in diameter or by temporarily removing pipe spools, fittings, or valves.
4. Drain piping after flushing and immediately dry piping with compressed air.

C. Blow clean each pneumatically tested piping system with compressed air unless specified otherwise.

3.05 PROCESS-MECHANICAL PIPING SCHEDULE

A. **SERVICE** column: Presents Flow Stream Identifiers for process-mechanical piping systems shown on Process-Mechanical Drawings and on Civil Drawings.

1. Civil Drawings may also show site utility, plumbing, fire protection, and HVAC piping systems which are not included in Process-Mechanical Piping Schedule. Site utility, plumbing, fire protection, and HVAC piping systems are specified in other sections.

B. **SIZE** column: Presents nominal pipe diameter(s) for each piping system shown on Process-Mechanical Drawings and continuation of piping system on Civil Drawings.

C. **PIPE MATL** column: Identifies material type to be provided for piping system. Piping material shall conform to requirements of referenced sections:

Pipe Material	Section	Abbreviation in Piping Schedule
General Service Steel Piping	40 05 24	GNSTL
Polyvinyl Chloride Piping	40 05 31.13	PVC
Chlorinated Polyvinyl Chloride Piping	40 05 31.23	CPVC

D. **LOCATION** Column: Identifies installation location of piping system. Piping system components shall be suitable for condition specified.

E. **MIN/MAX TEMP** column: Presents minimum and maximum operating temperature of piping system. Piping system components shall be suitable for operating temperatures shown.

F. **MAX PRESSURE** column: Presents maximum operating pressure of piping system and type of test to be provided. Piping system components shall be suitable for maximum operating pressure shown and test pressure specified.

1. Provide hydrostatic testing in accordance with Section 40 05 10 where maximum operating pressure value is followed by "-H".

2. Provide high pressure air testing in accordance with Section 40 05 10 where maximum operating pressure value is followed by "-P".
3. Provide low pressure air testing in accordance with Section 40 05 10 where "-A" is specified.
4. Test pressure for hydrostatic and high pressure air testing shall be 1.5 times maximum operating pressure, minimum, unless specified otherwise in REMARKS column. Test pressure for low pressure air testing shall be as specified in Section 40 05 10.

G. **COLOR** column: Specifies color coding and banding to be provided for non-buried piping systems. Provide color coding, banding, and labeling in accordance with Section 40 05 97.

H. **REMARKS** column: Provides further description of piping system and specifies additional requirements.

PROCESS-MECHANICAL PIPING SCHEDULE

Service	Size (in.)	Pipe Matl	Location	Min/Max Temp (ºF)	Max Press (psig)	Color	Remarks
60 – BIOSOLIDS DRYING BUILDING							
N	1/2	GNSTL	Inside Exposed, Embedded	50-200	150-H	Purple	Match existing N piping. Paint pipe in accordance with Section 09 96 00.
90 – SLUDGE DEWATERING BUILDING							
LPO	3	CPVC	Inside Exposed	50/180	45-H	Safety Purple	Paint pipe in accordance with Section 09 96 00.
PO	2-1/2, 3, 4	CPVC	Inside Exposed, Embedded	50/180	75-H	Safety Purple	Paint pipe in accordance with Section 09 96 00.
V	6	PVC	Inside Exposed, Embedded, Outside Exposed	50/180	10-H	Grey	Paint pipe in accordance with Section 09 96 00.
V	1/2	PVC	Inside Exposed	50/180	10-H	Grey	Paint pipe in accordance with Section 09 96 00.
OA/TA	1-1/2, 4	40 PVC	Inside Exposed	50/120	-	White	Refer to Section 23 31 16 for piping materials
OF	3	PVC	Inside Exposed	50/180	5-H	Safety Purple	Paint pipe in accordance with Section 09 96 00.
D	1, 2-1/2, 3	CPVC	Inside Exposed	50/180	5-H	Safety Purple	Paint pipe in accordance with Section 09 96 00.
95 – SECONDARY EFFLUENT JUNCTION BOX							
ALUM	1	PVC	Inside Exposed, Embedded	50/80	35-H	Safety Yellow	Paint pipe in accordance with Section 09 96 00.
YARD PIPING							
ALUM	1	PVC	Buried	50/80	35-H	None	Heat trace and insulate piping from 6'-0" below grade to wall of Secondary Effluent Junction Box.

END SECTION

SECTION 40 05 06
COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Couplings, flanged coupling adapters, and service saddles required for piping connections. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular products to be provided under this Contract.

1.02 REFERENCES

A. ANSI: American National Standards Institute

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for couplings and service saddles specified.
2. Catalog cuts and product specifications for couplings, flanged coupling adapters, and service saddles.

C. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain couplings and service saddles from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as a unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 COUPLINGS

A. Couplings for connecting plain-end steel or ductile iron pipe of same outside diameter:

1. Dresser Style 38.
2. Smith-Blair Product No. 411.

B. Transition couplings for connecting plain-end steel or ductile iron pipe of different outside diameter:
1. Dresser Style 162.

2. Smith-Blair Product No. 413.

C. Insulating couplings for connecting plain-end steel or ductile iron pipe and stopping flow of electrical current:

1. Dresser Style 39
2. Smith-Blair Product No. 416.

D. Restrained couplings for connecting plain-end steel, ductile, PVC, HDPE, or combinations of pipe of same outside diameter, where coupling requires restraint:

1. Smith-Blair Product No. 471
2. EBAA-Iron Series 3800

E. Pressure rating shall be greater than test pressure of piping system.

F. Materials:

1. Middle Ring and Gaskets: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.
2. Followers: Ductile iron or steel.
3. Bolts and Nuts: 316 stainless steel.

2.02 FLANGED COUPLING ADAPTERS

A. Flanged coupling adapters for connecting plain-end steel or ductile iron pipe to flanged pipe, fitting, valve, instrument, or equipment item:

1. Dresser Style 128.
2. Smith-Blair Product No. 913.

B. Pressure rating shall be greater than test pressure of piping system.

C. Materials:

1. Flange: Steel, faced and drilled to 150-pound class in conformance with ANSI B16.5.
2. Body: Steel.
3. Follower: Ductile iron or steel.
4. Gasket: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.
5. Bolts and Nuts: 316 stainless steel.

2.03 RESTRAINED FLANGED COUPLING ADAPTERS

A. Restrained flanged coupling adapters for connecting plain-end ductile iron or steel pipe to flanged spools and fittings.

1. EBAA-Iron MegaFlange Series 2100
2. Smith-Blair Product No. 913.

B. Pressure rating shall be greater than or equal to the pressure rating of the piping system in which it used.

C. Materials:

1. Flange: Ductile iron, drilled to 125/150-pound class in conformance with ANSI B16.5. Provide flat or raised face flanges to match piping system.
2. Body: Ductile iron
3. Gasket: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.
4. Bolts and Nuts: Match piping system as specified in Division 40 05 05.
5. Adapter shall be coated to match piping as specified in Division 09 96 00.

2.04 DISMANTLING JOINTS

A. Dismantling joint for valve, pump, meter, or other fitting installations with heavy duty joint restraint:

1. Style 975, by Smith Blair, Inc.
2. Or equal.

B. Pressure and Service: Same as connected piping.

C. Body: ASTM A53, ASTM A283 Gr C or carbon steel with a minimum yield of 30,000 psi.

D. Follower Flange: Ductile iron per ASTM A536, Steel section per ASTM A576GR1020HR, or carbon steel having a minimum yield stress of 30,000 psi.

E. Gasket: Recommended by the manufacturer.

F. Bolts and Nuts: Stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and nitrided stainless nuts.

G. Type 316 stainless steel anchor studs installed in pressure-tight anchor boss for restraint. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by manufacturer.

2.05 SERVICE SADDLES

A. Service saddles for tapping pipe sizes 18 inches and smaller shall be double strap design.

1. Dresser Style 91.
2. Smith-Blair Product No. 317.

B. Service saddles for tapping pipe sizes larger than 18 inches shall be triple strap design.

1. Smith-Blair Product No. 366.

C. Materials:

1. Body: Malleable iron or ductile iron.
2. Straps: 316 Stainless Steel.
3. Nuts and Washers: 316 Stainless Steel.
4. Gasket: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.

2.06 RUBBER EXPANSION JOINTS

A. Rubber expansion joints rubber designed to absorb all-directional movements and reduce noise and vibration manufactured by:

1. General Rubber.
2. Garlock.
3. Mercer.
4. Or equal.

B. Rubber Expansion Joints:

1. Cover, body, seamless tube, and integral full-faced flanges. Standard 125-pound flange drilling.
2. Materials and construction shall be suitable for fluid service, maximum operating temperature, maximum operating pressure and test pressure of piping system.
3. Single arch.

    a. Filled for wastewater, sludge and other fluids with suspended solids.
    b. Unfilled for air, clean water and other fluids without suspended solids.

4. Split 316 stainless steel retaining rings.
5. Provide control unit for each expansion joint:

    a. Gusset plates, washers, bolts, and elastomeric bushings.
    b. No metal-to-metal contact to eliminate transmission of noise and vibration.
    c. Size control units for maximum operating pressure and test pressure of piping system.
    d. Control unit hardware shall be 316 stainless steel.

6. Minimum movement capability for single, unfilled arch joints:

Joint Size (inch)	Axial Compression (inch)	Axial Extension (inch)	Lateral Deflection (inch)
≤ 6	7/16	1/4	1/2
8 to 18	11/16	3/8	1/2
20 to 24	13/16	7/16	1/2
26 to 40	15/16	1/2	1/2
≥ 42	1-1/16	9/16	1/2

7. Minimum movement capability for single, filled arch joints shall be at least 50 percent of movement specified above for unfilled arch joints.

2.07 ANCHORS

A. Provide anchors including, but not limited to, tie rods, lugs, harness assemblies, flanged spool pieces, friction collars and hardware for each coupling, and flanged coupling adapter. Anchors shall restrain pipe to prevent movement out of each coupling and flanged coupling adapter.

B. Design each anchor to sustain force developed by test pressure of piping system.

C. Anchor studs placed perpendicular to longitudinal axis of pipe is unacceptable.

D. Anchorage with welded attachments to ductile iron piping is unacceptable.

2.08 COATINGS

A. Coatings for couplings, flanged coupling adapters, and service saddles shall be same material as coatings for connected pipe.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install couplings, adapters, and specials for process piping in accordance with manufacturer's written instructions. Restrained flange adapters shall be used only where indicated on the Drawings or approved in writing by the Engineer. Restrained flange adapters not an acceptable equal to flanged spool sections in rigid piping systems.

B. Provide expansion joints where indicated on Drawings and elsewhere as determined by Contractor for adequate expansion compensation and vibration isolation of piping systems.

3.02 FIXED SUPPORTS

A. Provide fixed supports for each expansion joint. Fixed supports shall restrain pipe to prevent movement of fixed end of the expansion joint.

B. Fixed support shall be located on the same end of pipe as the “restraining ring” is welded.

C. Design each support to sustain force developed by test pressure of piping system.

D. Fixed supports with welded attachments to stainless steel piping are unacceptable.

E. Provide fixed supports in accordance with pipe hangars, supports, and anchors in accordance with Section 40 05 07.

3.03 ADJUSTABLE SUPPORTS

A. Provide adjustable supports for each expansion joint. Adjustable supports shall restrain pipe to prevent movement out of each expansion joint.

B. Fixed support shall be located on the same end of pipe as the “restraining ring” is welded.

C. Design each support to sustain force developed by test pressure of piping system.

D. Adjustable supports with welded attachments to stainless steel piping are unacceptable.

E. Provide adjustable supports in accordance with pipe hangars, supports, and anchors in accordance with Section 40 05 07.

END OF SECTION

SECTION 40 05 07
PIPE HANGERS AND SUPPORTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. System of pipe supports and anchors with necessary inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, and other accessories.

1.02 DEFINITIONS

A. Submerged: At or below point 1 foot 6 inches above peak (maximum) water surface elevations in water holding structure.

1.03 REFERENCES

A. MSS: Manufacturers Standardization Society

B. ASTM: American Society for Testing and Materials

C. ANSI: American National Standards Institute

1.04 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design, detail, and installation of pipe support system shall be responsibility of Contractor.
2. Pipe support system components shall withstand dead loads imposed by weight of pipes filled with water plus insulation, plus live loads due to thermal expansion, vibration, internal test pressures, and have minimum safety factor of 5.
3. Absence of pipe supports and details on Drawings shall not relieve Contractor of responsibility for providing them throughout plant.
4. Supply design loading criteria to precast concrete manufacturer for piping supported from precast members.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for pipe hangers, supports, and anchors specified.

C. Shop Drawings:

1. Pipe supporting system, including manufacturer's product data, dimensions, sizes, types, location, maximum loadings, thrust anchorage, and installation instructions.
2. Shop Drawing shall be stamped by a Structural Engineer registered in the State of Illinois.

D. Submit in accordance with Section 01 33 00.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain pipe hangers, supports, and anchor components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipe hangers, supports, and anchors to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store pipe hangers, supports, and anchors in clean, dry location.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. B-Line.

B. Grinnell.

C. Carpenter-Patterson.

D. Unistrut.

E. Superstrut.

2.02 GENERAL

A. MSS types indicated are typical of types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover locations where standard catalog supports are inapplicable.

B. Provide factory fabricated piping hangers and supports, clamps, hanger rod attachments, building attachments, saddles, shields, thrust anchorage, and other miscellaneous products of MSS SP69 type indicated or shop fabricated supports; comply with MSS SP58 and manufacturer's published product information. Where MSS type not indicated, provide proper selection for installation requirements and comply with MSS SP69, MSS SP89 and manufacturer's published product information.

2.03 MATERIALS

A. Hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories shall be of stainless steel construction unless otherwise noted.

B. Hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories in, wet, exterior, submerged or non-submerged location in wet wells, tanks, channels, or tank covers shall be Type 316 stainless steel.

2.04 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General:

1. Unless otherwise shown or specified, hangers for 2 1/2 inches and smaller pipe shall be split-ring, adjustable swivel, clevis or roller type, hangers for 3 inch pipe or greater shall be clevis or roller type.
2. Hangers for use with spring supports shall be split-ring or clamp type.
3. Hangers for fiberglass reinforced pipe shall be saddle type.
4. Each hanger shall be designed to permit at least 1/2 inch vertical adjustment after installation.

B. Adjustable Swivel Split Ring Hanger: MSS Type 6.

C. Adjustable Clevis Hanger: MSS Type 1, fabricated from stainless steel.

D. Adjustable Band Hanger: MSS Type 7, fabricated from stainless steel.

E. Adjustable Swivel-Band Hanger: MSS Type 10.

F. Clamp: MSS Type 4.

G. Single Roll Support: MSS Type 41, including axle roller and threaded sockets.

H. Adjustable Roller Hanger: MSS Type 43, including axle roller and clevis.

I. Roll/Stand: MSS Type 44, including roller, stand, and axle.

J. Adjustable Roller/Base: MSS Type 46, including roller, adjustable base, and stand.

K. Steel Brackets: Welded structural steel shapes complying with following:

1. Light Duty: MSS Type 31.
2. Medium Duty: MSS Type 32.
3. Heavy Duty: MSS Type 33.

L. Adjustable Saddle Support:

1. MSS Type 38, including saddle, pipe and reducer.
2. Fabricate base support from stainless steel pipe and include welded stainless steel plate. Use of threaded rod for pedestal support stanchions is not acceptable.

M. Stanchion Saddle Support:

1. MSS Type 37, including saddle and U-bolt.
2. Fabricate base support from stainless steel pipe and include welded stainless steel plate. Use of threaded rod for pedestal support stanchions is not acceptable.

N. Strap or wire hangers not acceptable.

2.05 VERTICAL PIPING CLAMPS

A. 2-Bolt Riser Clamp: MSS Type 8, stainless steel.

B. 4-Bolt Riser Clamp: MSS Type 42, include pipe spacers at inner bolt holes, stainless steel.

2.06 HANGER RODS AND ATTACHMENTS

A. Hanger Rods:

1. ASTM A36, threaded both ends or continuous thread.
2. Rods shall conform to following sizes.

Pipe Size (inches)	Minimum Rod Diameter (inches)
Up to 2	3/8
2 1/2 and 3	1/2
4	5/8
6	3/4
8 to 12	7/8
14 and Up	1
Trapeze Hangers	As Required

B. Turnbuckles: MSS Type 13.

C. Weldless Eye Nut: MSS Type 17.

D. Eye Socket: MSS Type 16.

E. Clevis: MSS Type 14.

2.07 BUILDING ATTACHMENTS

A. Individual Concrete Inserts:

1. MSS Type 18, stainless steel.
2. MSS Type 19, stainless steel.
3. Minimum Safe Load: 1,100 pounds.

B. Continuous Concrete Inserts:

1. Unistrut, P-3200 Series.
2. B-Line.
3. Grinnel.
4. Superstrut.
5. Or equal.

C. Top Beam C-Clamp: MSS Type 19.

D. C-Clamps: MSS Type 23, steel.

E. Single-Side Clamp: MSS Type 25.

F. Top I-Beam Clamp: MSS Type 25.

G. Side Beam Clamp: MSS Type 20.

H. Concrete Anchors:

1. Provide in accordance with Section 05 50 00.
2. Minimum Safety Factor: 5.

2.08 SADDLES AND SHIELDS

A. Protection Saddles: MSS Type 39.

B. Protection Shields: MSS Type 40.

C. Wood Insulation Saddle:

1. Elcen Metal Products Company.
2. Or equal.

2.09 MISCELLANEOUS MATERIALS

A. Metal Framing Systems:

1. Unistrut, stainless steel.
2. B-Line, stainless steel.
3. Grinnell, stainless steel.
4. Or equal.

B. Shop-Fabricated Anchors and Supports:

1. Steel Plates, Shapes, and Bars: 304 or 316 stainless steel.
2. Restraining Rods: 304 or 316 stainless steel

C. Concrete: Minimum 28 day compressive strength of concrete – 3,000 pounds per square inch.

PART 3 – EXECUTION

3.01 GENERAL

A. Proceed with installation of hangers, supports, and anchors after required building structural work is complete and concrete support structure has reached 28-day compressive strength as 3,000 pounds per square inch.

B. Install hangers, supports, clamps, and attachments from building structure. Comply with MSS SP-69. Group parallel runs of horizontal piping to be supported together on trapeze type hangers where possible.

C. Install supports to provide indicated pipe slopes and maximum pipe deflections allowed by ANSI B31.1 are not exceeded.

D. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

E. Do not support piping from other piping.

F. Prevent contact between dissimilar metals. Where concrete or metal pipe support is used, place 1/8 inch thick Teflon, neoprene rubber or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and support.

G. Prevent electrolysis in support of copper tubing by use of hangers and supports where are copper plated, plastic coated or by other recognized industry methods. Electrician's tape not acceptable isolation method.

H. Apply anti-seize compound to nuts and bolts.

3.02 INSTALLATION OF BUILDING ATTACHMENTS

A. Support piping from structural framing, unless otherwise noted.

B. Concrete Inserts:

1. Locate inserts so total load on insert does not exceed manufacturer's recommended maximum load. Location of inserts shall be approved by Engineer.
2. Where necessary to anchor supports to hardened concrete or completed masonry, use concrete anchors.

C. Attach to structural steel with beam clamps.

3.03 THRUST ANCHORS AND GUIDES

A. Thrust Anchors:

1. For suspended piping, center thrust anchors as closely as possible between expansion joints and between elbows and expansion joints. Anchors shall hold pipe securely and be sufficiently rigid to force expansion and contraction movement to take place at expansion joints or elbows and preclude separation of joints.
2. Provide thrust anchors as required to resist thrust due to changes in diameter or direction or dead ending pipe lines. Anchorage shall be required wherever bending stresses exceed allowable for pipe. Wall pipes may be used as thrust anchors.

B. Pipe guides shall be provided adjacent to sliding expansion joints in accordance with recommendations of National Association of Expansion Joint Manufacturers.

3.04 PIPE SUPPORT

A. Spacing:

Type of Pipe (inches)	Maximum Pipe Support Spacing (feet)
Steel	
10 and larger	22
8	19
6	17
5	16
4	14
3 1/2	13
3	12
2 1/2	11
2	10
1 1/2	9
1	7
3/4	6
1/2	5
Copper	
4	12
3 1/2	11
3	10
2 1/2	9
2	8
1 1/2	8
1 1/4	7
1	5
3/4	5
1/2	5
Plastic (Schedule 80 at 100 degrees Fahrenheit, F)	

Type of Pipe (inches)	Maximum Pipe Support Spacing (feet)
8	9-1/2
6	9
4	7-1/2
3	7
2	6
1 1/2	5-1/2
1	5
3/4	4-1/2
1/2	4-1/2
(For plumbing or chemical applications, plastic piping shall be supported at maximum of 4 ft-0 in. spacing.)	
Stainless Steel	
1 and smaller	6
1 1/2 through 4	8
6	8
8 and 10	10
12	10
14	12
16	12
18 and larger	14
Cast Iron and Ductile Iron	
1 and smaller	6
1 1/4 through 2 1/2	8
3 and 4	10
6	12
8	12
10 and 12	14
14	16
16 and 18	16
20	18
24 and larger	18
(For cast iron soil pipe plumbing applications, support as 5 ft-0 in. spacing.)	

B. Where piping of various sizes is to be supported together, space supports for smallest pipe size or install intermediate supports for smaller diameter pipe.

C. Provide minimum of 2 pipe supports for each pipe run.

D. Where piping connects to equipment, support by pipe support and not by equipment, unless approved by equipment manufacturer.

E. Unless otherwise shown or authorized by Engineer, place piping running parallel to walls approximately 1 1/2 inches out from face of wall and at least 3 inches below ceiling.

F. Pedestal pipe supports shall be adjustable with stanchion, saddle, and anchoring flange. Use of threaded rod for pedestal support stanchions is not acceptable.

G. Piping supports for vertical piping passing through floor sleeves shall be stainless steel riser clamps.

H. Piping passing through sleeves or openings in interior wall sleeves shall be carried by supports or hangers. Do not rest on wall.

I. Support piping in manner preventing undue strain on valve, fitting or equipment. Provide pipe

supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise shown. Do not install pipe supports and hangers in equipment access areas.

J. Install supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Piping shall be free to move when expands or contracts, except where fixed anchors are indicated. Where specified hanger rod swing length cannot be provided or where pipe movement based on expansion of 1 inch per 100 feet for each 100 degrees F change in temperature exceed 1/2 inch, provide approved roller supports.

L. Piping 6 inches and larger supported by trapeze hangers shall be supported with rollers.

M. Stacked horizontal runs of piping along walls may be supported by metal framing systems. Metal framing systems shall be attached to concrete insert channels.

N. Coat hangers, clamps, protective shields, metal framing support components, and hanger accessories in accordance with Section 09 96 00.

3.05 GALLERY AND TUNNEL PIPING

A. Support piping by metal framing system. Where possible, extend each insert channel continuously over gallery or tunnel ceiling and down both walls to floor.

3.06 INSULATED PIPING

A. Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed allowable pipe stresses.

B. Where low compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8 inches and larger, install wood insulation saddles.

C. Where insulation without vapor barrier is indicated, install protection saddles on piping 2 inches and larger.

3.07 BURIED PIPING

A. Provide unlugged bell and spigot or bell tees, Y-branches, and bends deflecting 11 1/4 degrees or more and plugs with reaction blocking, anchors, joint harness or other acceptable means for preventing movement of pipe and joints caused by internal pressure.

B. Concrete Blocking:

1. Extend from fitting to solid undisturbed earth and installed so joints accessible for repair.
2. Bearing area of concrete reaction blocking shall be as shown on Drawings.
3. If adequate support against undisturbed ground cannot be obtained, install metal harness anchorages consisting of stainless steel rods across joint and securely anchored to pipe and fitting or other adequate anchorage facilities to provide necessary support.
4. Should lack of solid vertical excavation face be due to improper trench excavation, cost of furnishing and installing metal harness anchorage in excess of Contract value of concrete blocking replaced by such anchorages shall be borne by Contractor.

C. Provide reaction blocking, anchorages or other supports for fittings installed in fills or other

unstable ground or above grade as shown on Drawings.

END OF SECTION

SECTION 40 05 09
WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Modular mechanical seals.
2. High density polyethylene (HDPE) sleeves.

1.02 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for sleeves and seals specified.

C. Submit in accordance with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. Single-Source Responsibility: Obtain sleeve and seals from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. GPT Industries, LINK-SEAL.

B. Advance Products & Systems (APS), Innerlynx.

2.02 MODULAR MECHANICAL SEALS

A. Modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill annular space between pipe and opening.

B. Seal Element: Ethylene propylene diene monomer (EPDM). Provide low-durometer EPDM elements for thin or soft walled pipes of HDPE, PVC, tubing, or others with a wall thickness less than 3/8-inches as recommended by manufacturer.

C. Pressure Plates: Composite.

D. Bolts and Nuts: 316 stainless steel.

2.03 FIRE RATED MODULAR MECHANICAL SEALS (LINK SEAL)

A. Modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill annular space between pipe and opening.

B. Seal Element: Silicone.

C. Pressure Plates: Zinc plated carbon steel.

D. Bolts and Nuts: Zinc plated carbon steel.

E. UL approved for 3-hour fire wall penetrations.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install sleeves and seals in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 40 05 10
TESTING PIPING SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Hydrostatic pressure testing, low pressure air testing, and high pressure air testing of piping systems.

B. Systems to be tested, type of test to be performed, and test pressure shall be as specified in other sections of Specifications.

1.02 SUBMITTALS

A. Test report for each piping system tested. Include following:

1. Date of test.
2. Description and identification of piping system tested.
3. Type of test performed.
4. Test fluid.
5. Test pressure.
6. Type and location of leaks detected.
7. Corrective action taken to repair leaks.
8. Results of retesting.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Test in presence of Engineer.

B. Owner will provide on-site source of water for testing specified herein.

1. Contractor shall bring water to point of us.

C. Provide pumps and piping required to bring water to point of use.

D. Provide air supply.

E. Provide test pressure equipment, meters, pressure gauges, and other equipment, materials, and facilities necessary to perform specified tests.

F. Provide bulkheads, flanges, valves, bracing, blocking, or other temporary sectionalizing devices that may be required.

G. Remove temporary devices after tests complete.

H. Perform tests on exposed piping after completely installed, including supports, hangers, and anchors.

I. Perform tests on piping before insulation installed.

J. Perform tests on piping that is clean and free of dirt, sand or other foreign material.

K. Plug pipe outlets with test plugs. Brace each plug securely to prevent blowouts.

L. Add test fluid slowly.

M. Include regulator set to avoid overpressurizing and damaging piping.

N. Perform pressure testing in accordance with local, state, and federal requirements.

O. Correct leaks or defects and retest at no additional cost to Owner.

3.02 HYDROSTATIC PRESSURE TESTING

A. Perform hydrostatic pressure testing for piping systems identified in other sections. Test pressure shall be as specified in other sections.

B. Open vents at high points to purge air pockets while piping system is filling. Venting may also be provided by loosening flanges or with equipment vents.

C. Testing:

1. After section of piping to be tested has been filled with water, apply test pressure by means of force pump of such design and capacity that required pressure can be applied and maintained without interruption for duration of test.
2. Measure test pressure by means of tested and properly calibrated pressure gauge acceptable to Engineer.
3. Maintain test pressure for sufficient length of time to permit Engineer to observe piping under test but not less than 2 hours.

D. With exception of buried piping with mechanical joints or push-on joints, piping systems shall show no visual evidence of weeping or leaking. If leakage is evident, make appropriate repairs and retest.

E. Maximum allowable leakage for buried piping with mechanical joints or push-on joints is as follows. If leakage is excessive, make appropriate repairs and retest.

$$L = \frac{NDP^{1/2}}{7{,}400}$$

Where:
L = Leakage, gallons per hr
N = Number of joints under test
D = Nominal diameter of piping, in.
P = Average pressure during test, lbs per sq in.

3.03 LOW PRESSURE AIR TESTING

A. General:

1. Perform low pressure air testing for gravity sewer and drainage piping systems identified in other sections.
2. Test pipes between adjacent manholes. Test time for air pressure to drop 1.0 psi.

    a. For pipes 4 in. through 36 in. dia comply with Table 40 05 10.
    b. Pipe over 36 in. dia shall not be tested by the low pressure air method.
    c. Ignore length of laterals.

B. Preparation:

1. Isolate pipe section to be tested by plugging each end with air tight plugs. Plug ends of branches, laterals and wyes which are to be included in test section.
2. Brace plugs to prevent slippage and blowout due to internal pressure.
3. One plug shall have inlet tap or other provision for connecting air supply.
4. Air control equipment shall consist of valves and pressure gauges to control rate at which air flows into test section and gauges to monitor air pressure inside pipe.

C. Testing:

1. If pipe to be tested is submerged in water, determine height of water above spring line of pipe at each end of test section and compute average. For each foot of water above pipe's spring line, increase test pressure by 0.43 psi.
2. Add air slowly to test section until pressure inside pipe is raised to 4.0 psi greater than average back pressure of water that may be over pipe
3. After pressure of 4.0 psi obtained, control supply of air so internal pressure maintained between 3.5 and 4.0 psi (above average water back pressure) for minimum of 2 minutes to allow temperature of air to come into equilibrium with temperature of pipe.
4. Determine rate of air lost by time pressure drop method.

    a. After temperature stabilized for 2 minute period, disconnect air supply. Allow pressure to decrease to 3.6 psi. At this pressure, start stopwatch to determine time required for pressure to drop 1.0 psi. Time required for loss of 1.0 psi is then compared to Table 40 05 10.
    b. If time is equal to or greater than time indicated in table, test shall be acceptable.
    c. If time is less than time indicated in table, make appropriate repairs and retest.

3.04 HIGH PRESSURE AIR TESTING

A. Perform high pressure air testing for piping systems as specified in other sections. Test pressure shall be as specified in other sections.

B. Perform preliminary test at not greater than 25 psi. Examine for leakage at joints with soap solution and visual detection of soap bubbles. Correct visible leaks.

C. Perform final test at test pressure specified. Pressure in system shall be gradually increased in small increments until test pressure reached. Test pressure shall be maintained for minimum of 10 minutes and additional time necessary to conduct soap bubble test examination of each joint for leakage.

D. Piping system shall show no evidence of leakage. If leakage is evident, make appropriate repairs and retest.

TABLE 40 05 10
LOW PRESSURE AIR TEST

Test time required for loss of air pressure of
1.0 psi for size and length of pipe indicated.

A	B	C	D	E	F
Pipe Dia (in.)	**Time/Ft Up To Length In Column C (sec)**	**Length Time In Column B Applies (ft)**	**Test Time For Length Between Columns C & E (min:sec)**	**Length Time In Column F Applies (ft)**	**Time/Ft Over Length In Column E (sec)**
4	0.18	636	1:54	1,432	0.08
6	0.40	424	2:50	955	0.18
8	0.71	318	3:47	716	0.32
10	1.11	255	4:43	573	0.49
12	1.60	212	5:40	477	0.71
15	2.50	170	7:05	382	1.11
18	3.62	141	8:30	318	1.61
21	4.92	121	9:55	273	2.19
24	6.42	106	11:20	239	2.85
27	8.14	94	12:45	212	3.62
30	10.00	85	14:10	191	4.44
33	12.14	77	15:35	174	5.40
36	14.37	71	17:00	159	6.39

END OF SECTION

SECTION 40 05 24
STEEL PROCESS PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various steel piping products: Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular steel piping products to be provided under this Contract.

1.02 REFERENCES

A. ANSI: American National Standards Institute

B. ASTM: American Society for Testing and Materials

C. AWS: American Welding Society

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Submit for pipe, fittings, flanges, bolting and gaskets.

C. Shop Drawings:

1. Shop Drawings showing layout for steel piping systems shall be submitted in accordance with and transmitted under appropriate piping system specification sections.
2. Provide layout drawings for all piping systems.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Piping systems shall be installed and cleaned in accordance with applicable section of the following:

1. ASME B31.1, Process Piping

C. Welders Qualifications:

1. Quality and certify welding procedures, welders and operators in accordance with ANSI

B31.3, Paragraph 127.5, for shop and project site welding of piping work.

PART 2 – PRODUCTS

2.01 PIPE

A. Unless indicated otherwise, provide piping as follows:

1. 2-inch and smaller:

a. Carbon steel, black, seamless, ASTM A53, Grade B.
b. Schedule 40.

2.02 JOINTS

A. 2-inch and smaller: Threaded except provide flanges where required to connect to flanged equipment and piping components.

2.03 FITTINGS

A. Fabrication tolerances shall be in accordance with the latest edition of Pipe Fabrication Institute Standard ES-3.

B. 2-inch or smaller: Threaded, 150-pound malleable iron, black ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3; unions, 300-pound malleable iron, galvanized, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3, brass to iron seat.

C. Flanges:

1. Class 150 Slip-on Flanges. Exceptions for weld neck flanges may be made, Contractor shall review locations with Engineer for approval prior to installation.
2. Thickness and drilling shall conform to ANSI B16.5 unless otherwise specified.
3. Raised face type.

D. Thread Lubricant

1. Teflon tape or nontoxic joint compound that is insoluble in water.

E. Couplings:

1. Grooved end pipe couplings shall be malleable iron, ASTM A47 or ductile iron, ASTM A536. Victaulic Style 75, Gustin- Bacon Style 100, or equal.
2. Threaded pipe couplings shall be malleable iron, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3.

F. Gaskets:

1. Gasket material shall be suitable for service and maximum operating temperature of piping system as specified in piping system specification section. Torque requirement of gaskets shall be less than torque rating of flange, bolt, and nuts.
2. Gaskets shall be ring or full face, 1/8-in. thick.

2.04 COATINGS

A. Preparation, priming, and finish coating of non-buried piping shall be compatible and in accordance with Section 09 96 00.

B. All piping to be insulated shall be prime coated and have first coat applied prior to installation of insulation.

C. Finish color for piping shall be as specified for the piping system in Section 40 05 05.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install all piping in accordance with manufacturer's installation instructions and referenced ASTM B31 standards.

B. Threaded end pipe shall be tapered and cut clean as per ANSI B1.20.1. Joints shall be drawn tight after applying thread sealant to male pipe end.

C. All pipe ends shall have sharp edges and burrs removed.

D. Flange boltholes shall straddle major centerlines of piping.

E. Weld-neck flanges shall be bored to match mating pipe or fitting.

F. All coated piping shall be handled with care to prevent damage to the coating.

G. Adequate care shall be taken during storage, handling, and installation to keep inside surfaces free of foreign material.

H. Locating piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams or details.

I. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of building; limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. When possible, locate insulated piping for 1.0" clearance outside insulation.

J. Welding:

1. All welding shall conform to applicable AWS and ASME codes and guidelines.
2. Welds shall be made by the shielded electric arc processes with full penetration of pipe thicknesses.
3. Preheat and postheat treatment of welded joints shall be in accordance with applicable ASME Codes.
4. Examine welds in accordance with applicable ASME Codes.

3.02 ADJUSTMENT AND CLEANING

A. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

3.03 PIPING TESTS

A. Test piping system in accordance with Section 40 05 05 and ANSI B31.

3.04 IDENTIFICATION

A. Identification: pipe identification shall be in accordance with Section 40 05 97.

END OF SECTION

SECTION 40 05 31.13
POLYVINYL CHLORIDE PROCESS PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various PVC piping products. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular PVC piping products to be provided under this Contract.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. ANSI: American National Standards Institute

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for PVC components specified.
2. Submit product data for pipe, fittings, flanges, gaskets, and bolting.
3. Submit proposed gasket material for each service. Submit document confirming gasket material selection is appropriate for fluid carried in system.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for PVC components.
2. Submit layout for PVC piping systems in accordance with and transmitted under appropriate piping system Specification section.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain PVC components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 PVC MATERIAL

A. Type 1, Grade 1 conforming to ASTM D1784.

2.02 PIPE

A. Schedule 80 PVC conforming to ASTM D1785.

2.03 PERFORATIONS

A. Provide perforations where perforated pipe called for on Drawings or in other Specification section(s).

B. Perforation requirements: 5/8-inch diameter holes on 5-inch centers 120 degrees apart.

2.04 FITTINGS

A. Schedule 40 or 80 PVC to match piping system.

1. ASTM D2464 for threaded joint type.
2. ASTM D2467 for socket joint type.

2.05 JOINTS

A. Provide socket type at all locations except unions, valves, and equipment with threaded or flanged end connections.

B. Threaded connections are not acceptable for nominal piping size greater than 2 inches.

C. Do not provide threaded joints for piping systems identified on Drawings or in other sections to be provided without threaded joints.

2.06 FLANGES

A. PVC, 1-piece socket type, flat faced, conforming to ANSI B16.5 150-pound bolt-hole drilling pattern.

2.07 GASKETS

A. Full-face, 1/8-inch thick flat type.

B. When mating flange has raised face, use flat ring gasket and provide filler gasket between outside diameter of raised face and flange outside diameter to protect flange from bolting moment.

C. Material compatible with fluid carried in system.

2.08 BOLTING

A. Type 316 Stainless Steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.

B. Bolts shall conform to ANSI B.1.20.1.

C. Provide washers same material as bolts.

2.09 SOLVENT CEMENT

A. Join socket connections with PVC solvent cement conforming to ASTM D2564.

B. As recommended by pipe and fitting manufacturer to assure compatibility fluid in piping system.

2.10 THREAD LUBRICANT

A. Teflon tape.

2.11 COATINGS

A. Surface preparation, priming, and finish coating of non-buried piping shall be compatible and in accordance with Section 09 96 00.

B. Finish color for interior and exterior piping shall be as specified in Section 40 05 05.

C. Coating for piping embedded in concrete is not required.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install PVC components in accordance with manufacturer's written instructions.

B. Install products as shown on Drawings, and as specified in applicable piping system Specification section(s).

3.02 IDENTIFICATION

A. Identification: pipe identification shall be in accordance with Section 40 05 97.

END OF SECTION

SECTION 40 05 31.23
CHLORINATED POLYVINYL CHLORIDE (CPVC) PROCESS PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various CPVC piping products. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular CPVC piping products to be provided under this Contract.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. ANSI: American National Standards Institute

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for CPVC components specified.
2. Submit product data for pipe, fittings, flanges, gaskets, and bolting.
3. Submit proposed gasket material for each service. Submit document confirming gasket material selection is appropriate for fluid carried in system.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for CPVC components.
2. Submit layout for CPVC piping systems in accordance with and transmitted under appropriate piping system Specification section.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain CPVC components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 CPVC MATERIAL

A. Class 23447.B conforming to ASTM D1784.

B. Pipe and fitting materials shall be specially formulated with sufficient UV screeners to provide for long-term outdoor exposure with no deleterious effects.

2.02 PIPE

A. Schedule 80 CPVC conforming to ASTM F441.

B. 3-inch diameter pipe shall be rated for 92.5-pounds per square inch at 180 degrees Fahrenheit (F).

2.03 FITTINGS

A. Schedule 80 CPVC.

1. ASTM F437 for threaded joint type.
2. ASTM F439 for socket joint type.

B. 3-inch diameter fittings shall be rated for 92.5-pounds per square inch at 180 degrees Fahrenheit (F).

2.04 JOINTS

A. Provide socket type at all locations except unions, valves, and equipment with threaded or flanged end connections.

B. Threaded connections are not acceptable for nominal piping size greater than 2 inches.

C. Do not provide threaded joints for piping systems identified on Drawings or in other sections to be provided without threaded joints.

2.05 UNIONS

A. Unions shall be O-ring seal type having interchangeable components with two union valves for maximum system versatility.

B. Unions intended for joining dissimilar materials shall be the transition type, which utilize components of the two dissimilar materials, joined with an elastomeric seal to absorb the thermal expansion coefficient differential. Seal material shall be compatible with fluid carried in system.

2.06 FLANGES

A. CPVC, 1-piece socket type, flat faced, conforming to ANSI B16.5 Class 150 bolt-hole drilling pattern.

2.07 JOINTS

A. Provide socket type at all locations except unions, valves, and equipment with threaded or flanged end connections.

B. Threaded connections are not acceptable for nominal piping size greater than 2 inches or for buried piping. If permitted by Engineer, threaded joints may be used in lieu of solvent welded joints in exposed interior locations where required to facilitate assembly. Use of threaded joints shall be held to a minimum.

C. Do not provide threaded joints for piping systems identified on Drawings or in other sections to be provided without threaded joints.

2.08 GASKETS

A. Full-face, 1/8-inch thick flat type.

B. When mating flange has raised face, use flat ring gasket and provide filler gasket between outside diameter of raised face and flange outside diameter to protect flange from bolting moment.

C. Material compatible with fluid carried in system.

2.09 BOLTING

A. Type 316 Stainless Steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.

B. Bolts shall conform to ANSI B.1.20.1.

C. Provide washers same material as bolts.

2.10 SOLVENT CEMENT

A. Join socket connections with CPVC solvent cement conforming to ASTM F493.

B. Provide solvents as recommended by pipe and fitting manufacturer to assure compatibility with media in pipe system.

2.11 THREAD LUBRICANT

A. Teflon tape.

2.12 COATINGS

A. Surface preparation, priming, and finish coating of non-buried piping shall be compatible and in accordance with Section 09 96 00.

B. Finish color for interior and exterior piping shall be as specified in Section 40 05 05.

C. Coating for piping embedded in concrete is not required.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install CPVC components in accordance with manufacturer's written instructions.

B. Install products as shown on Drawings, and as specified in applicable piping system Specification section(s).

3.02 IDENTIFICATION

A. Identification: pipe identification shall be in accordance with Section 40 05 97.

END OF SECTION

SECTION 40 05 53
PROCESS VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plug Valves.
2. Check Valves.
3. Ball Valves.
4. Gate Valves.
5. Solenoid Valves.

a. Polymer Dilution Solenoid 1, 2, 3 and 4 (FV-8-10-1, -2, -3, and -4)

6. Balancing/Globe/3-Way Valves.
7. Mechanical Regulating Valves.
8. Valve Accessories.

B. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular products to be provided under this Contract.

1.02 DEFINITIONS

A. psi – pounds per square inch

B. w.c. – water column

C. FOG – fats-oils-grease

D. Deg F – Degree Fahrenheit

E. CWP – cold working pressure

F. SWP – steam working pressure

G. NPT – National Pipe Thread

1.03 REFERENCES

A. ANSI: American National Standards Institute

B. ASTM: American Society for Testing and Materials

C. ASME: American Society of Mechanical Engineers

D. AWWA: American Water Works Association

E. ISO: International Organization for Standardization

F. MSS: Manufacturers Standardization Society

G. NEMA: National Electrical Manufacture's Association

H. NSF: National Sanitation Foundation

1.04 SUBMITTALS

A. Product Data and Shop Drawings:

1. Submit in accordance with Section 01 33 00 in sufficient detail to confirm compliance with the Drawings and this Section.
2. Submittal shall, at a minimum, include the items listed below.

a. Manufacturer's product data for each type of valve.
b. Motor data. Submit in accordance with Section 26 05 84.
c. Coating systems. Submit in accordance with Section 09 96 00.
d. Valve schedule. Identify all valves by type number, pipeline, location, joint type, manufacturer, and model or catalog number.

B. Instructional Services Documentation:

1. Submit in accordance with Section 01 61 00.

C. Operation and Maintenance (O&M) Data:

1. Submit in accordance with Section 01 78 23.

1.05 QUALITY ASSURANCE

A. Manufacturer shall be responsible for all components identified for each valve type, accessory, and actuator specified in this Section.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All equipment and parts shipped to the job site shall be properly protected from the elements so that no damage or deterioration occurs from the time of delivery to the time when the installation is complete and the units are placed into operation.

B. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

PART 2 – PRODUCTS

2.01 GENERAL

A. All valves shall be complete with all necessary operating hand wheels, chain wheels, extension stems, worm and gear operators, operating nuts, chains, wrenches, and other accessories that are required for proper completion of Work included under this section.

B. Valves installed in insulated piping systems shall be furnished with extended stem as required to allow operation of valve without damage to, or interference with, insulation system.

C. Unless otherwise shown, valves shall be same size as adjoining pipe.

D. All units shall have name of manufacturer and size of valve cast on body or bonnet or shown on permanently attached plate in raised letters.

E. Service for all items specified herein are shown on Drawings or in Specifications. Note, this is a general specification; some types listed herein may not be part of the Work.

2.02 PLUG VALVES

A. Type V025: Use for Natural Gas service.

1. Manufacturers:

a. Milliken 625 Series.
b. Key Port Figure 425.
c. Or equal.

2. Non-lubricated, resilient seated eccentric plug valve.
3. UL Listed for natural gas service.
4. Drip-tight shut-off up to full pressure rating of valve with pressure in either direction.
5. Pressure rating: 175-psig.
6. Cast iron body and plug.
7. Flanged end connections
8. Wrench nut operator.
9. Buna-N plug and stem seals.
10. Secondary seal of plug metal to metal seat interface.
11. Corrosion resistant bearings.

2.03 CHECK VALVES

A. Type V255: PVC Ball Check Valve

1. Manufacturers:

a. Spears Manufacturing.
b. Hayward Industrial Products, Inc.
c. Or equal.

2. Ball check valve.
3. Provide sizes as indicated on Drawings.
4. PVC construction, ASTM D1784.
5. Valve shall be true union type.
6. Provide with socket weld joints.
7. Viton seats and seals.
8. O-rings shall be EPDM.
9. All valve unions and nuts shall have Buttress threads.
10. Valve shall be suitable for installation in the vertical or horizontal position.
11. Rated for 150-psi at 73 deg F.

B. Type V260: CPVC Ball Check Valve

1. Manufacturers:

a. Spears Manufacturing.
b. Hayward Industrial Products, Inc.
c. Or equal.

2. Ball check valve.
3. Provide sizes as indicated on Drawings.
4. PVC construction, ASTM D1784.
5. Valve shall be true union type.
6. Provide with socket weld joints.
7. Viton seats and seals.
8. O-rings shall be EPDM.
9. All valve unions and nuts shall have Buttress threads.
10. Valve shall be suitable for installation in the vertical or horizontal position.
11. Rated for 235-psi at 73 deg F.
12. Maximum service temperature of 200°F.

2.04 BALL VALVES

A. Type V305: Carbon Steel, Threaded Ball Valve

1. Manufacturers:

a. Apollo.
b. Nibco, Figure T-580-CS-66.
c. Or Equal.

2. Two-piece carbon steel bar stock body.
3. Threaded end connections.
4. Conventional port.
5. Stainless steel ball and stem.
6. Reinforced TFE Seats.
7. 1,500 WOG rating.

B. Type V336: Stainless Steel, Threaded Water Service Ball Valve

1. Manufacturers:

a. Apollo, Figure 76-100.
b. Nibco, Figure T-580-S6-R-66.
c. Nibco, Figure K-590-S6-R-66.
d. Or Equal.

2. 3-inch and smaller for water service on stainless steel piping systems.
3. Comply with MSS-SP-110.
4. Conventional port, two-piece stainless steel body for threaded valves.
5. Conventional port, three-piece stainless steel body for socket weld valves.
6. Stainless steel ball and stem.
7. Reinforced TFE Seats.
8. 1,000 psi CWP.

C. Type V355: PVC, Socket-Weld Ball Valve

1. Manufacturers:

a. Spears Manufacturing.

b. Nibco.
c. Hayward Industrial Products, Inc.
d. Or equal.

2. 3-inch and smaller.
3. Provide sizes as indicated on Drawings.
4. PVC construction, ASTM D1784.
5. Valve shall be true union type.
6. Provide with socket weld joints.
7. Full-port.
8. PTFE ball seats.
9. O-rings shall be EPDM.
10. All valve unions and nuts shall have Buttress threads.
11. Rated for 150-psi at 73 deg F.
12. Unless indicated otherwise, provide with double-stop polypropylene handle operator.

D. Type V360: CPVC, Socket-Weld Ball Valve

1. Manufacturers:

a. Spears.
b. Nibco
c. Or equal.

2. 3-inch and smaller.
3. Provide sizes as indicated on Drawings.
4. CPVC construction, ASTM D1784.
5. Full-port.
6. Valve shall be true union type.
7. Provide with socket weld joints.
8. PTFE ball seats.
9. O-rings shall be EPDM.
10. All valve unions and nuts shall have Buttress threads.
11. Rated for 150-psi at 73 deg F.
12. Unless indicated otherwise, provide with double-stop polypropylene handle operator.

E. Type V382: Natural Gas Isolation Valve, 1-1/2 inch and smaller

1. Manufacturers:

a. Apollo, 80-100 Series.
b. Or Equal.

2. Listed shut-off valve for natural gas with operating temperatures as low as -30°F.
3. Bronze body.
4. Chrome plated ball.
5. RPTFE seats and seals.
6. Blow-out proof stem.
7. Threaded end connections.
8. Lockable lever handle.
9. 150-SWP.

2.05 GATE VALVES

A. Type V416: Iron Body Gate Valves

1. Manufacturers:

    a. American, AFC 2500 Series.
    b. Or Equal.

2. Class 125 iron body gate valve.
3. Bolted Bonnet.
4. Non-rising stem.
5. Ductile iron wedge encapsulated with EPDM rubber.
6. Stainless steel nuts and bolts.
7. Bronze mounted.
8. Rated for minimum 125-psi.
9. Certified to NSF standard 61 and NSF Standard 372.

2.06 SOLENOID VALVES

A. Type V525: Threaded Solenoid Valves for Water Service

1. Polymer Dilution Solenoid 1, 2, 3 and 4 (FV-8-10-1, -2, -3, and -4)
2. Manufacturers:

    a. Burkert, Type 5282
    b. Or Equal.

3. Pilot controlled solenoid valve with servo-diaphragm, media separated.
4. Closing and opening times shall be individually adjustable via restrictor screws in the body cover.
5. 1/2" through 2", provide in sizes indicated on Drawings.
6. Stainless steel body with threaded NPT ends.
7. NBR seals.
8. 14^{o} F to 194^{o} F media temperature range
9. 7 PSI differential pressure to fully open.
10. 100% continuous duty cycle rating.
11. Normally/fail closed design.
12. Rated at 110-psi differential pressure.
13. 120 Volt /1-phase/60-Hertz power supply.
14. NEMA 4X rated.
15. Provide with manual over-ride.

2.07 BALANCING/GLOBE/3-WAY VALVES

A. Type V680: Bronze Balancing Valve

1. Manufacturers:

    a. Bell and Gossett, Model CB.
    b. Or Equal.

2. 2-in and smaller.
3. Provide sizes as recommended by manufacturer for flow rates shown on Drawings.
4. Threaded connections.
5. Bronze body with brass ball.
6. Teflon seat rings.
7. Differential pressure read-out ports across valve seat area.
8. Read-out ports shall be fitted with internal EPT insert and check valve.
9. Body shall have ¼-in NPT tapped drain/purge port.

10. Memory stop to allow valve to be closed for service and then reopened to set point without disturbing balance position.
11. Provide with calibrated nameplate to assure specific valve setting.
12. Valves shall be leak tight at full rated working pressure.
13. Minimum Cv values as follows:

    a. ½-in: 1.5.
    b. ¾-in: 2.7.
    c. 1-in: 5.5.
    d. 1-1/4-in: 12.
    e. 1-1/2-in: 20.
    f. 2-in: 40.

2.08 MECHANICAL REGULATING VALVES

A. Type V708: Natural Gas Equipment and Building Pressure Reducing Valve

1. Manufacturers:

    a. Sensus, Model 243.
    b. Fisher.
    c. Or equal.

2. Utilize for pressure control of equipment with natural gas input rate between 1,000 and 12,000 SCFH.
3. Valve Manufacturer to recommend valve size based on scheduled flow rates and pressures.
4. Direct sensing pressure reducing valve with internal relief valve.
5. Suitable for inlet pressures up to 25-psig.
6. Adjustable outlet pressure range selected based on equipment served recommended maximum inlet pressure at midpoint of spring range.
7. Internal relief shall be capable of preventing outlet pressure of the valve from rising greater than 9-in. w.c. above outlet pressure setpoint.
8. Cast iron body with threaded end connections.
9. Die cast aluminum alloy diaphragm case.
10. Diaphragm shall be of Buna-N construction with nylon fabric insert.
11. Brass orifice and stem.

B. Type V755: CPVC Pressure Regulating/Relief Valve

1. Manufacturers:

    a. Hayward Flow Control Systems.
    b. Or equal.

2. 2-inches or smaller.
3. CPVC body.
4. FPM seals with no metal parts.
5. NPT connections.
6. Relief pressures from 10-150 psig.
7. Provide ¼-inch NPT gauge port on valve body for pressure gauge.

A. Type V776: Pressure Reducing Valve:

1. Manufacturers:

a. Zurn, 500XL
b. Or Equal

2. Self operating pressure reducing valve.
3. Bronze body.
4. Stainless steel trim.
5. Bronze “Y” strainer on inlet.
6. Nitrile elastomers.
7. Rated for 300 psig inlet and outlet pressure.
8. Install pressure gauges downstream of valve.
9. 25 to 75 psi outlet pressure range adjustment. Set to 60 psi initially.
10. 10 psi fall off at a flow rate of 85 gpm for 2 inch size.

2.09 ACCESSORIES

A. Valve Actuators:

1. Open by turning counter-clockwise.
2. Valves with centerline 5-feet 6-inch or less above operating floor: Handwheel for gear-actuated valves, lever for lever-actuated valves. Shall require no more than 40-pound effort to unseat valve.
3. Valves 4-inch and larger, unless otherwise noted on drawings, with centerline greater than 5-feet 6-inch above operating floor: Chainwheel.
4. Valves 4-inch and smaller and 6-inch butterfly valves, maximum operating pressure 25 psig and less: Lever.
5. Valves 4-inch and smaller, maximum operating pressure greater than 25 psig: Gear.
6. Valves 6-inch and larger: Gear.

B. Tee Wrenches:

1. Provide for buried and submerged valves.
2. Provide wrenches of varying lengths as needed so that when in operation the handle is 36-40 inches above the operating floor for each valve application.
3. Provide dual Type 316 stainless steel wall hooks, one on each branch of tee, for hanging each wrench. Anchors and hardware shall be type 316 stainless steel. Coordinate location of tee wrench wall hooks with Owner.
4. Provide wrench compatible with connection to 2-inch nut.

C. Chain Wheels and Chain Levers:

1. Provide chain wheels with guides and chain having coil proof design.
2. Provide chain levers with chain having coil proof design.
3. Galvanized or cadmium plate chain wheels, chain levers, guides, and chain.
4. Chain size as recommended by valve manufacturer.
5. Extend chains to within 4-feet of operating floor.
6. Provide chain hooks and tieback anchors for chains. Install so chain does not interfere with personnel traffic.

D. Buried and Submerged Valves:

1. Provide seals on shafts and gaskets on valve and actuator covers to prevent water entry.
2. Provide totally enclosed actuator mounting brackets with gasket seals.

E. Valve Boxes:

1. Provide for buried valves.
2. Three-piece screw type, cast iron box and cover.
3. Valve box diameter 5 ¼-inch, length as required for installation.
4. Provide extension stem as required for installation and 2-inch operating nut located within 6-inches from top of cover.

F. Extension Stems for Submerged Valves or Valves Below Operating Floor or Walkway:

1. Provide for valves as shown on Drawings.
2. Provide with intermediate stem guides with maximum spacing not exceeding 10 feet or L/R not exceeding 200.
3. Stem guides, stem, and couplings: Type 316 stainless steel.
4. Provide stem ends with transition pieces to connect to valve actuator and operator above.

G. Locking Devices:

1. Provide for valves as shown on Drawings.
2. Locking device shall be integral to the valve/operator and shall accept a normal padlock. Locking devices using chains and cables are not acceptable.
3. Provide two padlocks (one duty and one spare) for each pad-lockable valve.
4. Provide one key for each pad-lockable valve.
5. All padlocks provided shall be compatible with all keys provided. Different keys for each padlock are not acceptable.

H. Worm and Gear Actuators:

1. Totally enclosed design.
2. Sized for valve operation under valve rated pressure with pull of 40-pounds on handwheel or chain wheel.
3. Self-locking to prevent valve position creep.
4. Hardened alloy steel worm.
5. Reduction gearing runs in lubricant.
6. Orient operators to avoid interference with adjacent piping, equipment, and structures.
7. Include valve position indication.

2.10 COATINGS

A. Provide in accordance with Section 09 96 00 unless specified otherwise in this Section.

B. Manufacturer is responsible for surface preparation, prime coat, and second coat of equipment in the factory prior to shipment unless otherwise noted.

C. Manufacturer is responsible for the surface preparation and all motor coatings in the factory prior to shipment.

D. Contractor shall provide final third finish coat for equipment in the field and be responsible for touchup and any additional specified coatings.

E. Final color of exposed equipment and motors shall be selected by Owner.

F. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

G. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install valves in accordance with manufacturer's written recommendations and approved submittals.

B. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Before installing flanged valves, the flanged faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints.

C. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.02 FIELD QUALITY CONTROL

A. Tests:

1. Pressure test valves at same time connected piping is tested.
2. Repair leaking joints.
3. Protect parts of valves and actuators that could be damaged by test.

END OF SECTION

SECTION 40 05 97
PIPING AND EQUIPMENT IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plastic pipe markers.
2. Underground type plastic line marker.
3. Engraved plastic laminate signs.
4. Plastic equipment markers.
5. Piping system color coding schedule.

B. Identification furnished as part of equipment is specified as part of equipment assembly in other sections and shall comply with requirements of this section.

C. Refer to Division 26 for identification requirements of electrical and instrumentation work, not Work of this Section.

D. Refer to Division 10 for identification and signage requirements of architectural work, not work of this Section.

1.02 REFERENCES

A. ANSI: American National Standards Institute.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for piping and equipment identification specified.

C. Shop Drawings:

1. Submit piping system color coding schedule indicating flow stream identifier and proposed color. Submittal shall include color chart for reference. Schedule shall include all piping systems from Sections 40 05 05.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Regulatory Requirements:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Single-Source Responsibility: Obtain piping and equipment identification from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping and equipment identification to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store piping and equipment identification in clean, dry location.

1.06 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. Furnish minimum 5 percent extra stock of each mechanical identification material required for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Brady (W.H.) Company, Signmark Division.

B. Marking Services, Inc.

C. Seton Name Plate Corporation.

2.02 MECHANICAL IDENTIFICATION MATERIALS

A. Provide manufacturer’s recommended products as specified for each application.

B. Where more than single type is specified for application, selection is installer’s option, provide single selection for each product category.

C. Bands, markers, and identification materials used in mechanical rooms and process locations shall be rated for exterior application and suitable for withstanding occasional washdown.

2.03 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations, and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or if not indicated, as recommended by manufacturers or required for proper identification and operation and maintenance of mechanical systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown or specified, provide identification indicating individual system number as well as service (i.e., Boiler No. 3, Air Supply Unit No. 10-ASU-2).

2.04 PLASTIC PIPE MARKERS

A. Snap-on Type: Provide preprinted, semi-rigid snap-on, color coded pipe markers complying with ANSI A13.1.

B. Pressure Sensitive Type: Provide preprinted, permanent adhesive, color coded, pressure sensitive vinyl pipe markers complying with ANSI A13.1. Dot matrix printing is not acceptable.

C. Small Pipes: For external diameters less than 6 inch (including insulation, if any), provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of following methods:

1. Snap-on application of pretensioned, semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with color coded plastic adhesive tape not less than 4 inch wide, full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
4. For plastic chemical tubing use only snap-on type.

D. Large Pipes: For external diameter 6 inch and larger (including insulation, if any), provide either full band or strip type pipe markers not narrower than 3 times letter height (and of required length), fastened by one of following methods:

1. Taped to pipe (or insulation) with color coded plastic adhesive tape, not less than 4 inch wide, full circle at both ends of pipe marker, tape lapped 3 inch.
2. Strapped to pipe (or insulation) application of semi-rigid type with manufacturer's standard stainless steel bands.

E. Lettering: Comply with piping system nomenclature as specified, scheduled or shown and abbreviate only as necessary for each application length, and only with approval of Engineer. Lettering height shall be as follows:

Outside Pipe Diameter (inches)	Minimum Letter Height (inches)	Minimum Length of Marker (inches)
¾ to 1-1/4	½	8
1-1/2 to 2	¾	8
2-1/2 to 6	1-1/4	12
8 to 10	2-1/2	24
Over 10	3-1/2	32

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

G. Label and band colors in accordance with ANSI A13.1-2007, Process-Mechanical Piping Schedule Section 40 05 05 and following:

1. Lettering and arrows:

a. Black on yellow background for plant effluent.
b. Black on yellow background for polymer.
c. Black on yellow background for vent.
d. Black on yellow background for heating water supply/return.
e. White on green background for drain.

f. White on green background for W1, W2, and W4.
g. Red band for W3.

2. Banding: Colors and band spacing as scheduled or as shown on Drawings.

2.05 UNDERGROUND TYPE PLASTIC LINE MARKERS

A. Permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6 inch wide by 4 mils thick. Provide tape with printing most accurately indicating type of service of buried pipe.

B. Provide multi-ply tape consisting of solid aluminum foil core between 2 layers of plastic tape.

2.06 ENGRAVED PLASTIC LAMINATE SIGNS

A. Engraving stock melamine plastic laminate complying with FS L-P-387A(1) in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, white with black core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting necessary because of substrate.

B. Thickness: 1/16-inch for units up to 20 square inches or 8-inch length, 1/8-inch for larger units.

C. Fasteners: Self-tapping stainless steel screws except contact type permanent adhesive where screws cannot or should not penetrate substrate.

2.07 PLASTIC EQUIPMENT MARKERS

A. 2-ply, 1/8-inch thick laminated engraved plastic.

1. Color: Black letters on white background.

B. Nomenclature: Marker shall use terminology in Contract Documents as closely as possible:

1. Equipment Name (e.g., Chilled Water Pump No. 1).
2. Equipment Tag No. (e.g., 30-P-1).

C. Size: Provide approximate 3-inch by 6-inch (minimum) for equipment.

1. 1-inch high letters for equipment tag number.
2. ½-inch high letters for descriptive equipment name.

2.08 FLOW CONTROL AND MEASUREMENT DEVICE TAGS

A. Provide tags for all flow control devices (e.g., valves) and flow measurement devices (e.g., flowmeters) installed in piping of 4-inch diameter or larger.

B. Provide tags for all flow control devices (e.g., gates) that control flow from/in basins or channels.

C. 2-ply, 1/8-inch thick laminated engraved plastic.

1. Color: Black letters on yellow background.

D. Size: Adequate to accommodate letter height below.

1. 1/2-inch high letters for nomenclature.

E. Fastening: Fasten to device using nylon zip tie through metal eyelet in tag.

F. Nomenclature:

1. For devices that are named and tagged (e.g., electrically-actuated devices) in the Contract Documents, use the nomenclature in the Contract Documents.

    a. Equipment Name (e.g., Chilled Water Pump No. 1)
    b. Equipment Tag No. (e.g., 30-P-1)

2. For devices that are not named or tagged in the Contract Documents, use the nomenclature below.

    a. XXX-YYY-ZZZ where XXX = Structure Number, YYY = Device Type, ZZZ = Tag Number (e.g, 250-PV-001 represents plug valve 001 in Structure 250).
    b. Device Types, YYY shall be defined as follows: G = gate, PV = plug valve, BFV = butterfly valve, CV = check valve, GV = gate valve, ARV = air release valve, BV = ball valve, KV = knife valve, PRV = pressure regulating valve, PIV = pinch valve, MV = mud valve, SPV = specialty valve.

G. Submittal:

1. Submit device inventory in format shown below. Notes: [1] – example shows device that is not tagged in Contract Documents, [2] – example shows device that is named and tagged in Contract Documents.

Structure	Description	Tag Nomenclature
230	Butterfly Valve[1]	230-BFV-001
250	Ball Valve[1]	250-BV-001
230	Ball Valve[1]	250-BV-002
220	WAS Diverter Valve No. 2[2]	220-FV-0652
230	MHS Flushing Valve[2]	230-FCV-0941

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install piping and equipment identification in accordance with manufacturer's written instructions.

B. Coordination: Where identification is to be applied to surfaces requiring insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 IDENTIFICATION

A. Locate pipe markers with arrows and color bands as follows wherever piping exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exterior non-concealed locations.

1. Near each valve and control device.
2. Near locations where pipes pass through walls or floors, ceilings or enter non-accessible enclosures.
3. At access doors, manholes, and similar access points permitting view of concealed piping.
4. Near major equipment items and other points of origination and termination.

5. Spaced intermediately at maximum spacing of 30 feet along each piping run, except reduce spacing to 20 feet in congested area of piping and equipment.
6. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

B. Locate color bands at each marker and at intermediate spacing not to exceed 10 feet between bands, and at lesser spacing as indicated or as required by local codes.

C. Locate directional arrows at each marker. Provide 3 arrows at each tee or branch fitting.

D. Where piping is normally visible from more than 1 side, provide 2 or 3 labels and arrows spaced at 120 degree intervals around pipe in accordance with ANSI A13.1.

E. Painting or Coating:

1. Painting of piping, ductwork, and equipment is work of Section 09 96 00.
2. Colors listed are general. Colors shall match existing piping system color coding.
3. For piping scheduled to be color-coded, but not scheduled for complete painting (such as some plastic piping or aluminum jacked insulation) provide additional banding to represent background color. At each banding location provide following sequence:

a. 8-inch wide tape of scheduled pipe color.
b. 4-inch wide tape of scheduled band color.
c. 8-inch wide tape of scheduled pipe color.

F. Underground Piping Identification:

1. During backfilling/top soil placement of each exterior underground piping system, install continuous underground type plastic line marker located directly over buried line at 6 to 8 inch below finished grade. Where multiple small lines buried in common trench and do not exceed overall width of 16 inch, install single line marker.

G. Process Valve Identification:

1. Install engraved plastic marker at each process valve, gate, or flow control device as identified by P&ID tag numbers on Drawings.

H. Mechanical Equipment Identification:

1. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, if not otherwise specified for each item or device. Provide signs for each unit having equipment tag number on Drawings or in Specifications.

3.03 FIELD QUALITY CONTROL

A. Final Survey and Repairs:

1. 1-year after date of substantial completion, Contractor shall perform walk-through survey of mechanical identification systems and shall remove and replace any bands, labels, tags or markers that are loose, discolored, or defective.
2. Replacement materials shall be provided by Contractor, not drawn from Owner’s extra material.

3.04 ADJUSTMENT AND CLEANING

A. Adjusting: Relocate any mechanical identification device visually blocked.

B. Cleaning: Clean face of identification devices.

END OF SECTION

SECTION 40 42 13
MECHANICAL INSULATION AND JACKETING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Drawings and General Requirements of contract including General and Supplementary Conditions and Division 1 specification sections apply to work of this Section.

B. Extent of mechanical insulation specified in this section includes Piping and Ductwork Systems (where indicated).

1.02 QUALITY ASSURANCE

A. Installation shall meet the requirements local plumbing, mechanical, and energy codes.

B. Manufacturer - Subject to compliance with requirements, provide products of one of the following:

1. Armstrong World Industries, Inc.
2. Certainteed Corp.
3. Knauf Fiberglass
4. Manville Corp.
5. Owens-Corning Fiberglass Corp.
6. Pittsburg Corning Corp.
7. Rubatex Corp.

C. Installer - A firm with at least 3 years successful installation experience on projects with mechanical insulation similar to that required for this project.

D. Flame/Smoke Ratings - Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

1.03 SUBMITTALS

A. Product Data - Submit manufacturer's specifications and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, thickness, and furnished accessories for each mechanical system requiring insulation in accordance with Section 01 33 00.

B. Maintenance Data - Submit maintenance data and replacement material lists for each type of mechanical insulation in accordance with Section 01 78 23.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or level, affixed showing fire hazard ratings of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged insulation; remove from project site.

PART 2 - PRODUCTS

2.01 FIBERGLASS PIPE INSULATION MATERIALS

A. Fiberglass Pipe Insulation: Knauf 1000° Pipe Insulation, Johns Manville Micro-lok, or equal. Preformed insulation designed for nominal pipe sizes indicated on the drawings.

B. Meeting requirements of ASTM C547, ASTM C585, and ASTM C795.

C. Rigid, molded, noncombustible construction.

D. Maximum k = 0.23 Btu in./hr sq ft °F at 75°F.

E. Jacketing as specified for intended use.

2.02 POLYISOCYANURATE INSULATION MATERIALS

A. Manufacturers:

1. Trymer.
2. Dyplast Products.
3. Or equal.

B. Polyisocyanurate Insulation: Product meets the requirements of ASTM C591, type IV.

C. Thermal conductivity of 0.19 btu-in/hr-ft2-°F or lower at 75°F mean temperature.

D. Minimum 4 lb/ft3 density.

E. Flame spread/smoke developed performance tested via method ASTM E-84, UL 723, or NFPA 255 of 25/50 or better at thicknesses of 1.0 inches or less.

F. Heat traced piping systems shall be provided oversized as required for installation of heat tracing.

2.03 CELLULAR GLASS INSULATION MATERIALS

A. Manufacturers:

1. Pittsburgh Corning Corporation, Foamglas.
2. Or equal.

B. Cellular Glass Insulation: ASTM C552, density 7.0 to 9.5 pcf, maximum ASTM E96 permeability = 0.005 perm in., maximum k = 0.32 Btu in./hr sq ft °F at 75°F, to 850°F (427°C).

C. Buried system jacketing:

1. Flexible polyvinyldene chloride (PVDC), Saran 560 CX or equal.
2. 6.0-mils thickness.
3. 0.01-perms permeance rating.

2.04 JACKETING MATERIALS

A. Aluminum Piping Jacket Materials:

1. JRA, 0.016-in. aluminum, ASTM B209, with Pittsburgh seam, butt joint strips, matching fitting covers, stucco embossed finish and weather mastic.

B. Colored PVC Piping Jacket Materials:

1. Heavy-duty UV resistant PVC jacketing, ASTM D1784, 30 mil thickness, solid color, Johns Manville Zeston 300 PVC, or equal.
2. Color to be as selected by Owner or Engineer.

PART 3 – EXECUTION

3.01 SYSTEM INSULATION

A. For all Exterior and Buried Piping systems identified on Drawings, Section 40 05 05, or herein, to be heat traced and/or insulated and jacketed:

1. Insulate exterior above grade heat traced piping system with the following types and thicknesses of insulation:

a. Insulation:

1) Polyisocyanurate, 2-in. thickness for 2-in and larger pipes, 1-1/2-in thickness for 1-1/2-in and smaller pipes.
2) Cellular Glass, 2-in. thickness for 2-in and larger pipes, 1-1/2-in thickness for 1-1/2-in and smaller pipes.

b. Jacketing: Aluminum, stucco embossed.

2. Insulate exterior below grade heat traced piping system with the following types and thicknesses of insulation:

a. Cellular Glass, 2-in. thickness for 2-in and larger pipes, 1-1/2-in thickness for 1-1/2-in and smaller pipes.
b. Jacketing: Saran 560 CX, or equal.

B. For all Interior Process Piping systems identified on “M” Drawings, Section 40 05 05, or herein, to be insulated and jacketed unless specified otherwise:

1. Insulate interior piping system with the following types and thicknesses of insulation:

a. Insulation: Fiberglass, 2-in. thickness.
b. Jacketing: Colored PVC.

C. Plumbing Piping:

1. Insulate all interior W1, W2, W3, W4, HW, TW, TWRE piping:

a. Insulation: Fiberglass, 1-in. thickness.
b. Insulation for fittings shall be preformed with Colored PVC jacketing.
c. Jacketing: Colored PVC jacketing.

2. PVC Jacketing Colors:

a. W1, W2, W4, HW, TW, TWRE: light blue
b. W3: White with red stripe

3.02 INSTALLATION OF INSULATION

A. Install insulation products in accordance with manufacturer's written instructions.

B. Carbon steel piping systems insulated with Polyisocyanurate shall be provided with a 5-mil prime coat of epoxy primer.

C. Install insulation on pipe systems subsequent to testing and acceptance of tests.

D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

E. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

F. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

H. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

I. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

3.03 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 40 61 13
PROCESS CONTROL SYSTEM (PCS) GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section covers general provisions and requirements for all work necessary for Engineering, furnishing, installing, adjusting, testing, documenting, programming, and starting-up the Process Control System, complete.

B. Unless otherwise noted, the System Integrator shall assume responsibility for specification sections listed under Equipment, Systems and Services within this Specification.

C. The Contract Documents including drawings and specifications are complementary parts and what is called for by one part shall be as binding as if called for by all parts.

1.02 REFERENCES

A. ANSI: American National Standards Institute

B. IEEE: Institute of Electrical and Electronics Engineers

C. ISA: Instrumentation, Systems and Automation Society

D. NEMA: National Electrical Manufacturers Association

E. NFPA: National Fire Protection Agency

F. UL: Underwriters Laboratory

1.03 ABBREVIATIONS

A. HMI: Human/Machine Interface

B. I&C: Instrumentation and Controls

C. I/O: Input / Output

D. NEC: National Electrical Code

E. PC: Personal Computer

F. PCN: Process Control Network

G. PCS: Process Control System

H. PLC: Programmable Logic Controller

I. OIU: Operator Interface Unit

J. SCADA : Supervisory Control and Data Acquisition

K. UPS: Uninterruptible Power Supply

1.04 DEFINITIONS

A. Process Control System: a complete, integrated system of PLCs, PCs, Windows-based servers, instruments, devices, wireless and wired process control networks, software, application Engineering, and ancillary equipment for monitoring and control of wastewater collection and treatment facilities.

B. Process Control Network: a complete, integrated and secured communication network consisting of equipment and cabling that provides communications between components of the Process Control System.

C. System Integrator: Organization whose principal function is to design, program, configure, manufacture, install, and service the PCS. An organization, under the direction of the Contractor, who shall assume complete responsibility for: detail design, manufacture, installation, configuration, technically advising on and certifying correctness of installation, testing and adjusting, documenting and starting-up, and training of the complete PCS.

1.05 SUBMITTALS

A. In addition to the requirements of Section 01 33 00, the following information shall be provided in tabbed, booklet format covering all Project work.

B. Shop Drawings:

1. General:

a. Drawings shall include ancillary devices such as terminal strips, relays, fuses, utility lights and receptacles, fans, heaters, etc.
b. Typical drawings for multiple circuits or systems are not acceptable.

2. Panel Layout Drawings - Drawings shall show all panel mounted devices to scale and dimensioned and shall include legend.

a. Include cross-reference to a bill of material for components used.
b. Component designations shall match those used on elementary schematic diagrams and physical component labeling required per Section 40 67 15.
c. Prepare in general accordance with NFPA 79, Annex D.

3. Elementary Schematic Diagrams – Ladder type circuit diagrams prepared to facilitate the understanding of the system function and maintenance and fault detection.

a. Control devices shall be shown between vertical lines that represent control power wiring, with the left line representing control circuits common and right representing operating coils common except where permitted by Clause 9 of NFPA 79.
b. Control devices shall be shown on numbered horizontal lines (rungs) between the vertical lines.
c. Drawings shall include a cross referencing scheme used in conjunction with each relay, output device, limit switch, and other devices so that any contact related to a device can be readily located on the drawing.
d. Component designations shall be included for all devices, with the same designations used on Panel Layout Drawings.
e. Each panel terminal within a terminal strip shall be numbered; when multiple terminal strips exist each shall be given a unique identification. Terminal strip identification shall be included on Panel Layout Drawings.
f. All wires shall be numbered; wire numbers shall be applied to labels in accordance with Section 40 67 15. Wiring and devices external to panel shall be clearly identified.

g. Control devices shall utilize the symbology depicted in NFPA 79 and IEEE315.
h. Switch symbols shall be shown with utilities turned off and devices in their normal starting condition. Include control settings on the diagrams when available.

4. Panel Interconnection Diagrams – Wiring interconnection diagrams prepared to show all signal and power wiring for external connections to control panels provided for Project. Wire and cable tags information shall be provided to Contractor in an electronic format for in physical wire and cable tagging.

   a. Drawings prepared on a per control panel basis.
   b. Show interconnecting wiring, field device, control panel, and provision for 2 field located termination cabinets.
   c. Interconnecting wiring shall include wire and cable tag numbers.
   d. Field device information shall include device tag and description, signal description, signal electrical characteristics, and range.
   e. Control panel information shall include terminal strip identification and terminal number.
   f. Drawings shall indicate source of control signal power.
   g. Prepare drawings in accordance with requirements of NFPA 79.

5. PLC Equipment Layout Drawing including processing equipment, I/O components, power supplies, and peripheral devices.
6. Process Control Network Drawings – Updated drawings shall show connections between newly connected Process Control System devices including OIUs, PLCs, and other network devices. Drawings shall indicate network domain and device addresses, subnet masks, gateways, and other pertinent network address information.
7. Electrical power, UPS, Grounding, and DC Power Schematics for all equipment.
8. Heat calculations for all enclosures.
9. UPS sizing calculations.
10. Test reports.

C. List of special tools (including software) required for instrument calibration, startup, checking, testing, parts replacement, troubleshooting, and maintenance of all components of the Process Control System. Identify any special tools specially designed or adapted for use on parts of this system.

D. Product Data:

1. Catalog Information - Provide catalog information and descriptive literature on all equipment associated with the PCS.
2. Product Data (Specification) Sheets – Provide product data sheets for each component provided under this Section. The purpose of the data sheets is to supplement the generalized catalog information provided by citing all specific features for each specific component (e.g., scale range, materials of construction, special options included). Product Data Sheets shall follow General ISA S20 format.

E. Test Outline and Procedure Submittal

1. A detailed description of each specified test procedure and demonstration shall be submitted for approval. The decision of Engineer upon the acceptability of the procedure shall be final.
2. It is required that this be a two-step submittal: outlines first followed, upon receipt of Engineer's approval, by specific test descriptions.
3. Test descriptions shall be in sufficient detail to fully describe the specific tests to be conducted to demonstrate conformance with these Specifications.
4. Provide detailed step-by-step field test procedure in accordance with Section 40 61 21.

Include proposed test documentation and sign-off sheets and punch list forms.

5. Identify complete inventory of equipment to be tested at factory including make, model, and serial number. Label each piece of equipment.

F. Operation and Maintenance (O&M) Data:

1. Process Control System - Submit in accordance with Section 40 61 30.
2. Fully document copy of all application programs including PLC, PC and Server-based applications. See Section 40 61 30for requirements

G. Record Drawings: Submit in accordance with Section 40 61 30.

1.06 QUALITY ASSURANCE

A. Contractor shall engage the services of a qualified System Integrator for the purposes of furnishing the Process Control System, providing technical assistance on the installation of System and certifying the correctness of said installation.

B. Equipment shall be latest and most modern design at time of Notice to Proceed.

C. All software and firmware used in this Project shall be the latest version that is compatible with each other, as of the Notice to Proceed.

D. Like items of Equipment shall be end products of single manufacturer to achieve standardization for maintenance, spare parts, operation, and service.

E. PCS components shall be grounded in accordance with NEC requirements.

F. Coordination - In order to ensure timely performance of the Contract and the System's conformance with Specifications, coordination meeting(s) shall be held during the course of the project.

1. Within 30 days of date of Contract Time commencement, submit Progress Meeting schedule for final coordination by Owner/Engineer, Contractor and Systems Integrator. Submit also the Submittal Schedule and Project Activity Schedule for final review.
2. Progress Meetings shall be held at the project site and designated by Owner with Owner/Engineer’s, Contractor’s and System Integrator's representatives in attendance.
3. Purpose of Progress Meetings is to obtain Owner/Engineer’s clarification on intent of Contract Documents during Submittal preparation and prior to OIU/HMI and PLC software configuration at no additional cost to Owner. Progress Meeting(s) shall cover following:

    a. Review of functional descriptions describing equipment operation.
    b. Owner/Engineer selection of options.
    c. Owner/Engineer review documentation

4. Prepare and submit Startup Schedule, coordinated with overall Construction Schedule including the following:

    a. Review of Wiring Sign-Off forms by Owner/Engineer.
    b. I/O checkout by System Integrator.
    c. Plant startup.
    d. Training.
    e. Post-startup services.

1.07 SYSTEM INTEGRATOR RESPONSIBILITY

A. System Integrator shall inspect Equipment provided under this Section prior to shipment to Project sites.

B. System Integrator shall coordinate work with Contactor to ensure that:

1. All components provided under this Section are properly installed.
2. All components provided under this Section are properly configured.
3. The proper type, size, and number of control wires with conduits are provided.
4. Proper electric power circuits are provided for all components and systems.

C. System Integrator shall be responsible for coordination of voltage levels and signal types for signals connected to Process Control System. Provide relays, signal isolators, termination or pull-up resistors, signal conditioners or other devices only as required for proper interfacing and operation of non-compatible devices.

D. System Integrator shall supply all HMI, OIU and PLC software fully configured specifically to the process functions described herein.

E. System Integrator shall be responsible for establishing proper communication of all control system equipment as shown on drawings and specified. System Integrator shall test and document communications as part of testing specified in Section 40 61 21.

F. System Integrator shall be responsible for the operational testing of the HMI, OIU and PLC software programs.

G. Systems Integrator shall be responsible for configuration and setup of Variable Frequency Drive parameters. The setup shall include data access via the Process Control Network.

1. VFD’s shall be programmed for auto-restart enabled.
2. VFD’s shall be programmed such that a voltage dip is not considered a fault.
3. High temperature and/or leakage detection inputs wired to VFD’s shall be programmed for “enable” and not “fault”.

H. System Integrator shall coordinate Process Control Network addressing schemes with Owner and Application Engineer and incorporate agreed upon scheme for all equipment on the PCS including vendor supplied equipment.

I. All field located conduits, wiring and cables shall be provided in accordance with Division 26 – Electrical. Exception to this is copper Ethernet cable which shall be provided in accordance with Division 40.

J. Modifications to existing control equipment.

1. Provide equipment necessary to affect changes to existing control equipment as shown on drawings and specified.
2. Provide interposing relays and current-to-current isolation relays only as required to affect signal interfacing with non-compatible devices.
3. Modify documents of existing control equipment to reflect new as-built conditions.

K. Contractor shall furnish Owner with copy of all configured PLC application programs after On-Site Acceptance Test.

1.08 APPLICATION ENGINEERING SERVICES

A. Application Engineering Services shall be provided by System Integrator.

B. Application Engineering Services shall include the following:

1. Develop written loop descriptions from the Process Control Descriptions of Section 40 61 96. These loop descriptions will define the proposed operation and control of the plant equipment and treatment systems affected by the work on this project.
2. Develop sample Human Machine Interface (HMI) graphic screen layouts.
3. Organize and lead one single day Controls Workshop with Owner at the project site to review and discuss:

    a. Loop descriptions for operation and control of the plant equipment and treatment systems affected by the Work on this Project.
    b. Sample HMI graphic screen layouts.
    c. HMI navigation alternatives and approach.
    d. Trending requirements.
    e. Alarm and event requirements.
    f. HMI Security requirements.

4. Prepare draft meeting notes of this Controls Workshop including any mutually agreed-upon changes to the loop descriptions and the sample HMI graphics presented.
5. Develop PLC and HMI application software associated with the Project in accordance with Section 40 61 20. Application software will be based on the standards established with the Owner during the pre-programming phase of the construction of the project and will be integrated into the plant-wide process control system.
6. Install and test PLC and HMI application software. Modify tested software to incorporate changes agreed to between the Owner and Application Engineer.
7. Develop the alarm notification feature of the HMI software to alert operations and maintenance personnel of critical alarms by means of their existing cell phones.
8. Develop standard trends and set up custom trend features.
9. Prepare an operation and maintenance manual for the new PLC and HMI application software. The manual will serve as the basis for training provided by Application Engineer.
10. Provide one day of on-site training of Owner operations and maintenance personnel in the use of the HMI and PLC application software configurations provided.
11. Deliverables:

    a. One electronic copy of fully commented PLC programs and HMI program documentation on flash drive or other media acceptable to Owner.
    b. Three hardcopy and one electronic copy of O&M Manual prepared for this project. O&M manual electronic copy will be MSWord with supporting material in PDF.

1.09 WORK FOR HIRE

A. Any and all configuration, programming, setup or other software functions (Software) performed on all intelligent devices provided as part of this Project is to be considered “Work for Hire” under the 1976 Copyright Act as amended (Title 17 of the United States Code). The Software shall be owned by Owner and shall be turned over to Owner fully documented as the work is completed.

B. Owner intends only to obtain the Software for its own use.

C. Owner will not prevent the Software supplier from reuse of the Software concepts and ideas for other projects. Any reuse of the Software concepts and ideas generated under this Project is solely the responsibility of the Software supplier. The Software supplier shall defend,

indemnify and hold harmless Owner from all claims, damages and expenses (including reasonable litigation costs), arising out of any use, misuse or misapplication of Software concepts and ideas.

1.10 WARRANTY

A. Provide warranty in accordance with General Conditions.

B. Furnish a copy of the warranty together with the operating instructions and maintenance data for the complete system.

C. System defects and deficiencies shall be corrected by Contractor within 24 hours of notification if Owner does not have necessary replacement parts in stock and within 4 hours of notification if Owner has necessary replacement parts in stock.

PART 2 – PRODUCTS

2.01 SYSTEM INTEGRATORS

A. Wunderlich-Malec, Addison, IL

B. Allan Integrated Control Systems, Inc., Milwaukee, WI

C. Gasvoda & Associates, Inc., Calumet City, IL

2.02 SYSTEM INTEGRATOR EXPERIENCE REQUIREMENT

A. The Contractor shall utilize a System Integrator having the experience and knowledge, as defined herein, to undertake the work specified in this Section. The System Integrator shall be an organization having the following organizational and individual experience, knowledge, and capability:

1. System Integrator shall be regularly engaged in the design, installation, and servicing of wastewater treatment PCS.
2. System Integrator shall demonstrate the ability to produce electrical and control logic diagrams in the level of detail required by this specification.
3. System Integrator shall have previously executed a minimum of five (5) wastewater treatment PCS projects of similar size and complexity to this Project and incorporating PLCs and HMI platforms included in this Project.
4. Systems Integrator shall have previously successfully executed Ethernet wireless and wired networked projects of comparable size and complexity to this Project.
5. The person(s) performing the field I&C work as required by the Contract Documents shall have a minimum of five (5) years experience on PLC-based systems.
6. System Integrator shall provide, on-site, a Control Systems Engineer to commission the functional testing, start-up and training as required by the Contract Documents. The individual shall have authored and commissioned control logic for no fewer than three (3) projects of similar or greater complexity, and shall have a demonstrated proficiency in authoring logic in PLC Function Block Language.
7. Upon request of Owner and in addition to other specified requirements, Contractor shall provide a minimum of five (5) System Integrator references to confirm compliance with these requirements.

2.03 EQUIPMENT, SYSTEMS AND SERVICES

A. Equipment, Systems and Services provided under this Section shall conform to the following requirements.

1. UL 508 - Standards for Safety, Industrial Control Equipment.
2. NEMA ICS 1 - General Standards for Industrial Control and Systems.
3. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.
4. NEMA ICS 3 - Industrial Systems.
5. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
6. NEMA ICS 250 - Enclosures for Electrical Equipment.
7. NFPA 79 - Electrical Standard for Industrial Machinery
8. UL 698A Intrinsic Safe Circuits.

B. Equipment, Systems and Services provided under this section include the following.

1. Motor-Control Centers	Section 26 24 19.
2. Low-Voltage Controllers	Section 26 29 00.
3. Variable Frequency Drive Equipment	Section 26 29 23.
4. Process Control System – Configuration Services	Section 40 61 20.
5. Process Control System – Testing	Section 40 61 21.
6. Process Control System – Training	Section 40 61 26.
7. Process Control System – O&M Data	Section 40 61 30.
8. Process Control System I/O List	Section 40 61 93.
9. Process Control Descriptions	Section 40 61 96.
10. Operator Interface Units	Section 40 62 63.
11. Programmable Logic Controllers (PLC)	Section 40 63 43.
12. Network and Communication Equipment	Section 40 66 00.
13. Control Panels	Section 40 67 15.
14. Control Panel-Mounted Uninterruptible Power Supply (UPS)	Section 40 67 63.
15. Instrumentation of Process Systems	Section 40 70 00.
16. Flow Measurement	Section 40 71 00.
17. Level measurement	Section 40 72 00.
18. Pressure, Strain, and Force Measurement	Section 40 73 00.
19. Temperature Measurement	Section 40 74 00.
20. Process Gas Analytical Measurement	Section 40 76 00.
21. Panel Mounted Instruments	Section 40 78 00.
22. Miscellaneous Instruments	Section 40 79 00.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Contractor shall install and wire PCS equipment in accordance with System Integrator's and Instrument Manufacturer's written instructions and approved submittals.

3.02 PLC INPUT/OUTPUT SIGNAL POWER SOURCE

A. Except for 4-wire instruments, all analog loops shall be powered from respective process control panel.

B. 120 volts alternating and direct current for Process Control System inputs shall be sourced from respective process control panel.

C. 120 volts alternating and direct current for Process Control System outputs shall be sourced from respective location receiving control signal.

D. See Section 40 67 15 for additional signal interface requirements.

3.03 FIELD QUALITY CONTROL

A. Protection During Construction.

1. Throughout Contract, Contractor shall provide protection for materials and equipment against loss or damage and the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Specific storage requirements shall be in accordance with the Engineer-reviewed System Integrator's recommendations.

B. Cleaning and Touch-up Painting.

1. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish.

C. Panels and Panel-Mounted Equipment.

1. Panels and panel-mounted devices shall be assembled as completely as possible at the System Integrator's factory. No work, other than correction of minor defects or minor transit damage, shall be done on the panels at the job site.

D. Inspections.

1. System Integrator shall provide services of qualified service Engineer to supervise and inspect equipment installation to ensure system is installed in accordance with System Integrator's recommendations.
2. All materials, equipment, and workmanship shall be subject to observation at any time by Engineer’s representatives. Correct any work, materials or equipment not in accordance with these Contract Documents or found to be deficient or defective. Make corrections in a manner satisfactory to Engineer at no additional cost to Owner.
3. The System Integrator shall supervise final power and signal connections by Contractor to all equipment provided under this Section. For all equipment provided under this Section and all other equipment interfaced by the system, the System Integrator shall verify and certify by written notice to Engineer, correctness of final signal connections and correctness of adjustment.
4. System Integrator shall field calibrate equipment at time of complete startup on loop-by-loop basis. Submit calibration certification to Engineer for each piece of equipment. Make adjustments necessary to place equipment in satisfactory operation.
5. During this startup period, Contractor’s personnel are to thoroughly check all of the equipment and perform the on-site tests specified above.

3.04 SUBSTANTIAL COMPLETION

A. In addition to requirements identified in other parts of the Contract Documents, Substantial Completion shall require the following process instrumentation and control work is successfully completed:

1. Owner’s receipt of required site documentation including required O&M material.
2. Completion of specified training associated with equipment provided.
3. Successful completion of the specified demonstration period.
4. Owner’s receipt of required tools.

END OF SECTION

SECTION 40 61 20
PROCESS CONTROL SYSTEM (PCS) – CONFIGURATION SERVICES

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Configuration of Process Control System (PCS) in conjunction with following Sections:

1. Section 40 61 93 Process Control System I/O List.
2. Section 40 61 96 Process Control Descriptions.

1.02 RESPONSIBILITIES

A. Configuration Services (PLC Programming) shall be provided by the Application Engineer as defined in Section 40 61 13 using the following software:

1. PLC programming shall utilize Rockwell Studio 5000 Programming software (latest edition fully compatible with all hardware).

B. Configuration Services (Operator Interface Unit Programming) shall be provided by the Application Engineer as defined in Section 40 61 13 using the following software:

1. OIU programming shall utilize OIU embedded Rockwell FactoryTalk SE.

C. Configuration Services (SCADA HMI Programming) shall be provided by the Application Engineer defined in Section 40 61 13 using the following software:

1. HMI programming shall utilize Wonderware InTouch 2017 Update 3.
2. The HMI platform for the plant is existing and will be revised and expanded to represent work done as part of this project.

1.03 DEFINITIONS

A. Plant-Wide Process Network

1. A virtual network created by the Ethernet Switches. The Process Network shall primarily handle data communication between HMI Server and the PLC's in the system. This traffic shall contain collected data and control commands.

1.04 SYSTEM DESCRIPTION

A. For general requirements for PCS, see Section 40 61 13.

B. Design requirements:

1. System consists of existing Personal Computers (PCs) with automation software, serving as a Human/Machine Interface Unit (HMI) working in conjunction with Programmable Logic Controller (PLC) based data acquisition and control panels. Automation software configuration will be updated to accommodate new system PLC's and modified processes.
2. All System components shall be housed within control panels.
3. System shall use PLC form factor I/O subsystems to connect local and remote Equipment.
4. System shall provide separate 24 volts direct current regulated power supplies to power I/O

subsystem and to power analog instrumentation loops as required.

5. Data highway components shall be provided to interconnect PLC to data highway-enabled field devices, and PLC to existing Process Control System (PCS).
6. System shall provide peer-to-peer communication between PLC, HMI computer and other devices connected to System.
7. Isolation and surge protection shall be provided for all incoming and out-going power and signal lines.
8. System shall be provided with quantity and type of I/O as specified in Section 40 61 93 and as shown on the drawings.
9. System shall have a minimum of 20% prewired spare points of each type of I/O point used.
10. System shall be expandable, at future date, to accommodate additional I/O.

C. Performance requirements:

1. HMI shall serve only as operator interface to PLC and shall not contain automatic control functions. Automatic control functions shall be programmed into the PLC.
2. PLCs shall be programmed to be autonomous; a loss of the Process Control Network (PCN) shall not cause any PLC to lose the ability to maintain control of its respective processes.
3. System shall perform process monitoring and supervisory control using PLC and HMI computer.
4. PLC shall send/receive process data to/from field Equipment and be capable of following when configured:

    a. Receive analog data from primary control elements; convert to engineering units, process for alarms and responsibility checks, and store.
    b. Receive digital data from primary control elements, check for alarm and status change, and store.
    c. Perform control and arithmetic calculations, including software PID and other regulatory control functions, based on system parameters and real-time data and output the properly conditioned control commands to final control elements.
    d. Perform sequential control functions.
    e. Ascertain off-normal conditions of process parameters and generate alarms for monitoring at the HMI. The HMI shall not be the source of alarm generation.
    f. Communicate with HMI computer over Ethernet data highway.
    g. Communicate with all Plant Operator Interface Units (OIU's).
    h. Respond to operator requests for data and to control commands from HMI.
    i. Respond to inhibit, enable and interlock signals from other sources.
    j. Respond to supervisory requests for data, to control commands and to process parameter setting changes from plant PCS.

5. HMI computer shall receive/send process data from/to PLC, maintain databases and be responsible for the following:

    a. Real-time data collection. Receive and store process data from PLC.
    b. Receive and store manually entered data from keyboard or pointing device such as operator changes and process parameter setting changes.
    c. Send operator and process parameter setting changes to PLC.
    d. Display plant activity with alphanumeric and color graphic displays of I/O associated with PLC.
    e. Data collection for maintenance management. Provide operating information from which to generate reports and logs.
    f. Real-time data collection.
    g. Historical data storage and reporting.
    h. Provide overall plant alarm and status monitoring with visual and audible alarming.
    i. Record alarms and events on screen and store to file.
    j. Allow operator input of data not collected by System.

6. “Local” mode of field mounted Local/Remote selector switches shall enable field control of equipment. PLC control shall be inhibited in “Local” mode. “Remote” mode shall enable PLC based Manual or Automatic control. Field control shall be inhibited in “Remote” mode.
7. Control logic for “Automatic” mode shall be programmed functions of the PLC.
8. Field mounted Local/Remote selector switches shall be provided with extra contact blocks for monitoring of “Remote” mode at the PLC.

D. Control Panel Requirements:

1. Unless otherwise specified, “running” signals shall be derived from equipment motor starter normally open auxiliary contacts.
2. Electrical wiring and controls shall conform to Division 26 – ELECTRICAL.
3. Equipment on panels shall be identified as follows:

    a. Indicating Light Off: Equipment Not Running.
    b. Indicating Light Green: Equipment in Operation.
    c. Indicating Light Red: Equipment in Alarm Condition.
    d. Indicating Light White: Power Supply Energized.

4. Fail Logic: Failure of equipment, after having been “called to run”, shall generate a Fail alarm. Typical points of failure are motor overload (overcurrent), motor undercurrent (blower surge), motor under voltage, fail-to-start and power fail. Power fail shall include, in addition to loss of control power, the tripping of equipment circuit breakers while equipment is called to run. Provide necessary logic to sense discrepancy between “called to run” and “running” signals and activate Fail Alarm signal after adjustable time delay.
5. References to “selector switch” refer to maintained contact type functions. Loss and return of control power to circuit does not change control mode or requirement as dictated by switch position.
6. References to “pushbutton” refer to momentary contact type functions. Loss and return of control power to circuit reverts control mode or requirement to default condition. Initiating pushbutton is required to re-establish control mode or requirement.

E. Instrumentation & Control

1. I&C design is based upon the concept of facilities with automatic and semi-automatic control of specific plant functions. With this in mind, the following Instrumentation and Control design parameters were developed:

    a. Use of custom fabricated, PLC – based control panels. Panels shall act as area controllers, located in several of the process areas.
    b. Operator access to the PLC panels shall be through a system of distributed desktop type personal computers running HMI software (HMI terminal server computers). Wherever possible, these units shall be located in proximity to the PLC panels. PLC panels shall not incorporate panel-mounted PCs unless absolutely necessary.
    c. Use of Vendor furnished control panels with appropriate operator interface for individually packaged systems with above normal inter-system coordination requirements.
    d. Selection of automated control for processes dramatically affected by plant flow variations, loading variations, or where operating efficiencies are paramount.
    e. Use of a distributed HMI computer system to monitor critical and non-critical alarms, equipment run times, status conditions, plant flows and levels, and to act as input terminals for supervisory setpoint and timer function changes.
    f. PLC based control panels and central HMI shall be linked through the use of Ethernet for transmission of data. Data transmission shall be Ethernet protocol. See Section 40 66 00 for equipment and transmission media requirements.
    g. Use of locally mounted OIU’s provide monitoring and control of systems throughout the Plant along with operational status, critical, non-critical, and dial-out alarm conditions.

Definitions of these alarms are found in paragraph 2.a.1 (below).

h. Where appropriate, Vendor furnished panels shall be specified with PLC's or communications modules for data link interface for Ethernet system. Remainder of Vendor furnished panels shall be hard-wired to nearest PLC based control panel to pick up monitoring and control signals, and subsequent relaying of data to the HMI.
i. Any programmable device included as part of a vendor control package that includes an Ethernet RJ45 port and/or is capable of communicating via Ethernet TCP/IP shall be connected to the District infrastructure at the nearest network switch or router location.

2. I&C design is based upon the following additional considerations.

a. Alarms shall be provided for conditions which shall cause safety or health risk, environmental damage, property or equipment damage, or process failure. Alarms are considered critical, non-critical or dial-out in nature and are defined as follows.

1) Critical Alarms are defined as those which shall cause safety or health risk, environmental damage, significant property or equipment damage, or failure of process operations critical to meeting effluent limitations if not attended to and corrected immediately.
2) Non-critical Alarms are defined as those which, if not attended to and corrected within a specific timeframe, may eventually cause safety or health risk, environmental or property damage, or process failure.
3) Dial-out Alarms are defined as all critical alarms and those non-critical alarms which plant management wishes to be notified of immediately.

b. Critical Alarms shall be annunciated at a location where personnel responsible for operation of the facilities are expected to be stationed or on call at all times.
c. Non-critical Alarms shall be indicated at a location where the presence of an operator is expected periodically.
d. Timers, time clocks, and repeat cycle timers shall be a function of the PLC.

1.05 QUALITY ASSURANCE

A. Provide process control system hardware required to meet function of specifications. Configure Ethernet Network to maximize process control system availability. Provide fully operational process control system.

B. Label hardware revision levels on equipment and spares installed.

1.06 PLC INPUT/OUTPUT MODULE CONNECTION

A. Input and output signals for similar process equipment shall be assigned to I/O Modules so that failure of any one module does not affect all process equipment.

B. Inputs and outputs shall be configured in accordance with Sections 40 61 20 and 40 61 93.

PART 2 – SERVICES

2.01 SUMMARY

A. Provide configuration services for Process Control System HMI computers, Control Panel PLC's, Control Panel OIU's, and for Multifunction Display/Keypads (HKUs).

B. Graphic displays (screens) shall be formatted as schematic or symbolic representations of equipment shown on drawings.

C. Provide, as a minimum, one graphic display per major piece of process equipment.

2.02 PLC PROGRAMMING GUIDELINES

A. PLC programming shall follow existing Plant programming guidelines and standards. Any and all deviations shall be approved by the Owner prior to initiating programming work.

B. Set-points, alarm values, timer values, control loop tuning parameters, and other numeric values used within PLC and HMI programs shall be part of continuous common data table within program. Parameter changes shall not require modification to instructions within program. Parameter changes shall be adjustable by changing data table through operator input via HMI.

C. Unless specified otherwise, procedure for control power fail Restart for equipment shall be as follows:

1. Equipment shall shut down on loss of control power.
2. Upon restoration of power, previously running equipment shall be restarted using same sequence of startup used for “Auto” control.
3. Prior to Restart, Auxiliary equipment shall be placed in “Off” position.
4. Equipment Restart shall be sequenced through use of timer functions to prevent simultaneous restart.

D. PLC shall not be enabled to control equipment unless respective field Hand/Off/Auto, Local/Remote, On/Off/Remote or Open/Close/Remote selector switch is in “Remote” or “Auto” position. Equipment status monitoring/ displaying and process parameter logging/ trending shall continue in all modes of control.

E. Determination of high (low) Off-Normal conditions shall be by comparing an analog input value to Operator entered set-point values. Off-Normal status bit shall be set when rising (falling) input value is equal or greater (less) than entered set-point value. Off-Normal status bit shall be reset when falling (rising) input value is equal or less (greater) than entered set-point value minus (plus) entered deadband value. Operator entered high (low) set-point values are absolute values and deadband values are relative values. All values are entered through HMI.

F. Setting of Off-Normal status bits shall cause status conditions to be displayed and/or alarmed at HMI.

G. Resetting Off-Normal status bits shall cause status conditions displayed and/or alarmed at HMI to be cleared.

H. Adjustable delay timers on alarm points shall prevent nuisance alarming or nuisance clearing of alarms. Timer values shall be ranged 0-30 seconds. Initial setting, unless otherwise specified in functional descriptions of Section 40 61 96, shall be 5 sec.

I. All status conditions alarmed at HMI shall also be logged to data table.

J. Motor Running status shall be monitored and displayed at HMI continuously.

K. Setting of Motor Failed status bits:

1. If motor is required to run via PLC control (control station Hand/Off/Auto selector switch in “Auto”),
2. And If absence of Motor Running feedback status causes Motor Fail watchdog timer to time out,
3. Then Motor Failed status bit shall be set.

L. Setting a Motor Failed status bit shall cause motor command output to be inhibited and shall cause Motor Failed status to be displayed and alarmed at HMI.

M. Resetting of Motor Failed status bits:

1. If control station Hand/Off/Auto selector switch is in “Auto” position,
2. And if HMI On/Off/Auto control function is cycled to “Off” position from either “On” or “Auto” positions,
3. Then Motor Failed status bit shall be reset.

N. Resetting a Motor Failed status bit shall cause motor command output to be re-enabled and shall cause Motor Failed status displayed and alarmed at HMI to be cleared.

O. Unless specified in functional descriptions in Section 40 61 96, the following watchdog timer values shall cause equipment fail status bits to be Set:

1. Valve fail to open: 30 sec.
2. Valve fail to close: 30 sec.
3. Equipment fail to start: 30 sec.

P. Adjustable filtering of analog inputs shall eliminate process upsets due to noise. Filtering shall be by running-average method.

Q. Integration algorithm shall be included for “Totalizing” analog flow signals.

R. Integration algorithm shall be included for “Totalizing” Equipment Run times (Elapsed Time Meter).

S. Proportional/Integral/Derivative (PID) control outputs shall utilize sample and hold algorithm. Intent is to allow slow reacting processes to stabilize before additional control output changes are made by maintaining constant output from PID control for adjustable time period. PID control shall utilize deviation set-points to reactivate controller in event deviation is exceeded during controller off time. Unless specified otherwise in functional descriptions in Section 40 61 96, off time shall have an adjustable range of 0-30 minutes.

T. PLC input coils shall be configured as non-latched unless specified otherwise.

U. PLC output contacts shall be configured as maintained unless specified otherwise.

2.03 HMI COMPUTER PROGRAMMING GUIDELINES

A. HMI/OIU programming shall follow existing Plant programming guidelines and standards. Any and all deviations shall be approved by the Owner prior to initiating programming work.

B. For the purposes of this section, HMI and OIU functionality shall be functionally similar.

C. Screens:

1. Overview screens and reports shall be first screens configured. Coordinate layout and information requirements with Owner prior to development of screens.
2. Graphic screens for HMI shall be formatted to resemble P&IDs. As a minimum, one graphic display per process loop shall be provided.
3. Screens shall be simplified representation of process flow stream and associated equipment as shown on Drawings. Only major devices shall be shown. Non-reporting equipment (isolation valves, check valves, indicators) shall not be shown.
4. In addition to process related display screens, the following shall also be provided:

a. Main Screen: Director for all other screens. Selection of any other screens shall be by cursor pick of description for that screen or function key identifier for that screen.
b. Utility Screen: Equipment status, Motor Run totalizer (hours).
c. Alarm Screens: Screen for points in alarm as selected by alarm selection matrix and screen for equipment in off-normal state (ie. Out of Service).
d. Data Screens: Listing of all Operator and Engineering entered values.
e. Trend Screen: Operator selected points for trending.
f. Report Screen: Operator initiated report generator.

5. Operator and Engineering screens shall be segregated to allow password protection of engineering-entered values.
6. There shall be pick-fields on all screens that will allow for return to main menu or to adjacent process flow screen (continuation of all process flow paths, either entering or existing).
7. Pick-fields shall be activated by placing mouse cursor on object or text and clicking left mouse button, or by selection of associated function key (F1-F12).

D. External I/O Poll Times:

1. External I/O poll times shall be set initially as specified in Section 40 61 93.

E. Data Input:

1. Data entry areas shall be provided at HMI for adjustment of process and alarm set-points. Data entry areas shall be password protected.
2. Upper and lower limits shall be provided for all data entry values. Entry of values outside of limits shall not be accepted and shall generate appropriate error message on screen. Upper and lower limit values shall be adjustable at HMI and shall be password protected.
3. Upper and lower limits shall be provided for all logged analog input values. Logged values outside of limits shall generate appropriate alarm. Upper and lower limit values shall be adjustable at HMI and shall be password protected.
4. Upper and lower limits shall determine range of analog input value. Value shall be scaled in standard Engineering Units.
5. Password protection shall consist of alpha-numeric sequence and shall be intended for Plant Supervisor and Head Operator entry only.
6. Unless otherwise specified in Functional Descriptions, process points shall be scanned as follows:

a. Critical Alarm points and analog input process points shall be scanned continuously.
b. General Alarm points shall be scanned only on change of state into alarm condition.
c. All other points scanned only when required for display at HMI/OIU.

7. All dynamic screen displays shall be updated every 2 seconds, minimum.

F. Display Objects – General

1. Process piping and pumps/fans/mixers may be animated with color to show active/non-active status.
2. Tankage shall be rendered in 3D.
3. Use graphic symbology for rendering of objects.

G. Display Objects – Process Lines and Inline Device Symbology

1. Where inline devices are dynamic in nature, their equipment symbols shall be formatted as Display Objects to change color based upon feedback. Coordinate color use with Owner's existing HMI configuration. Recommended color use:

a. Off – Gray.
b. On – Green.
c. Warning – Red, Solid.
d. Fail/Alarm – Red, Flashing.
e. Status – Amber.

2. Inline devices shall have alphanumeric tag identified near them, adjacent to associated symbol.
3. Arrow heads shall be used as pointers for flow direction at all points of entrance to equipment, at all points where process lines change direction and at points of merger.
4. Process lines entering or leaving screen shall have points of continuation identified by boxed text, indicating From/To screen. One end of box shall form arrow to show direction of flow and act as pick-field for selection of screen of continuation. Color shall be same as associated process line.
5. Process lines shall be identified with flow stream abbreviation as listed in standard symbolic table and as shown on P&IDs, where convenient.

H. Display Objects – Large Equipment Symbology

1. Symbol shape shall be simple reflection of true shape of equipment being depicted.
2. Outline color shall be white.
3. Equipment tag and description name shall be located within shape. If not practical, locate near shape. Text shall be white and enclosed in white border box. For example:

a. Tank levels shall be displayed within tank symbol as vertical bar, with bar color representative of fluid within tank.
b. Tank level bar height shall be proportional to analog input value scaled from 0 to 100%. 100% shall be equal to full vertical height of symbol.

I. Display Objects – Data Fields

1. Analog process data not conducive to graphic symbology shall be formatted as rectangular Data Fields:
2. Process values (i.e. Flow, pH, D.O., Elapsed Time) shall be displayed as Data Fields near associated device symbol and shall consist of: alphanumeric tag, green in color; data value, white in color, right justified; engineering unit, green in color. Entire field shall be grouped as one block.
3. Data Fields shall be configured with high and low limits as described above.

J. Display Objects – Status Displays

1. Status Displays shall be similar to Data Fields but shall be linked to discrete data points or status bits:
2. Discrete equipment parameters (i.e. Run, Fail, On/Off, Open/Close) shall be indicated as rectangular Status Displays and shall consist of: alphanumeric tag, green in color; single or dual-state equipment value, white in color, center justified. Entire field shall be grouped as one block.
3. Displays shall be classified as Alarms or Events (see below).

K. Control Objects

1. Control Objects shall reside on graphic screens as either visible objects or as pop-up objects.
2. Visible Control Objects shall be restricted to simple functions. For example:

a. Single-State Pushbutton (i.e. Reset, Silence, Acknowledge, GoTo):

1) Display alphanumeric tag of equipment or function to be manipulated. Function shall be independent of equipment control mode. There shall be graphic representation of one pushbutton, black in color with white or green text, center justified. Button shall act as pick-field and when selected by cursor and activated by clicking left mouse button, shall generate programmed output. Output shall not latch. Button, when activated, shall highlight with white border.

b. Dual-State Pushbutton (i.e. Open/Close, On/Off, Start/Stop):

1) Display alphanumeric tag of equipment or function to be manipulated. Function shall be dependent upon equipment control mode. There shall be graphic representation of one pushbutton, black in color with white or green text, center justified. Button shall act as pick-field and when selected by cursor and activated by clicking left mouse button, shall generate programmed output. Pick-field shall indicate change of state by changing text within object and/or changing color. Output shall latch, requiring mouse click to toggle back to original state. Button, when activated, shall highlight with white border.

c. Data Entry Field:

1) Similar to Data Display Field described above. Allows operator entry of process values such as set-points.

3. Pop-up activation for dynamic control of equipment shall be by pick-fields associated with symbol of device to be controlled. Pop-up shall be small window or graphic overlay on current screen in location that will not interfere with current operation. Pop-up will contain necessary symbolism for dynamic control and worded prompts as necessary. Examples of pop-up Control Objects:

a. PID Controller Faceplate:

1) Display alphanumeric tag of final element being controlled. Mode of field Hand/Off/Auto or Open/Close/Remote selector switch shall be displayed. If in Auto, word “Auto” shall be displayed next to controller. If not in Auto, word “Hand” or “Off” shall be displayed – depending on field condition. Set-point, Process Variable, and Control Variable shall be displayed in vertical bargraph and digital formats. Bargraph shall be graduated scale equal to range of final element. Display bar shall be equal in length to graduated scale. Set-point and Process Variables shall be scaled in engineering units. Control Variable shall be scaled in percent of output. There shall be a graphic representation of a two-position pushbutton set (see below) labeled as “Auto-Manual” and shall act as pick-field. When selected by cursor and activated by clicking left mouse button, selector shall toggle between “Auto” and “Manual” modes of control. When selector is in “Auto”, PID controller calculates Control Variable. When selector is in “Manual”, Control Variable output shall follow setting by Operator. Control shall be available only when field selector switch is in “Auto”.

b. Flow Controller Faceplate:

1) Display alphanumeric tag of valve being controlled. Mode of field Hand/Off/Auto or Open/Close/Remote selector switch shall be displayed. If in Auto, word “Auto” shall be displayed next to controller. If not in Auto, word “Hand” or “Off” shall be displayed – depending on field condition. Set-point, Process Variable, and Control Variable shall be displayed in horizontal bargraph and digital formats. Bargraph shall be graduated scale equal to range of associated flow. Display bar shall be equal in length to graduated scale. Setpoint and Process Variables shall be scaled in engineering units. Control Variable shall be scaled in percent of valve position. There

shall be a graphic representation of a two-position selector (see below) labeled as "Auto-Manual" and shall act as pick-field. When selected by cursor and activated by clicking left mouse button, selector shall toggle between "Auto" and "Manual" modes of control. When selector is in "Auto", Flow Controller calculates Control Variable. When selector is in "Manual", Control Variable output shall follow setting by operator. Control shall be available only when field selector switch is in "Auto".

c. 2-Position Pushbutton Set (i.e. Manual/Auto, Start/Stop, Open/Close):

1) Operationally the same as Dual-state Pushbutton described above. Display alphanumeric tag of equipment to be controlled. Mode of field Hand/Off/Auto or Open/Close/Remote selector switch shall be displayed. If in Auto, word "Auto" shall be displayed next to controller. If not in Auto, word "Hand" or "Off" shall be displayed – depending on field condition. There shall be graphic representation of two pushbuttons, one red in color, the other green in color. Buttons shall act as pick-fields and when selected by cursor and activated by clicking left mouse button, shall indicate and generate programmed output. Output shall remain latched until other button is activated. Button activated shall highlight with black border. Pick-fields shall be available only when field selector switch is in "Auto".

d. 3-Position Switch Set (i.e. Local/Off/Remote, Hand/Off/Auto, Open/Stop/Close):

1) Display alphanumeric tag of equipment to be controlled. Mode of field Hand/Off/Auto or Open/Close/Remote selector switch shall be displayed. If in Auto, word "Auto" shall be displayed next to controller. If not in Auto, word "Hand" or "Off" shall be displayed – depending on field condition. There shall be graphic representation of three pushbuttons, one red in color, one green in color, the other white (amber) in color. Buttons shall act as pick-fields and when selected by cursor and activated by clicking left mouse button, shall indicate and generate programmed output. Output shall remain latched until another button is activated. Button activated shall highlight with black border. Pick-fields shall be available only when field selector switch is in "Auto".

e. Analog Output Control (i.e. "Speed-Pot", Process Set-point Control):

1) Display alphanumeric tag of equipment to be controlled. Mode of field Hand/Off/Auto or Open/Close/Remote selector switch shall be displayed. If in Auto, word "Auto" shall be displayed next to controller. If not in Auto, word "Hand" or "Off" shall be displayed. Analog Output Control shall be displayed in vertical (horizontal) bargraph and digital formats. Bargraph shall be graduated scale equal to range of output. Display bar shall be equal in length to graduated scale. Process Variable units shall be scaled in engineering units. Speed or Valve Position units shall be scaled in percent of output. Control shall be available only when field selector switch is in "Auto".

4. Pop-up Control Objects shall not be continually visible. Functions become complex depending upon numbers and types of smaller objects grouped together to create them. For example, a valve control object might be created by grouping a 2-Position Pushbutton Set (Local/Remote), a 3-Position Position Pushbutton Set (Open/Stop/Close) and Status Display Objects (Open, Closed) together.

L. Alarming Requirements

1. Alarms and Events shall be logged to data file.
2. Update alarm summary screen(s) at HMI.
3. Display only current alarms. Acknowledged alarms which are no longer active shall not be

displayed.

4. Allow operator to acknowledge alarms using single keystroke or cursor pick at alarm summary screen.
5. Alarm Display shall include following information:

    a. Time and date alarm initially occurred.
    b. Alarm point identification.
    c. Alarm value and engineering units for alarms generated from analog process points.
    d. Description of alarm (up to 40 characters).

6. Events shall be logged to separate data file. Events shall not be displayed unless evoked and shall not be annunciated.

M. Data Logging requirements – Analog and Discrete

1. All input process points shall be logged to the hard disk of the HMI computer.
2. Procedure for data collection and storage shall be as follows:

    a. HMI I/O driver shall poll process points as specified on I/O list and transfer data to image table.
    b. HMI shall scan image table for analog process points once every second, and log value to data base.
    c. HMI shall calculate minimum, maximum and average for each analog process point and log to data base.
    d. HMI shall scan image table for discrete process points on status change only, and log value to data base.

N. Trend Display Requirements

1. Configure HMI computer to display logged data in graphical trend format.
2. Trend Display Requirements:

    a. Identification of process point being displayed. Use same nomenclature as used on HMI screens.
    b. Start and end time of data being displayed.
    c. Display shall incorporate movable vertical cursor along time axis. Parameter values at cursor date and time shall be displayed digitally.
    d. Initial configuration of displays shall display data from present time back to 72 hrs prior to present time. Provide capability for operator to enter new start time for data being displayed to view parameter trend more than 72 hrs old.
    e. Displays shall include y-axis range identification, including values and engineering units.
    f. Configure trend displays to use maximum of computer screen area possible for purpose of increased resolution.
    g. Trend displays shall be accessible, via single keystroke, from graphic screen displaying trended point.

3. Organize graphics screens for trend displays into categories by process:

    a. Provide separate graphic screen within each category to display each process point trend. Provide different color for each process point.
    b. Provide separate category for manually entered data from HMI computer.

PART 3 – EXECUTION

3.01 PERFORMANCE

A. Configure PLC's and HMI computers consistent with Drawings and Specifications.

B. During course of Work and Warranty period, furnish all software and firmware with latest revisions published.

C. Refer to Section 40 61 93 for information on ranges, signal functions, set-points, initial values and activation points.

END OF SECTION

SECTION 40 61 21
PROCESS CONTROL SYSTEM (PCS) – TESTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes field testing requirements.

B. Testing of Process Control System (PCS) in conjunction with following Sections.

1. Section 40 61 93 Process Control System I/O List.
2. Section 40 61 96 Process Control Descriptions.

1.02 SUBMITTALS

A. In addition to submittal requirements of Section 40 61 13, provide the following:

1. Test Results:

a. Pass/fail status of all digital I/O.
b. Results of analog I/O testing.

2. Miscellaneous:

a. Detailed step-by-step test procedure at least 6 wks in advance of scheduled test date. Include sign-off sheets and punch list forms and description of configurations to be tested.
b. Complete inventory of equipment to be tested at factory including make, model, and serial number. Label each piece of equipment.

3. Submit in accordance with Section 01 33 00.

PART 2 – SERVICES

2.01 PREPARATION

A. Meet following criteria prior to start of test.

1. Complete submittals and resolve disputes, if any.
2. Engineer review of test procedure.
3. Include PLC processor, PLC network interface, and SCADA HMI in testing.
4. Coordinate test date agreeable to each party.

B. Schedule:

1. At end of test, meet to review list of deficiencies. Engineer will indicate those items which must be corrected.
2. Confirm, in writing, times and dates 2 weeks before tests.

2.02 FIELD INSPECTION AND PLC I/O AND SOFTWARE TESTING

A. General:

1. Field inspection and testing is intended to check installation of the Process Control System

PLC's in addition to providing a diagnostic check of field equipment and wiring.

2. Field testing shall make use of existing operator SCADA nodes. Provide configuration required to establish Ethernet communications with the new Process Control System PLC.
3. Testing shall begin after Process Control System PLC has been installed and all terminations are complete.
4. Inspect for the following:

    a. Verify the following in accordance with approved submittals:

        1) Panel dimensions.
        2) Equipment layout.
        3) Wiring.
        4) Wire and terminal identification.

    b. Verify proper access to equipment for maintenance.
    c. Verify proper access to field wire termination points.
    d. Inspect for neatness of wiring and wire harness construction.

5. Test as follows:

    a. Run hardware diagnostics.
    b. Testing of all input and output (I/O) signals by activation or injection of signal at field device.

        1) Digital input signals:

            a) For all equipment run signals, test by on/off operation of equipment. If operation of equipment is deemed inadvisable by Owner or PLC supplier due to potential process upset, inaccessibility of generating device, hazard to personnel or other factors, test by jumpering of motor starter auxiliary contact or other source of run signal.
            b) For all alarm or status signals, test by activation of device generating alarm. If generation of alarm is deemed inadvisable by Owner or PLC supplier due to potential process upset, inaccessibility of generating device, hazard to personnel or other factors, test by jumpering of alarm contact at nearest accessible location to generating device.
            c) For signals designated as spare, test by jumpering of signal at Process Control System PLC panel field termination point.
            d) Demonstrate change of state in PLC data table.
            e) Demonstrate change of state at SCADA HMI.
            f) Demonstrate change of state at local Operator Interface Unit.

        2) Digital or Relay output signals:

            a) Manipulate PLC data table or use forces to test response of all discrete output signals.
            b) Verify proper response of other devices in loop to signals.
            c) For signals designated as spare, test by checking signal at Process Control System PLC panel field termination point.

        3) Analog input signals:

            a) Verify impedance capabilities of transmitting device has not been exceeded by installation of Process Control System PLC.
            b) Disconnect transmitting device and inject 0, 4, 12, and 20 mAdc into loop.
            c) Demonstrate proper response to various signals in PLC data table.

d) Demonstrate change of value at SCADA HMI.
e) Demonstrate change of value at local Operator Interface Unit.
f) Verify proper response of other devices in analog loop to various signals.
g) For signals designated as spare, test by injection of signal at Process Control System PLC panel field termination point.

4) Analog output signals:

a) Verify impedance capabilities of analog outputs are not exceeded.
b) Generate 4, 12, and 20 mAdc signals for all analog outputs through PLC data table.
c) Demonstrate change of value at SCADA HMI.
d) Demonstrate change of value at local Operator Interface Unit.
e) Verify proper response of other devices in analog loop to various signals. Verify proper loop current through measurement.
f) For signals designated as spare, test by measuring of signal at Process Control System PLC panel field termination point.

B. Documentation

1. Prepare field testing sign-off document. Document shall include following as a minimum:

a. Project description and number.
b. Company name for Owner, PLC supplier, and Engineer.
c. Section labeled “Field Inspection”, with listing of items to be inspected as described above.

1) For each item, include area for initials of PLC supplier, Owner, and Engineer representative indicating passing of inspection.
2) Include area for handwritten notes of any corrections required.

d. Section labeled “Field Testing”, with listing of items to be tested as described above.

1) For each I/O point, include area for initials of PLC supplier, Owner, and Engineer representative indicating passing of inspection. Include separate line for I/O point to be tested.
2) Include area for handwritten notes of any corrections required.

C. Problem field devices or wiring.

1. Provide written documentation of any problems encountered with Owner’s existing field devices or wiring during testing.

PART 3 – EXECUTION

3.01 PERFORMANCE

A. Test PLC’s, SCADA, and Operator Interface Units consistent with Drawings and Specifications.

B. Refer to Section 40 61 93 for information on ranges, signal functions, set-points, initial values and activation points.

END OF SECTION

SECTION 40 61 26
PROCESS CONTROL SYSTEM (PCS) – TRAINING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes Training requirements.

B. Include Training on the following subjects:

1. Overview of equipment and how it interacts with equipment and processes.
2. Operation and use of control programs residing at each PLC and HMI.
3. Overview of equipment areas and how they interact with field panels and instruments and other area equipment.
4. Care-taking procedures for PLC's.
5. Overview of plant communications hardware and equipment.

C. Comply with requirements of Section 01 79 30 Instructional Services.

1.02 ABBREVIATIONS AND REFERENCES

A. HMI: Human Machine Interface

B. OIU: Operator Interface Unit

C. PLC: Programmable Logic Controller

D. SCADA: Supervisory Control And Data Acquisition

1.03 SUBMITTALS

A. General:

1. Two weeks prior to training provide to Engineer a copy of the training documents to be presented to participants.
2. Material shall be arranged in a 3-ring tabbed binder separated by primary subjects as defined below.
3. Material shall be comprensive, yet arranged in a manner easy to find or reference key information.
4. Partial submittals are not acceptable.

PART 2 – PRODUCTS – Not Applicable

PART 3 – EXECUTION

3.01 MAINTENANCE TRAINING

A. Cover following areas as a minimum:

1. Testing new programs to isolate faults to functional area.
2. Theory, logic flow, physical hardware awareness, and interface connections and assembly of each equipment item.
3. Diagnostic procedures using special and general purpose test equipment. Theory, testing, and troubleshooting procedures given for special test equipment.

4. Programming routines and procedures to enable students to take advantage of on-line and standby equipment for maintenance and performance verification.
5. Present short operator's course to ensure students understand operator functions and man/machine interfaces. Explain displays and printouts so students understand how information is derived, when it is presented incorrectly, and use of guidelines to differentiate between software and hardware problems.

3.02 INSTRUMENT TRAINING

A. Cover following areas as a minimum:

1. General principle of operation.
2. Calibration schedule.
3. Calibration procedure.
4. Calibration equipment required (if needed).
5. Recommended spare parts.
6. Consumable part – recommended replacement schedule (e.g. Reagents, filters, probe tips) and procedure.
7. General care and maintenance with special consideration to all instruments that may require cleaning such as level elements, etc.

3.03 HMI/OIU/PLC TRAINING

A. Expanded HMI functionality.

B. New OIU functionality.

END OF SECTION

SECTION 40 61 30
PROCESS CONTROL SYSTEM (PCS) – O&M DATA

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes requirements for Operations and Maintenance (O&M) data for Process Control System.

B. Comply with requirements of:

1. Section 01 33 00 Submittal Procedures.
2. Section 01 78 23 Operation and Maintenance Data.

PART 2 – SERVICES

2.01 HARDWARE MANUALS

A. General:

1. Provide inserts documenting new processes, systems, and panels to be added to Owner's existing O&M manuals. Existing O&M documents may be updated instead of replaced for modified systems and panels. Acquire existing documents from Owner prior to developing inserts or updates.
2. Defer to formatting of existing O&M documents where they conflict with requirements given in this Section.
3. Include equipment comprising systems. Provide instructions for O&M of installed system and individual equipment units comprising system.
4. Provide level of comprehension so experienced electronics technician can understand them. Convey understanding of how system operates and provide sufficient procedures for O&M. Use abbreviated tabular data such as charts, tables, checklists, and diagrams whenever practical, in lieu of written text. Make Drawings and tables integral part of manuals.
5. Standard hardware manuals are acceptable, if errata sheets are included to reflect specific equipment provided.

B. Organization and Content:

1. Introduction Section: Brief explanation of function of equipment covered. Be concise and do not include detailed descriptions. Provide quick orientation to use and purpose of manual and its relationship to system and equipment.
2. Safety Precautions: Major hazards to personnel and equipment peculiar to equipment or jobs covered. Intersperse specific hazard information, cautions or warning notes at appropriate points throughout other sections of manual.
3. Physical Description: Physical description (size, dimension, weight, special attachments, and physical orientation or clearances) for installation and operation. Identify special environmental (cooling, exhausting or noise) constraints.
4. Functional Description: How various functions operate together to cause desired results. Include block diagrams and flow diagrams for clarification and understanding. Provide text and diagrams which mutually support each other.
5. Operating procedures: Include maintenance-oriented operating procedures for individual equipment so maintenance personnel will be able to verify proper operation.

    a. Describe each equipment, unit, and assembly in detail with regard to technical or theoretical operation. Include information to component level. Describe each circuit and mechanical mechanism. Cross-reference descriptions so functions of each piece of

equipment are covered. Use schematic diagrams, sketches, equivalent diagrams, tables, and graphs to supplement text.

b. Applicable checkout, troubleshooting, servicing, removal and replacement, and in-place repair procedures which are performed on system basis. Provide written procedures for every adjustment point of equipment.

6. Checkout Procedures: Verify satisfactory operation of system, subsystem or unit as applicable. If checkout requires detailed step-by-step procedure include such procedures. Indicate why checkout is performed and what conditions are to be satisfied.
7. Troubleshooting Procedures: Isolate faulty components. Sequence troubleshooting procedures in logical progression from malfunction indication to location of faulty component(s). Indicate special connections or test equipment required for troubleshooting.
8. Servicing Requirements: Cleaning, lubricating, replenishing, and other housekeeping and preventive maintenance procedures applying to particular equipment. Make reference to applicable manuals which describe various servicing procedures.
9. Removal and Replacement Procedures: Step-by-step instructions for removal and replacement of items subject to frequent replacement. If special tools are required, identify by name and part number.
10. Diagrams: Schematic diagrams, logic diagrams, and associated data necessary for maintenance personnel to trace circuits, make continuity checks, and accomplish general and specific troubleshooting on inoperative or malfunctioning circuits. Provide pin wiring diagrams and cabling and plug tables showing to-and-from wiring information. Provide symbol chart where necessary to explain graphic symbols appearing on diagrams.
11. Tabular Listing: Special tools, equipment, and test equipment applicable to test, adjustment, and fault isolation procedures. Write systems maintenance instructions to enable correct use of test equipment.
12. Parts Lists: Provide clear traceability from equipment to replaceable component. Identify each component part with original manufacturer's name and part number. Identify component parts or assemblies modified for Project by part number. Parts lists may be tabulated or supplied in form of engineering or manufacturing drawings.

2.02 SOFTWARE AND CONFIGURATION MANUALS

A. Provide complete, organized, and standardized documentation. Structure documentation so each level develops different degree of detail. Begin with broad approach (Systems Manual), focus on smaller pieces of overall system (Subsystem Documentation), and finally pinpoint finest detail (Program Documentation).

B. Systems Manual: Describe overall content of systems software. Describe what is included in software and not how components function. Provide global view of system and complete description of interaction of various software subsystems. Include following.

1. Table of contents.
2. Overall narrative of system including special techniques and general philosophies.
3. Block diagram showing subsystem interaction.
4. List of subsystems including brief discussion of purpose of each.
5. List of programs included, categorized by subsystem, to which each belongs.
6. Description of files or tables within system which are not unique to any particular subsystem. Files or tables used uniquely within subsystem may be defined therein.

C. Cold Boot Manual and Boot Disks: Provide detailed instructions and bootstrap software for restoring all configured equipment to normal operation in the event of an equipment crash. Document all soft and hard points used, both in programming code and in Excel format.

2.03 SYSTEM CONFIGURATION DRAWING AND MANUALS

A. System configuration drawing showing Process Control System Equipment including, but not limited to PLC's, OIU's, remote I/O controllers such as those in vendor-furnished panels , and local area network hardware. Show cabling and interconnection between system components.

B. Configuration data manual describing how final system configured. Describe unique data and system parameters.

2.04 DRAWINGS

A. Provide following for Process Control System elements.

1. Block Diagram: Diagram showing major Process Control System components. Identify components by manufacturer and model number. Show interconnecting cables diagrammatically.
2. Power and Grounding Interconnection Diagrams:

    a. Power diagrams shall detail interconnections from power source through power conditioning equipment, to process control system equipment.
    b. Grounding diagram shall illustrate grounding philosophy and implementation.

3. Interconnecting Wiring Diagrams: Show Process Control System elements, interconnecting cables and wiring terminations, and terminations to interacting elements and subsystems. Number terminations. Label terminations for circuits extending outside PLC assemblies.

    a. Coordinate external circuit portion of diagram with Work specified under Division 26 and bear Contractor's mark showing Work is complete.
    b. Nomenclature for external connections shall be in accordance with I/O lists in these Contract Documents and on Drawings.

4. Shop Drawings for specifically assembled Process Control System equipment such as panels, consoles, and cabinets. Drawings shall include, but not be limited to, following.

    a. Complete connection diagram.
    b. Bill of materials listing each major item of assembly. Provide data sheets for each item, annotated as necessary to describe specific items/options furnished.
    c. Layout and fabrication drawings showing locations of components.
    d. Installation and mounting detail drawings.
    e. Anchor bolt size and location.
    f. Equipment weights.
    g. Cabinet details and location.

        1) Exterior dimensions.
        2) Cable ingress and egress areas.
        3) Cable routing.
        4) Power termination location.
        5) Ground lug location.
        6) Cable termination points.
        7) Nameplate schedules.

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 40 61 93
PROCESS CONTROL SYSTEM (PCS) – INPUT/OUTPUT LIST

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this Section shall conform to general requirements of Section 40 61 13 - PCS General Provisions.

B. Section includes Process Control System hard-wired PLC I/O and programming parameters, and is to be used in conjunction with the following Sections:

1. Section 40 61 20 PCS Configuration Services.
2. Section 40 61 96 Process Control Descriptions.

C. This section includes:

1. Schedule 1 to Section 40 61 93, Input/Output List.

D. I/O List as shown in Schedule 1 of this Section contains information to configure I/O subsystem hardware and to indicate range conversion or signal function.

1.02 ABBREVIATIONS AND REFERENCES

A. I/O: Inputs/Outputs

B. PLC: Programmable Logic Controller

C. RTD: Resistance Temperature Detector

PART 2 – SERVICES

2.01 I/O LIST DEFINITIONS

A. TAG is the field tagname given to the I/O point as designated on the Drawings.

1. This list is not to be considered a comprehensive list of PLC tagnames.

B. DWG is the Drawing number of Process and Instrumentation Diagram (P&ID) in which the I/O point is located.

C. PANEL is the tag number for the PLC/RIO/RTU panel the I/O point terminates at.

D. EQUIPMENT describes the equipment associated with the I/O point.

1. Equipment in Schedule 1 table may be truncated and/or abbreviated due to space considerations.
2. Shop Submittals for PLC Drawings shall have Equipment tagnames as described on Process and Instrumentation Diagram (P&ID) Drawings.

E. FUNCTION describes associated process parameter or programmable controller action.

F. I/O TYPE is defined as one of following:

1. AI Designates Analog Input.
2. AO Designates Analog Output.
3. DI Designates Discrete Input.
4. RO Designates Relay Output; momentary, maintained or latched relay contact output.

G. SIGNAL TYPE Description:

1. Analog Input (AI):

a. 4-20mA DC.
b. DATA 1: Process parameter range.
c. DATA 2: Process parameter engineering units.
d. POLL TIME: 0.25 second.

2. Analog Output (AO):

a. 4-20mA DC.
b. DATA 1: Process parameter range.
c. DATA 2: Process parameter engineering units.

3. Discrete Input (DI):

a. 120Vac.
b. DATA 1: Condition existing when field contact open.
c. DATA 2: Condition existing when field contact closed.
d. POLL TIME: Change-of-State, exception-based.

4. Relay Output (RO):

a. 120Vac.
b. DATA 1: Contact open function.
c. DATA 2: Contact closed function.

H. DATA 1 and DATA 2 describe function or signal characteristics. These are further defined under SIGNAL TYPE above.

1. I/O point data fields are subject to review and modification by Engineer during Shop Drawing review phase. Incorporate modifications into entire system.

PART 3 – EXECUTION

3.01 I/O CONFIGURATION

A. In addition to the PLC Configuration Standards included in Section 40 61 20, I/O shall be configured such that any single I/O module failure shall not shut down all the equipment for a given process. The objective of this configuration is to avoid a process strategy failure because of a single I/O module failure.

1. For example, if a treatment system includes 4 pumps, the I/O for each pump should be placed such that the failure of an I/O point or module will only affect one of the four pumps, with the remaining pumps operating normally.

B. I/O Point Spares Utilization.

1. Provide 25% prewired spare points per panel. Incorporate spare points into active point data

base. Include changing point names, descriptions, ranges, or status from spare to new point. Include related documentation changes. Spares utilization will be subject to following limitations:

a. Incorporation shall not significantly alter control software functions. Minor change is addition of device alarm input. Significant change is addition of control device.
b. Incorporation shall not significantly alter local area panels or field wiring to device. Minor alterations include additions of signals to terminations. Significant alterations include addition of major equipment.
c. Additions shall not increase size of reports beyond that specified elsewhere.
d. Changes shall not be made subsequent to submittal approval for a given panel or process area loop drawings.
e. Treat changing of active points to spare points in same manner as incorporation of spares.

(See following pages for Schedule 1 of this Section)

SCHEDULE 1 TO SECTION 40 61 93
I/O LIST

TAG	DWG	PANEL	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
IT-11-23-2	009-N-3	60-LCP-11-2	EXHAUST FAN	CURRENT	AI	4-20mAdc	0-XX	AMPS
IT-EF-1	009-N-3	60-LCP-11-2	TRANSFER FAN 1	CURRENT	AI	4-20mAdc	0-XX	AMPS
IT-TF-1	009-N-3	60-LCP-11-2	TRANSFER FAN 2	CURRENT	AI	4-20mAdc	0-XX	AMPS
IT-TF-2	009-N-3	60-LCP-11-2	ODOR CONTROL FAN	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
AAH-11-24-1	009-N-3	60-LCP-11-2	CAKE HANDLING	GAS ALARM	DI	120Vac	NORMAL	ALARM
AAH-11-24-2	009-N-3	60-LCP-11-2	DRYER ROOM	GAS ALARM	DI	120Vac	NORMAL	ALARM
AAH-11-24-4	009-N-3	60-LCP-11-2	HEATER ROOM	GAS ALARM	DI	120Vac	NORMAL	ALARM
YLZ-11-25-1	009-N-3	60-LCP-11-2	CAKE HANDLING	LOSS OF VENT.	RO	120Vac	NORMAL	ALARM
YAZ-11-25-1	009-N-3	60-LCP-11-2	CAKE HANDLING	ALARM STROBES	RO	120Vac	NORMAL	ALARM
YAZ-11-25-2	009-N-3	60-LCP-11-2	DRYER ROOM	ALARM STROBES	RO	120Vac	NORMAL	ALARM
YAZ-11-25-3	009-N-3	60-LCP-11-2	HEATER ROOM	ALARM STROBES	RO	120Vac	NORMAL	ALARM
TT-8-11	009-N-1	90-LCP-8-15	TRUCK BAY	TEMPERATURE	AI	4-20mAdc	0-140	°F
LT-8-12-1	009-N-1	90-LCP-8-15	LIQUID POLYMER TANK	LEVEL	AI	4-20mAdc	0-XX	FT
TT-8-13-1	009-N-1	90-LCP-8-15	LIQUID POLYMER CIRCULATION PUMP	STATOR TEMP.	AI	4-20mAdc	0-XX	°F
TT-8-9-1	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 1	STATOR TEMP.	AI	4-20mAdc	0-XX	°F
TT-8-9-2	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 2	STATOR TEMP.	AI	4-20mAdc	0-XX	°F
TT-8-9-3	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 3	STATOR TEMP.	AI	4-20mAdc	0-XX	°F
TT-8-9-4	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 4	STATOR TEMP.	AI	4-20mAdc	0-XX	°F
FT-8-9-1	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 1	FLOW	AI	4-20mAdc	0-XX	GPM
FT-8-9-2	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 2	FLOW	AI	4-20mAdc	0-XX	GPM
FT-8-9-3	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 3	FLOW	AI	4-20mAdc	0-XX	GPM
FT-8-9-4	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 4	FLOW	AI	4-20mAdc	0-XX	GPM
FY-8-9-1	009-N-2	90-LCP-8-15	BFP 1 POLYMER	FLOW CONTROL	AI	4-20mAdc	0-XX	GPM
FY-8-9-2	009-N-2	90-LCP-8-15	BFP 2 POLYMER	FLOW CONTROL	AI	4-20mAdc	0-XX	GPM
FY-8-9-3	009-N-2	90-LCP-8-15	BFP 3 POLYMER	FLOW CONTROL	AI	4-20mAdc	0-XX	GPM

TAG	DWG	PANEL	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
FY-8-9-4	009-N-2	90-LCP-8-15	BFP 4 POLYMER	FLOW CONTROL	AI	4-20mAdc	0-XX	GPM
LT-8-16-1	009-N-2	90-LCP-8-15	AGING TANK 1	LEVEL	AI	4-20mAdc	0-XXX	FT
LT-8-16-2	009-N-2	90-LCP-8-15	AGING TANK 2	LEVEL	AI	4-20mAdc	0-XXX	FT
LT-8-16-3	009-N-2	90-LCP-8-15	AGING TANK 3	LEVEL	AI	4-20mAdc	0-XXX	FT
LT-8-16-4	009-N-2	90-LCP-8-15	AGING TANK 4	LEVEL	AI	4-20mAdc	0-XXX	FT
SC-8-15-1	009-N-1	90-LCP-8-15	POLYMER MIXING SYSTEM 1	SPEED COMMAND	AO	4-20mAdc	0-100	% SPEED
SC-8-15-2	009-N-1	90-LCP-8-15	POLYMER MIXING SYSTEM 2	SPEED COMMAND	AO	4-20mAdc	0-100	% SPEED
SC-8-9-1	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 1	SPEED COMMAND	AO	4-20mAdc	0-100	% SPEED
SC-8-9-2	009-N-2	90-LCP-8-16	POLYMER FEED PUMP 2	SPEED COMMAND	AO	4-20mAdc	0-100	% SPEED
SC-8-9-3	009-N-2	90-LCP-8-17	POLYMER FEED PUMP 3	SPEED COMMAND	AO	4-20mAdc	0-100	% SPEED
SC-8-9-4	009-N-2	90-LCP-8-18	POLYMER FEED PUMP 4	SPEED COMMAND	AO	4-20mAdc	0-100	% SPEED
JA-0	009-N-1	90-LCP-8-15	UTILITY POWER	FAILURE	DI	120Vac	NORMAL	ALARM
JA-1	009-N-1	90-LCP-8-15	SURGE PROTECTOR	FAILURE	DI	120Vac	NORMAL	ALARM
JA-2	009-N-1	90-LCP-8-15	24VDC POWER SUPPLY	FAILURE	DI	120Vac	NORMAL	ALARM
JA-3	009-N-1	90-LCP-8-15	UPS	FAILURE	DI	120Vac	NORMAL	ALARM
JA-3.1	009-N-1	90-LCP-8-15	UPS	LOW BATTERY	DI	120Vac	NORMAL	ALARM
HS-8-12	009-N-1	90-LCP-8-15	POLYMER FILL	HORN SILENCE	DI	120Vac	NO ACTION	SILENCE
HS-8-13-1	009-N-1	90-LCP-8-15	POLYMER CIRCULATION PUMP	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
MA-8-13-1	009-N-1	90-LCP-8-15	POLYMER CIRCULATION PUMP	OVERLOAD	DI	120Vac	NORMAL	ALARM
MS-8-13-1	009-N-1	90-LCP-8-15	POLYMER CIRCULATION PUMP	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PSH-8-13-1	009-N-1	90-LCP-8-15	POLYMER CIRCULATION PUMP	HIGH PRESSURE	DI	120Vac	NORMAL	ALARM
LSH-8-14	009-N-1	90-LCP-8-15	TRUCK BAY POLYMER CONTAINMENT	FLOOD	DI	120Vac	NORMAL	ALARM
HS-8-15-1	009-N-1	90-LCP-8-15	POLYMER MIXING SYSTEM 1	IN REMOTE	DI	120Vac	IN LOCAL	IN REMOTE
MS-8-15-1	009-N-1	90-LCP-8-15	POLYMER MIXING SYSTEM 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
HS-8-15-2	009-N-1	90-LCP-8-15	POLYMER MIXING SYSTEM 2	IN REMOTE	DI	120Vac	IN LOCAL	IN REMOTE
MS-8-15-2	009-N-1	90-LCP-8-15	POLYMER MIXING SYSTEM 2	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
HS-8-9-1	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 1	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
MS-8-9-1	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PSH-8-9-1	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 1	HIGH PRESSURE	DI	120Vac	NORMAL	ALARM
HS-8-9-2	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 2	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO

TAG	DWG	PANEL	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
MS-8-9-2	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 2	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PSH-8-9-2	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 2	HIGH PRESSURE	DI	120Vac	NORMAL	ALARM
HS-8-9-3	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 3	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
MS-8-9-3	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 3	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PSH-8-9-3	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 3	HIGH PRESSURE	DI	120Vac	NORMAL	ALARM
HS-8-9-4	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 4	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
MS-8-9-4	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 4	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PSH-8-9-4	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 4	HIGH PRESSURE	DI	120Vac	NOT IN AUTO	IN AUTO
MY-8-9-1	009-N-2	90-LCP-8-15	BFP 1 POLYMER	CALL TO RUN	DI	120Vac	NOT CALLED	CALLED
MY-8-9-2	009-N-2	90-LCP-8-15	BFP 2 POLYMER	CALL TO RUN	DI	120Vac	NOT CALLED	CALLED
MY-8-9-3	009-N-2	90-LCP-8-15	BFP 3 POLYMER	CALL TO RUN	DI	120Vac	NOT CALLED	CALLED
MY-8-9-4	009-N-2	90-LCP-8-15	BFP 4 POLYMER	CALL TO RUN	DI	120Vac	NOT CALLED	CALLED
FQS-8-9-1	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 1	PULSE TOTAL FLOW	DI	120Vac	NO ACTION	INC. TOTAL
FQS-8-9-2	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 2	PULSE TOTAL FLOW	DI	120Vac	NO ACTION	INC. TOTAL
FQS-8-9-3	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 3	PULSE TOTAL FLOW	DI	120Vac	NO ACTION	INC. TOTAL
FQS-8-9-4	009-N-2	90-LCP-8-15	POLYMER FEED PUMP 4	PULSE TOTAL FLOW	DI	120Vac	NO ACTION	INC. TOTAL
LAZ-8-12	009-N-1	90-LCP-8-15	POLYMER FILL	ALARM HORN	RO	120Vac	SILENT	HORN
LLZ-8-12-1	009-N-1	90-LCP-8-15	LIQUID POLYMER TANK	FULL	RO	120Vac	NOT FULL	FULL
MC-8-13-1	009-N-1	90-LCP-8-15	POLYMER CIRCULATION PUMP	REQUIRED	RO	120Vac	STOP	START
MC-8-15-1	009-N-1	90-LCP-8-15	POLYMER MIXING SYSTEM 1	REQUIRED	RO	120Vac	STOP	START
MC-8-15-2	009-N-1	90-LCP-8-15	POLYMER MIXING SYSTEM 2	REQUIRED	RO	120Vac	STOP	START
MC-8-9-1	009-N-1	90-LCP-8-15	POLYMER FEED PUMP 1	REQUIRED	RO	120Vac	STOP	START
MC-8-9-2	009-N-1	90-LCP-8-15	POLYMER FEED PUMP 2	REQUIRED	RO	120Vac	STOP	START
MC-8-9-3	009-N-1	90-LCP-8-15	POLYMER FEED PUMP 3	REQUIRED	RO	120Vac	STOP	START
MC-8-9-4	009-N-1	90-LCP-8-15	POLYMER FEED PUMP 4	REQUIRED	RO	120Vac	STOP	START
MIA-8-9-1	009-N-1	90-LCP-8-15	BFP 1 POLYMER	PUMP FAIL	RO	120Vac	NOT FAILED	FAILED
MIS-8-9-1	009-N-1	90-LCP-8-15	BFP 1 POLYMER	PUMP RUN	RO	120Vac	NOT RUNNING	RUNNING
MIA-8-9-2	009-N-1	90-LCP-8-15	BFP 2 POLYMER	PUMP FAIL	RO	120Vac	NOT FAILED	FAILED
MIS-8-9-2	009-N-1	90-LCP-8-15	BFP 2 POLYMER	PUMP RUN	RO	120Vac	NOT RUNNING	RUNNING
MIA-8-9-3	009-N-1	90-LCP-8-15	BFP 3 POLYMER	PUMP FAIL	RO	120Vac	NOT FAILED	FAILED

TAG	DWG	PANEL	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
MIS-8-9-3	009-N-1	90-LCP-8-15	BFP 3 POLYMER	PUMP RUN	RO	120Vac	NOT RUNNING	RUNNING
MIA-8-9-4	009-N-1	90-LCP-8-15	BFP 4 POLYMER	PUMP FAIL	RO	120Vac	NOT FAILED	FAILED
MIS-8-9-4	009-N-1	90-LCP-8-15	BFP 4 POLYMER	PUMP RUN	RO	120Vac	NOT RUNNING	RUNNING
ZC-8-10-1	009-N-1	90-LCP-8-15	POLYMER DILUTION SOLENOID 1	OPEN/CLOSE	RO	120Vac	CLOSE	OPEN
ZC-8-10-2	009-N-1	90-LCP-8-15	POLYMER DILUTION SOLENOID 2	OPEN/CLOSE	RO	120Vac	CLOSE	OPEN
ZC-8-10-3	009-N-1	90-LCP-8-15	POLYMER DILUTION SOLENOID 3	OPEN/CLOSE	RO	120Vac	CLOSE	OPEN
ZC-8-10-4	009-N-1	90-LCP-8-15	POLYMER DILUTION SOLENOID 4	OPEN/CLOSE	RO	120Vac	CLOSE	OPEN

Schedule contains only new hardwired I/O. Existing I/O and networked I/O are not included.

SECTION 40 61 96
PROCESS CONTROL DESCRIPTIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes Process Control System in conjunction with P&IDs.

B. Items specified in this section shall conform to general requirements of Section 40 61 13.

C. See Section 40 61 20 for PCS Configuration Requirements.

1.02 REFERENCES

A. NEMA: National Electrical Manufacturer's Association

1.03 ABBREVATIONS

A. HMI: Human/Machine Interface

B. I/O: Input / Output

C. OIU: Operator Interface Unit

D. LOS: Line of Sight

E. NEC: National Electrical Code

F. PC: Personal Computer

G. PCS: Process Control System

H. P&IDs: Process and Instrumentation Diagrams

I. PLC: Programmable Logic Controller

J. SCADA : Supervisory Control and Data Acquisition

K. UPS: Uninterruptible Power Supply

L. I&C: Instrumentation and Controls

PART 2 – PROCESS CONTROL DESCRIPTIONS

2.01 RAS PUMPS CONTROL PANEL – 45-LCP-4-7

A. The yard alum piping will be modified so that the primary feed point will be in the Secondary Effluent Junction Box. The existing feed point will remain as a secondary option, with manual valves for selection. The new alum line will be heat traced (HTU-4-6) for freeze protection and be monitored for failure by the PLC. Provide an alarm at the HMI for Heat Trace Fail.

2.02 POLYMER SYSTEM CONTROL PANEL – 90-LCP-8-15

A. Provide SCADA System HMI functions as shown on P&IDs

B. Functional Description – Polymer Delivery and Storage (009-N-1)

1. The Des Plaines Water Reclamation Facility uses polymer in its sludge dewatering process. The existing dry polymer storage, preparation, and delivery systems will be replaced in their entirety with emulsion polymer systems to improve consistency and efficiency and prepare the plant for future upgrades to the dewatering process itself.
2. Liquid polymer will be delivered to the site by truck and stored in a bulk Liquid Polymer Tank (T-8-12-1) located in a new containment structure in the Sludge Dewatering Building (Str. 90) Truck Area.

    a. A temperature transmitter (TE/TIT-8-11) will send the Truck Area temperature to SCADA for display, and where an Operator can set a low temperature alarm point at the HMI.
    b. A vertical float switch (LSH-8-14) will monitor the new containment for flooding, generating a leak alarm at the HMI.

3. The Liquid Polymer Tank will have a top-mounted radar level element (LT-8-12-1) to measure current tank level for remote indication. Tank Level will be displayed at the HMI, and an Operator will be able to adjust set-points for Tank Full, Tank Overfill, Tank Order Refill, and Low Level Cutout. Alarms will be generated at the Overfill, Refill, and Cutout levels.
4. A Polymer Tank Truck Fill Control Panel (90-LCP-8-12) will provide an interface to truck drivers delivering polymer.

    a. A process indicator will display tank level as measured by the tank's radar unit before passing the level signal to SCADA.
    b. A red Tank Full light will illuminate once the tank reaches the Tank Full level as determined by the PLC.
    c. An audible alarm horn will sound if the tank reaches the Tank Overfull level as determined by the PLC. A Horn Silence pushbutton will allow the hauler to quiet the horn – the PLC will then suspend the alarm horn signal until tank level is sustained below the alarm level for 30 minutes (adjustable), at which point both the horn and horn silence circuits will reset.

5. The Liquid Polymer Circulation Pump (P-8-13-1) is a progressing cavity pump that will be used to mix the tank and prevent settling and separation during extended storage. The pump will draw from the tank outlet piping and will discharge to the tank inlet/fill line.

    a. The pump will be provided with an RTD monitoring stator temperature (TE-8-13-1). A temperature transmitter (TIT-8-13-1) will receive the RTD signal for local display and for transmission to SCADA as an analog signal. An adjustable set-point for high temperature will stop the pump if the stator overheats – coordinate initial setting with pump manufacturer's recommendation.
    b. A pressure switch will be located on the pump discharge (PISH-8-13-1) configured to trip on a high pressure, indicating pipe blockage or a closed valve. This switch will be monitored by the PLC to interlock pump operation.
    c. The pump will be powered out of a new Liquid Polymer Circulation Pump Motor Starter (90-MS-8-13-1), which will include a Hand/Off/Auto selector switch for local control. Run and Overload pilot lights will display pump status. The starter will include a local power disconnect switch.

        1) With the Hand/Off/Auto selector switch in "Hand", the pump will be energized regardless of any interlocks. PLC control will be inhibited. "Hand" is intended for maintenance purposes only.
        2) With the Hand/Off/Auto selector switch in "Off", the pump will remain off. PLC control will be inhibited.
        3) With the Hand/Off/Auto selector switch in "Auto", the pump will be controlled by the PLC. Interlocks will be respected. Local control will be inhibited. Manual and

Automatic modes of operation will be available at the HMI.

a) With the HMI in Manual, an Operator will be able to start and stop the pump.
b) With the HMI in Automatic, an Operator will set an interval-duration schedule for operation for the pump. The pump will then start every interval and run for the set duration – initial setting shall be to run 20 minutes every 2 hours.

4) If the Hand/Off/Auto selector switch is not in "Auto" for more than 24 hours, generate an alarm.

6. Interlocks:

a. Pump Stator High Temperature
b. Pump Discharge High Pressure
c. Tank Low Level Cutout

7. Alarms:

a. Truck Area Low Temperature
b. Polymer Containment Flood
c. Tank Overfull
d. Tank Refill Level
e. Tank Low Level Cutout
f. Liquid Polymer Circulation Pump High Stator Temp
g. Liquid Polymer Circulation Pump High Disch. Pressure
h. Liquid Polymer Circulation Pump Overload
i. Liquid Polymer Circulation Pump Fail to Start
j. Liquid Polymer Circulation Pump Not in Auto

C. Functional Description – Polymer Mixing and Aging (009-N-1,2)

1. Prior to being used for dewatering, liquid polymer must be diluted with water and activated/aged in dedicated tanks. To maintain sufficient retention time within the space constraints of the existing building, the Polymer Aging Tanks will be piped in parallel pairs. Tanks 1 and 2 (T-8-16-1 and -2) will be a pair of new open-top aging tanks, while Tanks 3 and 4 (T-8-16-3 and -4) will be a pair of existing closed-top tanks. Dimensions of existing tanks must be field-verified for the calculations described under Retention Mode below.

a. Each tank will have a ceiling-mounted radar level element (LT-8-16-1, -2, -3, -4) to measure current tank level for remote indication. Tank Level will be displayed at the HMI, with set-points for Tank Overflow and Low Level Cutout that will generate alarms. The initial overflow setting will be set 12" below the rim of the new open-top tanks for all tanks, including existing.
b. The tank pairs will normally be hydraulically connected by their outlets, causing both radar units to have the same reading. The Operator will select which unit to use for control of that pair of tanks. If the readings differ by more than an Operator-adjustable differential, an alarm shall be generated at the HMI. This alarm may be disabled if a single tank needs to be isolated for maintenance.

2. A pair of vendor-packaged Polymer Mixing Systems (M-8-15-1, -2) will provide for the dilution and initial activation of the liquid polymer. Both systems will draw from the single outlet of the Liquid Polymer Tank and normally discharge to separate pairs of Aging Tanks (System 1 to Tanks 1 and 2, System 2 to Tanks 3 and 4). Manually-valved crossover piping will allow one mixing system to fill the other pair of tanks if required.

a. Polymer will be fed to the skid mixer by a single adjustable-speed progressing cavity

pump. A motorized mixing chamber will combine the liquid polymer and dilution water and provide mixing energy to remove the protective oil from the polymer strands, beginning polymer activation.

b. Manual valves on the system skid will allow adjustment of the dilution water rate. A solenoid valve will then be used to turn the dilution water on or off.

c. Each system will have its own local Control Panel (90-LCP-8-15-1, -2) mounted outside the containment and equipped with a PLC and interface touchscreen. The panel will control operation and interlocks for the system pump, mixer, and water valves. The screen will allow the system to be put in Local or Remote.

    1) In Local, an Operator can turn the system on and off and adjust the polymer feed rate. PLC control will be inhibited. Local is intended for maintenance purposes only.
    2) In Remote, control of the system will be by the PLC. Local control will be inhibited but system status can still be observed. Manual and Automatic (Level, Retention) modes will be available at the HMI.

        a) With the HMI in Manual, an Operator can start and stop the system and adjust the system feed rate. Prior to starting the dewatering system the Operator will make the first batch of polymer in this mode to prime the system. The Operator will also return to this mode prior to shutting down the dewatering system, to run the aging tanks to empty. Manual startup/shutdown will be replaced with fully automated schedules that include the dewatering equipment in a future project.
        b) With the HMI in Automatic – Level mode, the system will run based on levels in the Aging Tanks.

            i. An Operator will set a target level and deadband for a given pair of Aging Tanks. The Operator may assign a Mixing System to either pair of tanks in the event crossover is required, but manual valve adjustment is necessary. In a crossover configuration only one Mixing System may run in Auto.
            ii. Whenever the assigned Aging Tanks are being drawn from by energized Polymer Feed Pumps (see Polymer Feed), the Mixing System will be called to run. The PLC will adjust system discharge flow to maintain the level set-point in the tanks. The flow set-point update will be slow-acting to allow the mixing system to stabilize concentration and avoid unnecessary wear on the water valves. If the level cannot be maintained and exceeds the deadband in either direction, an alarm will be generated at the HMI. The system will not shut off until the Overflow Level is reached, and will automatically resume once the level drops below the lower deadband.

        c) With the HMI in Automatic – Retention mode, the system will run based on a combination of levels in the Aging Tanks and based on polymer feed rate to the dewatering systems (see Polymer Feed below).

            i. Retention Mode is an expansion on Level mode. Operation of the system will be as under Level mode described above, with the target level being calculated by the PLC based on additional criteria.
            ii. An Operator will set a target retention time for a pair of Aging Tanks. The PLC will then calculate the required level in the tank to meet the retention time, based on the outflow rate:

$$\text{Target Level (ft)} = \text{Target Retention Time (min)} \times \text{Outflow (gal/min)} \div 2 \times \text{Tank Base Area (ft}^2\text{)}$$

    3) The Control Panels will be connected to SCADA via Ethernet. Specific interlocks and system feedback data will be provided over this connection, such as speed feedback or a loss of dilution water. The panel screen will also have remote access enabled allowing an Operator at the HMI to bring up the local display.

4) If the Local/Remote selector switch is not in “Remote” for more than 24 hours, generate an alarm.

3. Interlocks:

   a. Liquid Polymer Tank Low Level Cutout (see Polymer Delivery and Storage)
   b. Polymer Aging Tank Overflow Level

4. Alarms:

   a. Polymer Mixing System Unable to Maintain Level (x2)
   b. Polymer Mixing System Loss of Flow (x2)
   c. Polymer Mixing System Unable to Start (x2)
   d. Polymer Mixing System Not in Remote (x2)
   e. Polymer Aging Tank Overflow

D. Functional Description – Polymer Feed (009-N-2)

1. Aged and activated polymer is ready to be used for dewatering. The Polymer Feed Pumps (P-8-9-1, -2, -3, -4) are adjustable-speed progressing cavity pumps designed to deliver activated polymer to the dewatering processes.

   a. The plant has four separate dewatering units (currently Belt Filter Presses 1-4) and under normal operation each pump feeds one unit. Manually-valved crossover piping between Pumps 1 and 2, and between Pumps 3 and 4 allow for some flexibility if a mismatched pump and press are out of service simultaneously.
   b. The feed pumps draw from the Polymer Aging Tanks. Normally Pumps 1 and 2 draw from Tanks 1 and 2, and Pumps 3 and 4 draw from Tanks 3 and 4. A manual valve allows the pump suction headers to be connected – it is recommended this only be done when one pair of Aging Tanks is out of service and are isolated from the header. The Operator must select at the HMI which pair of tanks each pair of pumps is drawing from for the purposes of Polymer Mixing System control (see Polymer Mixing and Aging).

2. Each pump will be provided with an RTD monitoring stator temperature (TE-8-9-1,-2, -3, -4). Temperature transmitters (TIT-8-9-1, -2, -3, -4) will receive the RTD signal for local display and for retransmission to SCADA as an analog signal. An adjustable set-point for high temperature will stop the pump if the stator overheats – coordinate initial setting with pump manufacturer’s recommendation.
3. Pressure switches will be located on the pump discharges (PISH-8-9-1, -2, -3, -4) configured to trip on a high pressure, indicating pipe blockage or a closed valve. This switch will be monitored by the PLC to interlock pump operation.
4. Each feed pump will have a magnetic flow meter on their discharge to monitor flow (FE-8-9-1/FIT-8-9-1, -2, -3, -4). Flow will be sent to SCADA in form of both analog instantaneous flow and a flow total pulse; the meter will be configured to pulse every 50 gallons. Flow will be displayed at the HMI, as well as totalized by the PLC. The pulse total and calculated total will both be available to compare by trending.

   a. Flow data will also be used to calculate retention time in the Polymer Aging Tanks. All pumps assigned to the same Aging Tank pair will have their instantaneous flows summed before using the following equation:

      $$\text{Retention Time (min)} = \text{Tank Level (ft)} \times 2 \times \text{Tank Base Area (ft}^2\text{)} \div \text{Outflow (gal/min)}$$

   b. Retention Time will be displayed at SCADA.

5. The pumps will be powered by new Variable Frequency Drives (90-VFD-8-9-1, -2, -3, -4),

with Control Stations equipped with Hand/Off/Auto selector switches (CS-8-9-1, -2, -3, -4) for local control. The VFD keypad will display pump status. There will also be local disconnects at the pumps (JS-8-9-1, -2, -3, -4) for lockout maintenance purposes. Each disconnect will be wired to the VFD for Enable to prevent drive faults when the disconnect is opened.

a. With the Hand/Off/Auto selector switch in “Hand”, the pump will be energized regardless of any interlocks (aside from an open disconnect). The pump will run at the speed set at the VFD interface. PLC control will be inhibited. “Hand” is intended for maintenance purposes only.
b. With the Hand/Off/Auto selector switch in “Off”, the pump will remain off. PLC control will be inhibited.
c. With the Hand/Off/Auto selector switch in “Auto”, the pump will be controlled by the PLC. All interlocks will be respected. Local control will be inhibited. Manual and Automatic modes of operation will be available at the HMI.

    1) With the HMI in Manual, an Operator will be able to start and stop the pump and adjust its speed from the HMI.
    2) With the HMI in Automatic, the Polymer Feed Pumps will run according to external signals received from the various dewatering control panels. To accommodate crossover piping described previously, an Operator will be able to designate at the HMI which pump is currently feeding each dewatering process.

        a) The PLC will receive Call to Run signals from each of the Belt Press Control Panels. The associated pump will energize and run at a speed received from the Sludge/Polymer Control Panel located near the appropriate Belt Press.
        b) The PLC will provide Pump Run and Pump Fail contacts back to the Belt Press Control Panels. In addition to VFD Fault and Fail to Start, any interlocks that prevent a pump from running (such as low-level cutout) will send a Pump Fail signal.

d. If the Hand/Off/Auto selector switch is not in “Auto” for more than 24 hours, generate an alarm.

6. Additional dilution water may be added to the polymer after it is pumped and metered. Polymer Dilution Solenoids (FV-8-10-1, -2, -3, -4) control the addition of dilution water, while manual valves and variable area flowmeters (FI-8-10-1, -2, -3, -4) allow an Operator to regulate the amount of dilution water. Static mixers (M-8-17-1, -2, -3, -4) are located downstream of the water injection point to ensure uniform consistency. The solenoid valves will have Manual and Automatic control modes at the HMI.

    a. With the HMI in Manual, an Operator can open and close the solenoid valve from the HMI.
    b. With the HMI in Automatic, the solenoid valve will open whenever the associated Polymer Feed Pump is running.

7. Interlocks:

    a. Local Disconnect Open (x4)
    b. Pump Stator High Temperature (x4)
    c. Pump Discharge High Pressure (x4)
    d. Polymer Aging Tank Low Level Cutout (x2)

8. Alarms:

    a. Polymer Feed Pump High Stator Temperature (x4)
    b. Polymer Feed Pump High Discharge Pressure (x4)

c. Polymer Feed Pump VFD Fault (x4)
d. Polymer Feed Pump Fail to Start (x4)
e. Polymer Feed Pump Not in Auto (x4)

2.03 BIOSOLIDS DRYING BUILDING CONTROL PANEL – 60-LCP-11-2

A. Provide SCADA System HMI functions as shown on P&IDs

B. Functional Description – HVAC Monitoring (009-N-3)

1. The lower level Cake Handling Room in the Biosolids Drying Building uses ventilation to de-rate the space's hazardous environment. This ventilation is sourced from the Dryer Room, which in turn is served by a Makeup Air Unit 60-MAU-1. The PLC currently monitors 60-MAU-1 for Running and Failure status. Current monitoring will be added to the remaining fans (60-TF-1, 60-TF-2, 60-EF-1) responsible for ventilating the Cake Handling Room.

   a. Motor current to the fans will be displayed at the HMI. Adjustable low current set-points will monitor the fans for failure. No current will indicate the fan is Off. Low current will indicate the fan has failed (running but not moving air).
   b. Low current settings will be determined experimentally at start-up by disconnecting the fan blades from the motor and observing the running current.
   c. Lack of Running status or Failure from any fan or the Makeup Air Unit will generate a Loss of Ventilation Alarm for the building.

2. A Carbon Vessel (M-11-23-1) and associated Odorous Air Blower (M-11-23-2) will be added to the exhaust from the condensate sump to eliminate excess odor escaping the structure. The blower motor starter will be monitored for Running status which will be displayed at SCADA. An alarm will be generated if the blower is not Running after a set downtime limit. The Operator may disable this alarm during periods of extended downtime.
3. The Biosolids Dryer Control Panel (60-LCP-11-1) currently monitors the exhaust duct on the dryer for vacuum pressure using an existing transmitter. Add a Loss of Vacuum alarm to this panel and display at the HMI.

C. Functional Description – Gas Detection (009-N-3)

1. Gas sensors will be added throughout the Biosolids Drying Building. The Cake Handling Room will have sensors for Combustible Gas (AE-11-24-1-1) and Hydrogen Sulfide (AE-11-24-1-2). The exhaust of the Dryer Off-Gas Compressor, which removes air from the Dryer and the cake storage vessels, will be monitored for Carbon Monoxide (AE-11-24-2-1). The Dryer Room will have two sensors for Carbon Monoxide, located by the product screen (AE-11-24-3-1) and by the heating oil heat exchanger (AE-11-24-3-2). The Heating Room will have a fourth Carbon Monoxide sensor (AE-11-24-4-1).
2. Gas concentrations will be reported to a single controller (ASH-11-24) located in the Dryer Room. The controller will provide discrete outputs indicating high gas concentrations for each area monitored. Gas alarms for each space will be indicated separately at the HMI.

D. Functional Description – Alarm System (009-N-3)

1. An alarming system consisting of strobe lights and a horn will alert all personnel in the Biosolids Drying Building of the presence of a Gas Alarm or Loss of Ventilation condition (see HVAC Monitoring and Gas Detection above). All lights in the building and the horn will activate regardless of the location of the generating alarm. Lights will be split into pairs, with amber lenses for Loss of Ventilation and red lenses for Gas Alarm.
2. An Operator will have a Test/Active/Off selection available at the HMI. With the HMI in "Test" all lamps and the horn will energize. With the HMI in "Active" the system will be armed and respond to alarms normally. With the HMI in "Off" the lights and horn will remain off. "Off" is

intended for alarm system suppression in the event of erroneous operation only, and will generate an un-clearable alarm at SCADA while in this mode.

3. A Horn Silence button will be available at the north building entrance (HS-11-25) as well as at the HMI. Pressing either will stop the horn from sounding after an alarm condition occurs. The Horn Silence interlock will be set globally for all alarm conditions, meaning it will not sound for new alarms until reset. The interlock will reset automatically once all active alarm conditions are cleared or after 30 minutes elapse (adjustable), whichever happens first. The Operator may also reset the alarm early from the HMI.

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 40 62 63
OPERATOR INTERFACE UNITS

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes panel-mount Operator Interface Units for Process Instrumentation and Control Systems and Equipment.

1.02 ABBREVIATIONS AND REFERENCES

A. NEC: National Electrical Code

B. NEIS: National Electrical Installation Standards

C. NEMA: National Electrical Manufacturers Association

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
2. Submit Product Data and Shop Drawings in one complete submittal package.
3. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for devices specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for control devices specified.
2. Submit in accordance with Section 01 33 00 – Submittal Procedures.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic cleaning for Operator Interface Units in service.
3. Submit in accordance with Section 01 78 23 – Operation and Maintenance Data.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Devices shall be latest and most modern design at time of bidding.

C. As much as possible devices shall be products of one manufacturer to achieve standardization

for maintenance, spare parts, operation, and service.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. All equipment specified in this Section shall be the product of a single manufacturer.

B. Manufacturer:

1. Rockwell Automation
2. No substitutes.

2.02 PANELVIEW PLUS 7 PERFORMANCE

A. General:

1. Microprocessor based graphical operator interface.
2. NEMA 12, front of panel mount.
3. 0-55°C operating range.
4. Touchscreen interface, function and numeric entry.
5. PLC peer to peer network, Ethernet or direct serial interface.
6. Application memory standard 32MB, include 2GB memory card expansion.
7. Battery Backup

B. Display

1. 15 inch diagonal minimum.
2. 1024 X 768 XGA minimum resolution.
3. 18-Bit Color.
4. Active matrix Thin Film Transistor.

C. Display Functionality:

1. Pushbutton.
2. Pilot light.
3. Numeric data entry and display.
4. Alarm display.
5. Bar graph display.
6. Time display.
7. Selector switch.
8. Bit mapped graphics.

PART 3 – EXECUTION

3.01 TRAINING

A. Manufacture’s training shall be provided on-site prior to Substantial Completion of project in accordance with Section 40 61 26.

3.02 INSTALLATION

A. Install and wire in accordance with equipment manufacturer’s written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

END OF SECTION

SECTION 40 63 43
PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.01 SUMMARY

A. Specification includes hardware required for a fully functional Programmable Logic Control System.

B. Programmable Logic Control System shall be from single manufacturer.

1.02 ABBREVIATIONS

A. IEC: International Electrotechnical Commission

B. I/O: Input/Output

C. NRTL: Nationally Recognized Testing Laboratory

D. PLC: Programmable Logic Controller

1.03 REFERENCES

A. NEC: National Electrical Code

B. NEIS: National Electrical Installation Standards

C. OSHA: Occupational Safety and Health Administration

D. UL: Underwriters Laboratories

1.04 SYSTEM DESCRIPTION

A. Specification includes hardware using the CompactLogix™ PLC platform by Rockwell Automation.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for hardware specified.
2. Dimensional data of PLC equipment.
3. Interface terminations and cable data for each module.
4. Hardware manuals (4 sets).
5. Detailed bill of materials with manufacturer’s part numbers for each rack.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for hardware.
2. Wiring Diagrams: Show control connections and distinguish between factory-installed and field-installed wiring.
3. Addressing system and card layout, including special configuration rules and limitations for each rack.
4. Submit in accordance with Section 40 61 13.

D. Operation and Maintenance (O&M) Data:

1. Provide in accordance with Sections 01 78 23 and 40 61 30.
2. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
3. Manufacturer's written instructions for periodic replacement of any backup batteries used on equipment including estimated battery replacement calendar dates.

1.06 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

B. Single Source Responsibility: Obtain hardware from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment and system components to their final location in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage. Remove protection only after equipment is made safe from such hazards and ready to install.

B. Store items in a clean, dry, secure location.

1.08 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, dated, and identified with labels describing contents.

a. One shelf spare for each type of I/O module used on project.
b. One shelf spare for each type of communications module used on project.
c. One shelf spare for each type power supply used on project.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Allen Bradley 1769 CompactLogix™ Series.

B. No Substitute Permitted.

2.02 PROCESSOR

A. CompactLogix 1769-L33ER

1. 2 MB User Memory
2. Two embedded 10/100 Mbps Ethernet Ports.
3. One embedded USB 2.0 Port.
4. 32 Ethernet/IP Nodes, and 256 EtherNet/IP Connections supported.
5. 1 GB non-volatile memory module installed (1784-SD1).
6. 16 Module expansion capability for local I/O.
7. Programming Languages Supported:

    a. Relay Ladder Logic (RLL)
    b. Sequential Function Chart (SFC)
    c. Structured Text
    d. Function Block Diagram

8. UL Listed Industrial Control Equipment.

2.03 POWER SUPPLY

A. CompactLogix 1769-PA4

1. 85-265Vac Power Supply Input Range.
2. 47-63 Hz.
3. Current Capacity:

    a. 4.0A @ 5Vdc
    b. 2.0A @ 24Vdc

4. Operating Temperature: 32°F to 140°F.
5. 8 I/O modules can be connected on either side of the power supply for a total of 16 modules.
6. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations. UL File E10314.

2.04 I/O MODULES

A. I/O modules specifically designed for interfacing of I/O signals to PLC processor.

B. 120Vac Digital Input:

1. 79-132Vac as required by application.
2. 47-63 Hz.
3. 16 points per module.
4. LED indication of on/off status of each point.
5. 1769-IA16.

C. 24Vdc or 120Vac Relay Output:

1. 5-125Vdc, 5-265Vac Operating Voltage Range.
2. 16 points per module.
3. Pilot Rating: C300/R150.
4. Contact Rating: 2.5 amps continuous at 120vac.
5. Contact configuration: Normally open
6. LED indication of on/off status of each point.
7. 1769-OW16.

D. Analog Input:

1. 8 inputs per module.
2. Differential or single ended.
3. Accepts 4-20 mAdc or 1-5 vdc inputs as required by application.
4. Resolution: 16 bit (unipolar).
5. 1769-IF8.

E. Analog Output:

1. 8 outputs per module.
2. Single-ended.
3. Transmits 4-20 mAdc.
4. Drive capability: Current Output 0-1000 ohm.
5. Resolution: 16 bit (unipolar).
6. 1769-OF8C.

F. Address Reserve Module:

1. 1769-ARM.

2.05 PLC PROGRAMMING

A. PLC shall be programmed using Rockwell Automation Studio 5000 Software Enterprise Series Software (v.30).

1. Latest firmware version compatible with all existing operating systems and hardware.
2. IEC 61131-3 compliant (as standard).
3. 9324 series (Professional Edition)

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with System Integrator and/or Equipment manufacturer's written instructions and approved submittals, applicable requirements of the NEC, NECA "Standard of Installation", and recognized industry practices.

B. Each installation shall monitor raw incoming power (prior to a UPS) in order to identify plant power failures. This power failure shall be monitored by discrete input.

C. Provide orderly shutdown on PLC Panel power failure, saving register contents with automatic restart on power restoration.

D. Each input shall be individually fused.

1. Exception: when a group of inputs serve a common device or common function such as a remote control station for equipment.

E. Include sufficient I/O modules to accommodate 25% spare I/O prewired to terminal strips. Where no I/O of a listed type (digital input, digital output, analog input, analog output, etc.) is shown, provide one spare prewired module.

F. I/O modules shall be segregated by process such that the failure of any single I/O module shall not shut down all equipment in respective process (i.e.: Each pump for a given wet well shall have

its own set of DI, DO, AI, and AO modules exclusive from the other Pumps).

G. Analog I/O shall use specialty field terminal blocks specifically designed for 4-20mA signal wiring.

H. Communication software and configuration shall meet monitoring and control requirements of each process in accordance with functional descriptions.

I. Each hardware unit communicating over data highway shall include executive routines or traffic controller to control and coordinate activities on communication links. Use integrated, standard products for communication software to manage transmission protocols, line error detection, and message switching.

J. Provide Owner one hardcopy (in 3-ring binder format) of fully-commented PLC programs at the completion of the project for each processor installed.

END OF SECTION

SECTION 40 66 00
NETWORK AND COMMUNICATION EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes plant-wide data highway communication devices, equipment, and processes.

C. General Design Requirements:

1. Provide high speed link between new PLC's and the existing Process Control Network to allow sharing of real-time data.
2. Provide couplers, terminators, junction boxes, and other associated cable connectors.
3. Provide cabling suitable for conduit routing as shown elsewhere.
4. Provide data highway as shown on Drawings.
5. Process Control Network within buildings shall be Cat 6 UTP (100Base-TX).
6. Maximum distance between nodes within a building is 100 meters.

1.02 ABBREVIATIONS AND REFERENCES

A. FCC: Federal Communications Commission

B. IEEE: Institute of Electrical and Electronics Engineers

C. ISO: International Standards Organization

D. LAN: Local Area Network

E. NEC: National Electrical Code

F. NEIS: National Electrical Installation Standards

G. NRTL: Nationally Recognized Testing Laboratory

H. PLC: Programmable Logic Controller

I. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
2. Submit Product Data and Shop Drawings in one complete submittal package.
3. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cut sheets and product specifications for devices specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for control devices specified.
2. Cable routing drawings for Process Control Network.
3. Cable termination detail drawings.
4. Location and function of all communication module types.
5. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

PART 2 – PRODUCTS

2.01 UNMANAGED DATA SWITCHES

A. Manufacturer:

1. Hirschmann SPIDER Series.
2. No Substitute Permitted.

B. Features:

1. Unmanaged EtherNet switch, copper and/or fiber ports based on application.
2. Provide five RJ-45 10/100BaseTX ports.
3. Locate equipment in enclosure to allow addition of one additional module in the future, including sufficient length of DIN rail.
4. Hardened ESD port protection.
5. Include OPC switch monitoring.
6. UL Listed.
7. Redundant power inputs 10-30Vdc.
8. Ambient temperature (operation) -20°C to 70°C.

2.02 ENHANCED CAT 6 UTP CABLE

A. Manufacturer:

1. Siemon.
2. Or Equal.

B. 4 pair Category 6 cable shall conform to TIA/EIA 568A Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and UL® LAN Certification and Follow-up Program.

C. Indoor installations shall be plenum rated.

D. Cables shall be marked as UL verified and RoHS Compliant.

E. When traversing enclosures and panels containing 3-phase power, cable shall be rated for 600V.

F. Applications standards supported should include, but be not limited to, IEEE 802.3, 1Base5, 10BASE-T; IEEE 802.5, 4Mbps, 16Mbps (328 ft [100m]) and TP-PMD.

G. In addition, cable shall be capable of supporting evolving high-end applications such as 1000 BASE-T Gigabit Ethernet (100 meters), and 10Gbps (up to 40 meter distance).

H. Cables shall be identified at Network connections with equipment name (e.g. Polymer Mixing System 1 Control Panel) and tag number (e.g. LCP-8-15-1)

I. Cable shall be round, and shall meet the following electrical requirements:

1. All Values are guaranteed:

Frequency (MHz)	Insertion Loss (dB)	NEXT (dB)	ACR (dB)	PSACR (dB)	Return Loss (dB)	Propagation Delay (ns)
1	2.0	77.3	75.3	73.3	20.0	550
4	3.8	68.3	64.5	62.5	23.6	532
10	5.9	62.3	56.4	54.4	26.0	525
16	7.5	59.2	51.8	49.8	26.0	523
20	8.4	57.8	49.4	47.4	26.0	522
31.25	10.6	54.9	44.3	42.3	25.0	520
62.5	15.2	50.4	35.1	33.1	23.5	519
100	19.6	47.3	27.7	25.7	22.5	518
160	25.4	44.2	18.9	16.9	21.5	517
200	28.7	42.8	14.1	12.1	21.0	517
250	32.6	41.3	8.8	6.8	20.5	516

J. Operating Temperature: -20° to 60°C.

K. Bend Radius: 1 inch.

L. #23AWG solid bare copper.

M. 75°C temperature rating of insulation (minimum).

N. DC Resistance: <9.38Ω/100m.

O. Mutual Capacitance: <330pF/100m.

2.03 UTP PATCH CORDS FOR EQUIPMENT ENCLOSURES

A. Manufacturer:

1. Lucent Technologies.
2. Panduit.

B. Provide Category 6 Modular Patch Cords as follows:

1. Power sum rated.
2. Patch cords shall not exceed 3 feet in length unless specifically required for application.
3. Conform to the requirements of EIA/TIA 568B Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and UL® LAN Certification and Follow-up Program.
4. Equipped with molded 8 pin modular connector (RJ45, 8x8) on each end and conform to the length(s) specified on the detailed drawing.
5. Round, and 24-AWG copper, stranded conductors, tightly twisted into individual pairs.
6. Built-in exclusion features to prevent accidental polarity reversals and split pairs.

C. UL® Verified for EIA/TIA 568B Electrical Performance

D. UL® and c (UL®) Listed for Fire Safety

E. ISO 9001 Certified Manufacturer

F. Austel Approved

G. FCC Compliant

2.04 DATA OUTLET – FRONT OF PANEL

A. Manufacturer:

1. Grace Port.
2. Hubbel.
3. Automation Direct Zipport Series.
4. Or equal.

B. Features:

1. NEMA Rating to match panel.
2. Flush Mount.
3. Polycarbonate hinged cover.
4. GFI outlet wired to convenience outlets in panel.
5. RJ-45 style plug for connection to PCN.
6. Include padlock provision.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

END OF SECTION

SECTION 40 67 15
CONTROL PANELS

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes panel and enclosure requirements for Process Instrumentation and Control Equipment.

1.02 ABBREVIATIONS AND REFERENCES

A. ISA: Instrument Society of America

B. NEC: National Electrical Code

C. NEIS: National Electrical Installation Standards

D. NEMA: National Electrical Manufacturers Association

E. NFPA: National Fire Protection Agency

F. NRTL: Nationally Recognized Testing Laboratory

G. OSHA: Occupational Safety and Health Administration

H. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for panels and enclosures specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for panels and enclosures specified.
2. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing panels and enclosures of types and materials indicated that have record of successful in-service performance.

B. Enclosures and components contained within the enclosure provided under this Section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing

Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. Field Inspection – see Section 40 61 21.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels and enclosures to their final locations in protective wrappings, containers, and other protection that will exclude dirt, moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards, and is ready for immediate installation.

B. Store panels and enclosures in clean, dry location.

1.06 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below packaged with protective covering for storage, dated and identified with labels describing contents.

a. Provide minimum of 5 or 10%, whichever is greater, of each type fuse used on project.
b. Provide minimum of 5 or 10%, whichever is greater, of each type relay used on project.
c. Provide minimum of 5 or 10%, whichever is greater, of each type pilot light replacement bulb used on project.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Hoffman.

B. Saginaw.

C. Hammond.

D. Rittal.

2.02 GENERAL REQUIREMENTS

A. Panels shall be constructed using factory-fabricated enclosures.

B. Follow PLC manufacturer’s written installation requirements for layout of PLC-specific panels.

C. Provide a minimum of 25% free back panel space for future expansion unhindered by current devices, wiring, etc.

D. Provide a minimum of 25% free terminal blocks of each type used in each panel. This is in additional to planned spare wiring terminations. Spares shall be shown on panel drawings.

E. Install instruments and devices, plumb, and wire panels at panel shop or other facility prior to

shipment to job-site.

F. Standard Signal Interfaces:

1. Unless otherwise specified, discrete input and output signals shall conform to the following:

a. Isolated non-powered (dry) contact closure.
b. Dry contacts shall be powered from panel or device receiving signal.
c. PLC based outputs shall be provided with an interposing relay when any of the following conditions apply:

1) When driving solenoids.
2) Potential in-rush current exceeds 75% of rated capacity of the I/O Module.
3) The current requirement of the driven device is insufficient to fully engage the output module consistently.
4) The voltage required to drive the output is incompatible with the output module.

2. Unless otherwise specified, analog input and output signals shall conform to the following:

a. 4-20 mAdc.
b. For 2-wire, loop-powered transmitters, provide regulated, fused, and isolated 24Vdc power supply at panel for driving of devices. Size power supply for 30% minimum spare capacity minimum.
c. Where isolation is required for interfacing with particular equipment supplied, provide necessary I/I converters. Provide I/I converters where impedance capabilities of new or existing signal transmitter will be exceeded by addition of PLC input.

G. Wiring:

1. In addition to Division 26, NEC and NEMA requirements, wiring shall conform to following:

a. Power: 12 AWG stranded minimum, type MTW, 600V.
b. Control: 16 AWG stranded minimum, type MTW, 300V.
c. Analog Signal: Twisted pair, 18 AWG, Beldon 8760 or equal.

2. Wire color code:

a. AC neutral conductor: White.
b. AC hot conductor: Black.
c. Grounding conductor: Green.
d. AC control conductor, powered from within panel: Red.
e. AC control conductor, powered from remote source: Orange.
f. DC (+) power conductor, discrete signal: Blue.
g. DC (-) power conductor, discrete signal: Blue with white stripe.
h. DC control conductor, discrete signal: Blue.
i. Twisted pair cable (+) signal conductor, analog signal: White.
j. Twisted pair cable (-) signal conductor, analog signal: Black.

3. Design control panels to keep 120Vac power and discrete signals, and analog and other low voltage signals separated.

a. Do not run 120Vac power and discrete signals, or analog or other low voltage signals in the same conduit or wire-duct.
b. Where 120Vac power and discrete signals, or analog or other low voltage signals must cross, they shall do so at right angles.

4. Wiring Within Wire Duct:

    a. Wherever feasible plastic wire duct with cover shall be used for routing of wire within control panel.
    b. Size wire duct to be no more than 50% full.
    c. Maintain 2” clearance between wire duct and terminals.

5. Wiring outside of wire duct.

    a. Wiring outside of ducts shall be restrained by use of plastic wire-ties.
    b. Restrain wiring every six inches (minimum).
    c. Provide abrasion protection for wires passing through holes or across abrasive metal edges.
    d. Adhesive type wire fasteners shall not be used. Hard screw type shall be employed.

6. Each conductor or twisted pair cable shall be labeled near its termination point.
7. Color-coded multi-conductor cable or multi-pair cable shall be labeled on overall jacket near its point of fan-out. Each pair of a multi-pair cable, when not color-coded, shall be labeled at its termination point in addition to the overall jacket.
8. Labels shall be machine-printed wrap-around types with tag visible from front without removal of wire from termination.

H. Terminations:

1. Wiring within control panel shall be continuous and terminated only at terminal blocks or equipment terminals. Splices or butt connectors shall not be used within panel.
2. No more than two wires shall be terminated at any one terminal.
3. Make external connections by way of numbered terminal blocks on numbered terminal strips.
4. When signals are powered from remote location, switched terminal blocks shall be used where conductors enter or leave panel.
5. When signals are powered from within panel, fused terminal blocks shall be used where conductors enter or leave panel.
6. Provide integral bussing system on terminal block array where more than two terminations require common source or drain connection. Jumpered terminations shall not be acceptable.
7. Provide knife disconnect-type terminal blocks with test sockets for all analog loops.
8. Include provisions for grounding of shields on shielded twisted pair cables entering or leaving panel. Cable shields shall be grounded at terminal block end only. Shields shall run entire length of cable within panels. Running of twisted pairs without shields within panels is not permissible.
9. Provide separate terminal strips for each of the following types of signals.

    a. 120Vac power circuits.
    b. 120Vac discrete signals.
    c. 12Vdc, 24Vdc or 48Vdc discrete signals.
    d. Analog signals.
    e. Serial or parallel digital communication signals.

I. Power Distribution:

1. Provide circuit breaker on power supply entering panel.
2. Provide single-phase surge suppression/line conditioner, sized for total panel loadings (Benden, Isotrol) between circuit breaker and 120Vac power distribution block.
3. Provide monitoring relay on incoming power supply to indicate presence of utility power to the PLC. Utility Power, UPS Status, and Surge Protection Device (SPD) status shall be continuously monitored by SCADA system.
4. Provide separately fused power supply to each major panel component.

5. Additional panel requirements.

    a. Provide separately fused power circuits for panel powered devices entering panel from field. Provide separate circuit for each device. Devices may be 5-Amp fused terminal blocks.

        1) Solenoid actuated valves
        2) Loop powered transmitters
        3) 120Vac switched cord and receptacles
        4) Relays

    b. Include digital transient surge suppressor/varistor installed in parallel with output contact at terminal strip for each PLC output signal driving an inductive load including:

        1) Relays.
        2) Solenoids.
        3) Motor starters.
        4) Motors.

J. Labels and Nameplates:

1. Panel Designation:

    a. Engraved with Engineer's tag number and description shown on the Drawings and in Specifications.
    b. Laminated white plastic with ½-in. high black characters.
    c. Fastened with stainless steel screws.

2. Front of panel mounted devices.

    a. Provide nameplate for each front of panel device with descriptive phrase using nomenclature as listed on Drawings and in Specifications.
    b. Laminated white plastic with 3/16-in. high black characters.
    c. Fastened with stainless steel screws.

3. Rear of panel mounted devices.

    a. Provide nametag for each rear of panel device with labels used on panel drawings.
    b. Thermo-embossed or laser printed with 1/8-in. high black characters on clear or white background or laminated white plastic with 3/16-in. high black characters.
    c. Self-adhesive backing.
    d. Clean area with mineral spirits prior to affixing labels

K. Panel Finish:

1. Remove mill scale, grease, and oil.
2. Primer thickness shall be 0.8 mil., minimum.
3. Finish coat shall be two-part epoxy or baked dry powder, 3-mil., minimum dry film thickness.
4. Color: Standard manufacturer's finish.

L. Conveniences:

1. Freestanding and floor mounted control panels shall be provided with door-activated, internal fluorescent panel lighting units.

    a. One unit shall be provided for every 3 feet of panel width and shall be mounted on the

inside, top of the panel.
b. Lighting shall be consistent for entire project.

2. Freestanding and floor mounted control panels shall be provided with 120Vac, service outlet circuits within the back-of-panel area. The circuits shall be provided with three-wire, 120Vac, 15-ampere duplex GFCI receptacles, one for every 3 feet of panel width and spaced evenly along the back-of-panel area. GFCI receptacles shall not be used for supplying power to UPS.
3. UPS receptacle – Provide simplex non-GFCI receptacle for plug in of UPS where applicable. Receptacle shall be labeled “120VAC FOR UPS ONLY”.

2.03 PANEL CONSTRUCTION – INDOOR AND OUTDOOR ENCLOSURES

A. Indoor and outdoor enclosures shall conform to NEMA requirements as follows:

1. NEMA 4X type 316 stainless steel for outdoor enclosures or indoor enclosures in wet and/or corrosive environment;
2. NEMA 12 for indoor enclosures not in classified or corrosive environments.

B. In addition to NEMA standards, conform to the following requirements:

1. Minimum metal thickness: 14 Ga.
2. Indoor enclosures: equip with rubber-gasketed doors with continuous metal hinges. Equip doors with 3-point lockable latches.
3. Outdoor enclosures: equip with hinged dead-front inner doors and rubber-gasketed, continuous metal hinged outer weather doors. Equip weather doors with toggle style door clamps.
4. Equip outdoor enclosures with thermostatically controlled heaters capable of maintaining internal panel temperature of 50°F with 20mph wind at ambient temperature of -20°F. Heater shall operate at 120Vac, 60Hz power.
5. NEMA 4X enclosures shall be furnished with door gaskets.
6. Size to adequately dissipate heat generated by equipment mounted in or on panel.

C. Prior to final fabrication of panels, verify layout of front-of-panel devices with respect to rear-of-panel devices. Maintain minimum of 3 inches clearance between door and sub-panel mounted devices.

2.04 BIOSOLIDS DRYING BUILDING CONTROL PANEL – 60-LCP-11-2

A. Existing Panel

B. PLC I/O signals

1. Provide in accordance with Section 40 61 93.

2.05 POLYMER TANK TRUCK FILL CONTROL PANEL – 90-LCP-8-12

A. Panel

1. Indoor Enclosure.
2. NEMA 4X Stainless Steel.
3. Wall mount – Single Door.
4. Dimensions (Nominal): 16”H x 12”W x 8”D
5. Loop-powered components.

B. Panel Mounted Devices

1. Tank Full pilot light.
2. Silence Horn pushbutton.
3. Process Indicator, displaying tank level in gallons.
4. Panel Annunciator (mounted to underside of panel).

2.06 POLYMER SYSTEM CONTROL PANEL – 90-LCP-8-15

A. Panel

1. Indoor Enclosure.
2. NEMA 12.
3. Free Standing – Single Door.
4. Dimensions (Nominal): 72”H x 36”W x 18”D
5. 120Vac Power Supply.

B. Front of Panel Mounted Devices

1. Data Outlet.
2. Power Light.
3. PanelView OIU.

C. Rear of Panel Mounted Devices

1. CompactLogix PLC.
2. Ethernet Switch
3. Line Filter/Surge Protector.
4. 24Vdc Power Supplies.
5. Relays and Timers (as required).
6. Circuit breakers and fuses as required.
7. Cooling fan with thermostat.

D. PLC I/O signals

1. Provide in accordance with Section 40 61 93.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer’s written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

B. Coordinate housecleaning pad dimensions with enclosure dimensions.

C. Install control panels in locations indicated on Drawings and in accordance with manufacturer’s written instructions and approved submittals.

D. Touch-up panel finish if marred during installation using manufacturer’s paint matching enclosure.

E. Each Panel shall have (3) sets of “as built” final circuit Drawings.

F. Field installation and wiring of panel components shall be in accordance with approved submittals, manufacturer’s recommendations, and any applicable federal, state, and local codes.

G. Perform field test of PCS upon completion of installation, wiring and field inspection.

H. Field testing shall conform to Section 40 61 21.

3.02 IDENTIFICATION

A. Engrave Engineer tag number as listed in Specifications and on Drawings.

END OF SECTION

SECTION 40 67 63
CONTROL PANEL-MOUNTED UNINTERRUPTIBLE POWER SUPPLY

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes UPS equipment.

C. Site Conditions:

1. Input power: 120Vac utility grade.

1.02 ABBREVIATIONS AND REFERENCES

A. NEC: National Electrical Code

B. NEIS: National Electrical Installation Standards

C. PLC: Programmable Logic Controller

D. UL: Underwriters Laboratories

E. UPS: Uninterruptible Power Supply

1.03 SUBMITTALS

A. General:

1. Tabulated listing of all device and equipment power loads connected to UPS for each installation. This shall be used to identify UPS sizing requirements together with requirements listed below.
2. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
3. Submit Product Data and Shop Drawings in one complete submittal package.
4. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for equipment specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for equipment specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test for equipment in service.
3. Manufacturer's written instructions for periodic battery replacement for equipment in service.
4. Submit in accordance with Section 01 78 23.

PART 2 – PRODUCTS

2.01 UNINTERRUPTIBLE POWER SUPPLY

A. Manufacturer:

1. Alpha
2. Emerson
3. ABB

B. Features:

1. UPS shall supply power to PLC, OIU, Ethernet Switches, DC power supplies, field instruments, and other low voltage control devices as specified and as shown on Drawings and Plans.
2. Size UPS at 125% of connected electrical load (minimum).
3. Minimum UPS size shall be 750VA.
4. Tower form factor shall be used unless stated otherwise on Drawings or Specifications.
5. Provide true on-line non switching uninterruptible power supply (UPS).
6. Double power conversion on-line operation including rectifier and inverter, constantly conditioned AC output.
7. UL Listed.
8. Provide bypass contactor or other means to automatically bypass UPS allowing operation of system controls in event of UPS failure. Device contacts shall be rated for inductive loads and shall meet or exceed current protection of circuit.
9. Each system shall consist of a static dc to ac sine wave inverter, a battery charger, sealed batteries, a monitor and transfer switch, and accessories as listed below.
10. Each system shall operate on a 120-volt, 60-Hz ac branch circuit. The input ac circuit shall supply energy to the battery charger which shall supply energy to the inverter as well as to the battery to maintain its charge. The output of the inverter shall supply energy to the load. If the input ac circuit is interrupted, the inverter shall continue to supply energy to the load without interruption, drawing power from the battery. If the input ac circuit is restored prior to discharge of the battery, the charger shall resume the supply of energy to the inverter and shall restore the battery to full charge. In the event of malfunction of the battery charger, battery or inverter that results in interruption of the output from the inverter, the monitor shall detect this condition and shall automatically transfer the load to the system's ac input circuit within 25 milliseconds. After the malfunction is corrected, the load shall be retransferred to the inverter manually.
11. System output voltage shall be regulated within plus or minus 5 percent of 120 volts and frequency stability shall be plus or minus 1/2 percent of 60-Hz. The output characteristic shall be sinusoidal with not more than 5 percent total harmonic distortion at full load with input ac circuit at 120 volts. For a 20 percent instantaneous load change, voltage overshoot or undershoot shall be not more than plus or minus 10 percent. For a 10 to 90 percent load change, recovery time shall be not longer than 100 milliseconds.
12. Input protection shall be provided by a panel-mount circuit breaker. Each inverter shall be the load current-limiting type and each shall have overload and short circuit protection provided by a circuit breaker. Efficiency shall be 75 percent for the inverter and 85 percent for the battery charger minimum.
13. UPS shall have enough capacity to power connected devices for a period of 15 minutes after the utility power has failed. Provide with extended battery module(s) to meet this requirement. Additional batteries shall be contained within panel enclosure unless approved by Owner and Engineer.
14. UPS shall include dry contact status signal outputs including as minimum: low battery, equipment malfunction/failure.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Condition power as required to provide stable Process Control System.

B. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

END OF SECTION

SECTION 40 70 00
INSTRUMENTATION OF PROCESS SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13 – Process Instrumentation and Control.

B. Section includes instrumentation and initial parameters.

1.02 ABBREVIATIONS AND REFERENCES

A. NEC: National Electrical Code

B. NEIS: National Electrical Installation Standards

C. NEMA: National Electrical Manufacturers Association

1.03 DEFINITIONS

A. The Rating column of instrument tables refers to the NEC hazardous environment rating the device is to be installed in.

1. CID1 – Class I Division 1 Group D
2. CID2 – Class I Division 2 Group D
3. CIID1 – Class II Division 1 Group G
4. CIID2 – Class II Division 2 Group G
5. NR – Not Rated

1.04 SUBMITTALS

A. Provide submittals under the specification section that is referenced for each instrument/device/equipment listed below.

B. Submittals are not required for Section 40 70 00.

C. Provide devices/instrumentation/equipment as listed below and as shown on Drawings:

PART 2 – PRODUCTS

2.01 (F4) MAGNETIC FLOW ELEMENT AND TRANSMITTER (Ref. Section 40 71 00)

Tag	Description	Service	Pipe Dia. (in)	Range (gpm)	Rating
FE-8-9-1/FIT-8-9-1	Polymer Feed Pump 1	Polymer	1-1/2	0-60	NR
FE-8-9-2/FIT-8-9-2	Polymer Feed Pump 2	Polymer	1-1/2	0-60	NR
FE-8-9-3/FIT-8-9-3	Polymer Feed Pump 3	Polymer	1-1/2	0-60	NR
FE-8-9-4/FIT-8-9-4	Polymer Feed Pump 4	Polymer	1-1/2	0-60	NR

2.02 (F44) VARIABLE AREA FLOWMETER (Ref. Section 40 71 00)

Tag	Description	Pipe Dia. (in)	Range (gpm)	Rating
FI-8-10-1	Polymer Dilution Water 1 Flow	2	0-60	NR
FI-8-10-2	Polymer Dilution Water 2 Flow	2	0-60	NR
FI-8-10-3	Polymer Dilution Water 3 Flow	2	0-60	NR
FI-8-10-4	Polymer Dilution Water 4 Flow	2	0-60	NR

2.03 (L8) VERTICAL FLOAT LEVEL SWITCH (Ref. Section 40 72 00)

Tag	Location	Setting (Elev)	Rating
LSH-8-14	Polymer Storage Containment Flood	2” Sump Depth	NR

2.04 (L19) LEVEL ELEMENT AND TRANSMITTER, MICROWAVE RADAR (Ref. Section 40 72 00)

Tag	Location	Mount	Range (ft)	Rating
LT-8-12-1	Liquid Polymer Tank	Flange	0-12	NR
LT-8-16-1	Polymer Aging Tank 1	Ceiling	0-6	NR
LT-8-16-2	Polymer Aging Tank 2	Ceiling	0-6	NR
LT-8-16-3	Polymer Aging Tank 3	Ceiling	0-6	NR
LT-8-16-4	Polymer Aging Tank 4	Ceiling	0-6	NR

2.05 (P8) PRESSURE SWITCH WITH LOCAL ELECTRONIC DISPLAY (Ref. Section 40 73 00)

Tag	Location	Seal Type	Settings	Rating
PISH-8-9-1	Polymer Feed Pump 1 Discharge	Diaphragm	High Set: 60 PSI Deadband: 10 PSI	NR
PISH-8-9-2	Polymer Feed Pump 2 Discharge	Diaphragm	High Set: 60 PSI Deadband: 10 PSI	NR
PISH-8-9-3	Polymer Feed Pump 3 Discharge	Diaphragm	High Set: 60 PSI Deadband: 10 PSI	NR
PISH-8-9-4	Polymer Feed Pump 4 Discharge	Diaphragm	High Set: 60 PSI Deadband: 10 PSI	NR
PISH-8-13-1	Liquid Polymer Circulation Pump Discharge	Diaphragm	High Set: 30 PSI Deadband: 5 PSI	NR

2.06 (T3) TEMPERATURE TRANSMITTER, UNIVERSAL (Ref. Section 40 74 00)

Tag	Description	Sensor	Range (°F)	Rating
TIT-8-9-1	Polymer Feed Pump 1 Stator	TE-8-9-1	40-300	NR
TIT-8-9-2	Polymer Feed Pump 2 Stator	TE-8-9-2	40-300	NR
TIT-8-9-3	Polymer Feed Pump 3 Stator	TE-8-9-3	40-300	NR
TIT-8-9-4	Polymer Feed Pump 4 Stator	TE-8-9-4	40-300	NR
TIT-8-13-1	Liquid Polymer Circulation Pump Stator	TE-8-13-1	40-300	NR

2.07 (T4) TEMPERATURE ELEMENT, RTD (Ref. Section 40 74 00)

Tag	Location	Range (°F)	Rating
TE/TIT-8-11	Truck Bay Ambient Temperature	-20-120	NR

2.08 (AG10) GAS DETECTION SYSTEM (Ref. Section 40 76 00)

Tag	Location	Transmitter	Gas Sensed	Rating
AE-11-24-1-1	Cake Handling Room	AIT-11-24-1	Combustible (Methane)	NR
AE-11-24-1-2	Cake Handling Room		Hydrogen Sulfide	NR
AE-11-24-2-1	Dryer Exhaust	AIT-11-24-2	Carbon Monoxide	NR
AE-11-24-2-2	Product Screening	AIT-11-24-3	Carbon Monoxide	CIID2
AE-11-24-2-3	Heat Exchanger		Carbon Monoxide	CIID2
AE-11-24-2-4	Heater Room	AIT-11-24-4	Carbon Monoxide	NR

Tag	Description	Connected Sensors	Rating
ASH-11-24	Drying Building Gas Controller	6	NR

2.09 CONTROL STATIONS (Ref. Section 40 78 00)

A. Mount operators in common control station enclosures with specified rating in accordance with room classification shown on Drawings and listed in table below:

Tag	Equipment	Devices	Rating
CS-8-9-1	Polymer Feed Pump 1	(1) 3-Pos. Switch for Hand/Off/Auto	NR
CS-8-9-2	Polymer Feed Pump 2	(1) 3-Pos. Switch for Hand/Off/Auto	NR
CS-8-9-3	Polymer Feed Pump 3	(1) 3-Pos. Switch for Hand/Off/Auto	NR
CS-8-9-4	Polymer Feed Pump 4	(1) 3-Pos. Switch for Hand/Off/Auto	NR
HS-11-25	Biosolids Drying Building	(1) Pushbutton for Horn Silence	NR

2.10 (M31) INTERIOR/EXTERIOR MOUNTED ALARM LIGHT (Ref. Section 40 79 00)

Tag	Location	Color	Rating
YL-11-25-1-1	Cake Handling Room East Entrance	Amber	NR
YL-11-25-1-2	Dryer Room North Entrance	Amber	NR
YL-11-25-1-3	Dryer Room East Entrance	Amber	NR
YL-11-25-1-4	Dryer Room West Entrance	Amber	CIID2
YL-11-25-1-5	Cake Handling Room Interior	Amber	NR
YL-11-25-1-6	Dryer Room Interior	Amber	CIID2
YL-11-25-1-7	Heater Room Interior	Amber	NR
YL-11-25-2-1	Cake Handling Room East Entrance	Red	NR
YL-11-25-2-2	Dryer Room North Entrance	Red	NR
YL-11-25-2-3	Dryer Room East Entrance	Red	NR
YL-11-25-2-4	Dryer Room West Entrance	Red	CIID2
YL-11-25-2-5	Cake Handling Room Interior	Red	NR
YL-11-25-2-6	Dryer Room Interior	Red	CIID2
YL-11-25-2-7	Heater Room Interior	Red	NR

2.11 (M34) INTERIOR/EXTERIOR MOUNTED ALARM HORN (Ref. Section 40 79 00)

Tag	Location	Rating
YA-11-25	Drying Building	NR

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

END OF SECTION

SECTION 40 71 00
FLOW MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field flow elements, sensors, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. NEC: National Electrical Code

B. NEIS: National Electrical Installation Standards

C. NEMA: National Electrical Manufacturers Association

D. NIST: National Institute of Standards and Technology

E. NRTL: Nationally Recognized Testing Laboratory

F. OSHA: Occupational Safety and Health Administration

G. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation

and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification section 40 70 00.

PART 2 – PRODUCTS

2.01 (F4) MAGNETIC FLOW ELEMENT AND TRANSMITTER

A. Manufacturer:

1. Krohne Optiflux
2. No Substitute Permitted

B. Design is based on startup average velocity of 3 ft/sec through meter. Meters requiring greater velocities to meet specified accuracy and proper performance are not acceptable.

C. Flowmeter system accuracy shall be ±0.25% of flow rate over 10:1 turndown minimum. Repeatability shall be ±0.1% and response time programmable from 1 sec to 100 sec.

D. Meters shall be furnished with NIST certification of calibration.

E. Flow Element:

1. Low frequency, electromagnetic induction type producing dc pulse signal directly proportional and linear to liquid flow rate.
2. Splashproof and weather-resistant NEMA 6P design housing (when provided with remote transmitter). Watertight external and internal electrical conduit connections.
3. Provide power from signal converter.
4. Provide power from signal converter.
5. Unless otherwise specified, materials of construction shall be:

a. Flow meter liner: Polypropylene or PFA/PTFE.
b. Electrode materials: Hastalloy C.
c. Electrode type: Bullet nose.
d. Grounding rings: 316 Stainless Steel.

6. Use grounding rings or gaskets on each end of magnetic flow meter to provide ground path and prevent interference with flow signal. Probes are not acceptable.
7. Sensing head interchangeable with meter body of same manufacturer without performing

flow recalibration.
8. High impedance device of not less than 1012 ohms to minimize span shift due to electrode coating.
9. Laying length of meters shall be minimum of 1-1/2 times nominal meter size.

F. Transmitter:

1. Integrally mounted and shown on Drawings and Plans, microprocessor controlled.
2. Operate on 120Vac, 60 Hz power.
3. Provide pulsed dc voltage to magnet coils of magnetic flow meter to establish magnetic field.
4. Convert flow signal from magnetic flow meter to analog and digital output signals, for bidirectional flow.
5. Span to be continuously adjustable between 2 and 31 ft/sec. Adjustment shall be by keypad.
6. Display shall have 2 rows of 16 alpha numeric characters minimum. Top row shall indicate instantaneous flow rate in direct engineering units, field selectable.
7. Converter interchangeable with magnetic flow meter of same manufacturer and requires no additional flow calibration adjustment.
8. 4-20 mAdc analog current output into 0 to 900 ohm load and 24Vdc scaled, pulse output software adjustable.
9. Locate flow rate indicator within each converter. Indicator shall display flow rate in engineering units as listed in Section 40 70 00.
10. House in cast aluminum enclosure to meet NEMA 4X requirements.
11. Noise reduction feature to minimize effects of noise generating processes.
12. Automatic empty pipe detection.
13. Suitable for -5°F to +140°F ambient temperature (-40°F to +140°F for outdoor applications).
14. Provide thermostatically controlled condensate heater to allow use in condensate environments.

G. Cable:

1. Provide sufficient standard length of manufacturer's signal cable connecting meter and converter without splice.

2.02 (F44) VARIABLE AREA FLOWMETER

A. Manufacturer:

1. ABB FGM
2. Brooks Instrument
3. Omega
4. King Instruments

B. Glass tube style with position of the float in the conical meter tube is a measure of the flow-rate.

C. Stainless steel fittings and protection shield.

D. 250mm scale length minimum.

E. Mounting position shall accommodate scale reading without difficulty.

F. Flow rate: As noted in Section 40 70 00.

G. Process pipe size: As noted in Section 40 70 00.

H. Process connection: Threaded pipe with throttling valve for flow control.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Engrave with Engineer tag number and title/description as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 72 00
LEVEL MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field level elements, sensors, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. NEC: National Electrical Code

B. NEIS: National Electrical Installation Standards

C. NEMA: National Electrical Manufacturers Association

D. NRTL: Nationally Recognized Testing Laboratory

E. OSHA: Occupational Safety and Health Administration

F. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 (L9) VERTICAL FLOAT LEVEL SWITCH

A. Manufacturer:

1. Contegra FS 202.
2. Or Equal

B. Stem: PBT.

C. Float: Buna-N.

D. Retention clip: PVDF (Kynar).

E. When located in Class I, Divisions 1 or 2 hazardous (classified) locations, provide intrinsically safe relay in corresponding control panel.

F. Mounting shall be in accordance with manufacturer’s recommendations.

G. Switch: Magnetically actuated, hermetically sealed, snap action reed switch for low potential, low current, dry circuit applications.

2.02 (L19) MICROWAVE RADAR LEVEL ELEMENT AND TRANSMITTER

A. Manufacturers:

1. VEGA
2. No Substitute Permitted

B. Antenna:

1. Design transducer to emit radar signal with time lapse between transmitted and received signal converted into usable voltage capable of driving totalizer, sample rate counter, and flow rate meter or liquid level indicator. DC voltage produced shall be proportional to distance from detector to material being measured.
2. Operating temperatures: -40°F to +392°F.
3. Impervious to damage from submersion in wastewater or concentrated ferric chloride or

alum, and have high resistance to corrosive and gaseous industrial atmosphere.

4. Mounting shall be as shown on Drawings and identified in the table in Section 40 70 00. Other methods of mounting will be considered if recommended by detector manufacturer.

    a. Ceiling mounted units shall be provided with manufacturer's standard mounting strap.
    b. Flange mounted units shall be provided with a 3" collar flange.

5. Non-contact design detector with no moving parts or mechanical linkages.

C. Transmitter:

1. Provide integral with monitoring unit.
2. Linear, isolated 4-20 mAdc HART, signal for remote indication from each monitoring unit.
3. Enclosure: NEMA 4X for exterior application or wet locations.
4. Temperature:

    a. Ambient: -40°F to 176°F.
    b. Process: -40°F to 266°F.

5. Loop Power: 24VDC

D. Design Requirements:

1. Accuracy of system: +1% of full scale at any point in calibrated range.
2. Based on Drawings, installation details, and Section 40 70 00, radar manufacturer shall select radar equipment; type of antenna, horn diameter and coordinate antenna length, or extensions required, with Contractor for each monitoring location.
3. Radar shall be configured and programmed by manufacturer's representative on-site.
4. Radar manufacturer shall determine and coordinate flanged pipe sizes required at each location.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Engrave with Engineer tag number and title/description as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 73 00
PRESSURE, STRAIN, AND FORCE MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field pressure elements, sensors, switches, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. FM: Factory Mutual

B. NEC: National Electrical Code

C. NEIS: National Electrical Installation Standards

D. NEMA: National Electrical Manufacturers Association

E. NRTL: Nationally Recognized Testing Laboratory

F. OSHA: Occupational Safety and Health Administration

G. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation

and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 (P7) PRESSURE SEAL, DIAPHRAGM

A. Manufacturer:

1. Ashcroft Type 101.
2. Ametek, Mansfield and Green Division, Type SG.

B. Lower Housing Material: Unless otherwise noted, type 316 Stainless Steel with flushing connections.

C. Diaphragm Material: Unless otherwise noted, type 316 Stainless Steel.

D. Upper Housing Material: Steel with bleed screw.

E. Connections: Threaded Female NPT.

F. Filling Fluid: Silicone (Temperature Range: -40° to 600°F).

G. Volumetric displacement of the seal must be greater than the attached instrument.

H. Unit shall be pressure-sensing suitable for measuring dirty or corrosive fluids.

I. Unit shall be arranged and designed to directly transmit the process pressure by means of the fluid through an opening in the lower housing to a pressure-sensing device attached and sealed to the upper housing by a drilled and threaded boss.

J. Seal shall be suitable for fluid pressures to 500 psig.

K. Unit shall have fill connections and other features required permitting refill of the seal volume and calibration of unit in the field.

L. Unit shall be suitable of for temperature of media monitored.

2.02 (P8) PRESSURE SWITCH WITH LOCAL ELECTRONIC DISPLAY

A. Manufacturer:

1. United Electric One Series.
2. No Substitute Permitted.

B. Gage Pressure set point as noted in Section 40 70 00.

C. Adjustable set point pressure, and adjustable deadband by keypad.

D. Accuracy: 0.5% of full range span, at room temperature.

E. Set Point Repeatability: 1% of full range span.

F. Ambient Operation: -40° to +185°F.

G. Power: 7.8-50Vdc or 70-240Vac depending on PLC discrete input voltage. Contractor shall coordinate switch selection based upon PLC discrete input module voltage.

H. Programming and data backup by non-volatile FRAM.

I. 4-digit x 0.5” backlit LCD display.

J. 316L stainless steel wetted parts.

K. Process connection: ½ inch NPT.

L. Housing: NEMA 4X/IP66 epoxy-coated aluminum alloy, with tempered glass window.

M. When wired in series with interposing relays, the relay coil specifications must not exceed the maximum switch rating of 0.1 amperes (de-rate at 0.001 amperes per °C above 25°C).

N. Accessories:

1. Include isolation valve to isolate from process when being serviced.
2. When noted in Section 40 70 00, provide with diaphragm seal as specified in this Section.

O. Hazardous Locations:

1. When located in a hazardous environment, switch shall be FM Explosion-proof.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer’s written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Engrave with Engineer tag number and title/description as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 74 00
TEMPERATURE MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes thermal field elements, sensors, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. NEC: National Electrical Code

B. NEIS: National Electrical Installation Standards

C. NEMA: National Electrical Manufacturers Association

D. NRTL: Nationally Recognized Testing Laboratory

E. OSHA: Occupational Safety and Health Administration

F. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this Section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 (T3) TEMPERATURE TRANSMITTER, UNIVERSAL

A. Manufacturers

1. Rosemount 3144P
2. Endress+Hauser iTEMP
3. PR Electronics 7501

B. Transmitter capable of accepting RTD, T/C, mV, and ohm sensor inputs to produce analog current signal as a function of process temperature.

C. Transmitter head only, for use with temperature elements specified elsewhere – see table in Section 40 70 00.

D. Transmitter

1. Transmitter Type:

a. NEMA 4X Enclosure.
b. Materials: Low-copper aluminum alloy.
c. Flat Cover type with threaded cover.
d. Loop powered, 2-wire.
e. Electrical: 3/4 inch NPT connection, unless noted otherwise.
f. Locate within connection head.

2. Performance:

a. Ambient Temp: -20°F to +120°F. Variations shall not affect accuracy by more than plus or minus 0.25 percent of range per 50°F.
b. Accuracy: Plus or minus 0.25 percent of reading, or, plus or minus 0.25°F, whichever is greater. Conform to SAMA Standard RC 21-4-1966.
c. Repeatability: Plus or minus 0.1 percent of span.
d. Response Time: Less than 10 seconds (bare bulb test in agitated water).

2.02 (T4) TEMPERATURE ELEMENT AND TRANSMITTER – RESISTANCE

A. Indoor or outdoor ambient sensing application with housing for wall mount.

B. Manufacturers:

1. Durable Controls (Krohne)
2. No Substitute Permitted

C. Temperature Element:

1. Element Type:

a. Single-element, three-wire, RTD.
b. Platinum, 100 ohm nominal resistance at 0°C.

2. Performance:

a. Accuracy: Plus or minus 0.25 percent of reading, or, plus or minus 0.25 degrees F, whichever is greater. Conform to SAMA Standard RC 21-4-1966.
b. Repeatability: Plus or minus 0.1 percent of span.
c. Response Time: Less than 10 seconds (bare bulb test in agitated water).

D. Transmitter

1. Transmitter Type:

a. Loop powered, 2-wire.
b. Locate within connection head

2. Enclosure:

a. Integrity: IP68
b. Mounting: Wall

3. Performance:

a. Ambient Temp: -30°F to +120°F. Variations shall not affect accuracy by more than plus or minus 0.25 percent of range per 50°F.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Engrave with Engineer tag number and title/description as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 76 00
PROCESS GAS ANALYTICAL MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field mounted sensors and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electrical Code

G. NEIS: National Electrical Installation Standards

H. NRTL: Nationally Recognized Testing Laboratory

I. OSHA: Occupational Safety and Health Administration

J. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. Single Source Responsibility: Obtain instrumentation and controls from single manufacturer with responsibility for entire instrumentation analysis system.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 (AG10) GAS DETECTION SYSTEM (COMB, H2S, CO)

A. Manufacturer:

1. MSA
2. No Substitutes Permitted

B. Provide controllers, transmitters, and sensor types and quantities as listed in Section 40 70 00.

C. General requirements:

1. The Gas Detection system shall include sensors, sensor assemblies, transmitters, area controllers, and calibration kits. Gases to monitor are methane, hydrogen sulfide, and carbon monoxide.

D. Sensor specifications:

1. Gas sensors shall use High Performance infrared sensors for LEL and electrochemical cells for hydrogen sulfide and carbon monoxide. Sensors shall be programmed for a 0-100% LEL range on methane, 0-50 ppm on hydrogen sulfide, and 0-100 ppm on carbon monoxide. Housing shall include a flow baffle weather housing and water/dust barrier.
2. The LEL sensor shall transmit a signal to analyzer for control. The LEL sensor shall be a high performance IR sensor with a 12 year light source guarantee. It shall use open path technology that does not require routine calibration or maintenance and shall not require any consumable part. It shall not provide any false alarm and shall provide fault indication for all

failures. Housing shall be stainless steel and approved for hazardous environments.

3. Provide a remote LEL sensor with splashguard option with Tygon Tubing enabling the operator to introduce test gas from floor level.
4. The hydrogen sulfide sensor shall be smart thereby storing calibration data, sensor type, range and other variables. The sensor shall be factory calibrated and shall communicate its range and calibration gas to the transmitter automatically. Gas detector shall display sensor life bar graph after each calibration on the electrochemical cell. The sensor shall be replaceable while unit is under power.
5. The carbon monoxide sensor shall be smart thereby storing calibration data, sensor type, range and other variables. The sensor shall be factory calibrated and shall communicate its range and calibration gas to the transmitter automatically. Gas detector shall display sensor life bar graph after each calibration on the electrochemical cell. The sensor shall be replaceable while unit is under power.
6. The sensors shall be suitable for classified areas, Class I Division 1 and Class II, Division 2 as noted in table in Section 40 70 00.

E. Transmitter specifications:

1. Support for up to two sensors.
2. 4-20 mA outputs for each connected sensor.
3. Control settings to enable the Operator to calibrate the sensor.
4. Powered by 10-30VDC and takes less than 5 watts.
5. Ambient temperature -40 to +60 °C.
6. The transmitter shall be rated for Class I Div. 1 and Class II, Division 2 applications as noted in table in Section 40 70 00.

F. Controller specifications:

1. The controller shall have menus enabling the Operator to configure the outputs, set the alarms, reset the alarms, configure the backlight, set the password, view the history log, and force operation of the outputs.
2. The controller shall have minimum of 4 channels. It shall simultaneously display gas values at each sensor location, alarm functions and alarm status. Each channel shall have 4-20 mA output for each channel and 2 adjustable alarm levels with relay outputs for 5 amps or better. Relays shall be adjustable and used for high and fault conditions. Controller shall have menus enabling the operator to configure the outputs, set the alarms, reset the alarms, configure the backlight, set the password, view the history log, and force operation of the outputs.
3. Controller is powered by 85-256VAC 50/60 Hz and shall provide 24Vdc power to connected gas transmitters.
4. Ambient conditions include -10 to +50 °C at 95% humidity.

G. Provide a calibration test kit for each gas. Each kit shall have test gas for methane, hydrogen sulfide, and carbon monoxide, a flow regulator, carrying case and 5 feet of tubing. Provide a year's supply of each gas.

H. Non-Intrusive Calibration:

1. All sensor/transmitters can be calibrated without opening any enclosures.
2. Calibration of the sensor shall be so that only one person is required to complete calibration.
3. Successful calibration must be visually indicated via the LCD and / or HART hand held communicator.

I. Approvals:

1. The transmitter shall have the following performance approvals:

a. CSA 22.2 No. 152
b. FM 6310, 6320
c. ANSI/ ISA 92.0.01
d. IEC/EN 60079-29-1, EN 61779-4:2000 Toxic and Oxygen

2. Manufacturer shall be capable of supplying all equipment necessary to check or calibrate the sensor/transmitter.
3. The manufacturer must be capable of providing on-site service with factory trained personnel.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number and title/description as listed in Specifications and on Drawings.

3.03 SIGNAGE

A. Label (Sign) each alarm lamp location with a warning sign describing the alarm associated with the color of lamp, as depicted in the Drawings.

B. Sign shall be affixed to wall using stainless steel wall anchors and bolts and reside beneath alarm lamp.

C. Sign text shall be engraved on a red plastic laminate that is bonded to 0.110" thick aluminum backing.

D. Sign shall have rounded corners with 7/32" mounting holes.

E. Sign shall be of a color contrast and letter size such that it is readable from 50 feet.

F. Multiple alarm signage shall be consistent.

3.04 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 78 00
PANEL MOUNTED INSTRUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this Section shall conform to general requirements of Section 40 61 13.

B. Section includes control panel devices for Process Instrumentation and Control Systems.

1.02 ABBREVIATIONS AND REFERENCES

A. IEC: International Electrotechnical Commission

B. IEEE: Institute of Electrical and Electronics Engineers

C. NEC: National Electrical Code

D. NEIS: National Electrical Installation Standards

E. NEMA: National Electrical Manufacturers Association

F. NRTL: Nationally Recognized Testing Laboratory

G. OSHA: Occupational Safety and Health Administration

H. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
2. Submit Product Data and Shop Drawings in one complete submittal package.
3. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for devices specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for control devices specified.
2. Submit in accordance with Section 01 33 0.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Devices shall be latest and most modern design at time of bidding.

C. As much as possible devices shall be products of one manufacturer to achieve standardization for maintenance, spare parts, operation, and service.

PART 2 – PRODUCTS

2.01 PILOT DEVICES.

A. Manufacturer:

1. Allen Bradley 800T/800H.
2. Square D Class 9001, Type K.

B. Construction:

1. Heavy duty.
2. Watertight.
3. Oil-tight.
4. Flush panel mounting.
5. Size to mount in 30.5-mm diameter cutout.
6. Match NEMA rating of device with the installed location environmental classification.

C. Pushbuttons:

1. Flush head unless specified elsewhere.
2. Contact Blocks:

    a. Double break silver contacts.
    b. Ac Ratings: 7,200 va make, 720 va break.
    c. Single pole, single throw.
    d. Up to six tandem blocks.

3. Momentary contact unless specified elsewhere.
4. Non-illuminated.
5. Legend plates, as required, for type of operation or as specified elsewhere.

D. Selector Switches:

1. Maintained position unless specified elsewhere.
2. Contact Blocks:

    a. Double break silver contacts.
    b. Ac Ratings: 7,200va make, 720va break.
    c. Single pole, double throw or double pole, single throw.
    d. Up to six tandem blocks.

3. Operators:

    a. Number of positions as specified elsewhere.

b. Standard knob type unless specified elsewhere.

4. Legend plates as required for type of operation or specified elsewhere.

E. Pilot Lights:

1. LED Lamp.
2. Transformer type.
3. Bayonet, 6Vac bulb.
4. Colored lens as specified elsewhere.
5. Interchangeable lenses.
6. Transformer rated for 120Vac
7. Push to test.
8. Legend plates as specified elsewhere.

F. Control Stations.

1. Describes enclosures used to house pilot devices.
2. NEMA rating as follows:

a. NEMA 7 in Class I, Division 1 or 2 Hazardous (Classified) Locations.
b. NEMA 4X 316 Stainless Steel in indoor wet or corrosive locations or outdoors.
c. NEMA 12 in other areas.

3. Nameplates:

a. Engraved laminated plastic.
b. Letters 3/16 in. high.
c. Black letters on white background.
d. Identify per equipment controlled, using names found on Drawings.

2.02 MOTOR STARTER CONTROL RELAYS.

A. Manufacturer:

1. Square D 8501XMO40.
2. No Substitute Permitted.

B. Construction:

1. Industrial type.
2. 300Vac rated.
3. Ac operation.
4. Used for operation of large motor starter coils or other 120Vac loads whose current requirements (continuous or inrush) exceed capacity of control relays listed below.

C. Operating data:

1. Pickup time: 11 ms maximum.
2. Dropout time: 6 ms maximum.

D. Coil:

1. Molded construction.
2. 120Vac, 60Hz.

3. Continuous rated.
4. 155va inrush, maximum.
5. 22va sealed, maximum.

E. Contacts:

1. Double break.
2. Silver alloy.
3. Convertible.
4. Color-coded to indicate status.
5. 60 amp make, 6 amp break (120Vac inductive).

F. DIN rail-mounting capability.

G. Accessories:

1. Add-on pole attachment.

a. 4 NO and 4 NC contacts.
b. Add-on to 0 to 4-pole relay.

2. Latch attachment.

2.03 CONTROL RELAYS.

A. Manufacturer:

1. Square D 8501KPR12P14V20
2. No Substitute Permitted.

B. Operating Data:

1. Pickup Time: 13 ms maximum.
2. Dropout Time: 10 ms maximum.
3. Operating Temperature: -45°F to 150°F.

C. ac Coil:

1. 120Vac.
2. Continuous rated.
3. 3.5va inrush maximum.
4. 1.2va sealed, maximum.
5. 50-60 Hz.
6. Light to indicate energization.
7. Minimum Dropout Voltage: 10% of coil rated voltage.

D. dc Coil:

1. 24Vdc.
2. Continuous rated.
3. Light to indicate energization.
4. Minimum Coil Resistance:

a. 24Vdc: 450 Ω.

E. Contacts:

1. Gold flashed fine silver, gold diffused for 1 amp or less resistive load.
2. Silver cadmium oxide.
3. 3 form C.
4. 300Vac.
5. 10 amp make, 1.5 amp break, (inductive).

F. Rated at 10 million operations.

G. 11 pin, square socket.

H. DIN rail mountable.

I. Enclosed and protected by polycarbonate cover.

J. Visible indication of energized coil.

K. Provide relay-retaining clips.

2.04 TERMINAL BLOCKS

A. Manufacturer:

1. Square D 9080GP6
2. No Substitute Permitted

B. 300 v rating for 120 v circuits and below, 600 v rating for 480 v circuits.

C. Clamping screw type.

D. Isolating end caps for each terminal.

E. Identification on both terminals.

F. Clip-mounted on DIN rail.

G. Accepts AWG 12 to 22.

H. Feed-Through Terminals:

1. 20 Amp rating

I. Switched Terminals:

1. Knife disconnect with test sockets.
2. 10 Amp rating.

J. Fused Terminals:

1. Hinged fuse removal/disconnect.
2. 10 Amp rating.
3. Include blown fuse indication.

2.05 DC POWER SUPPLIES

A. Manufacturer:

1. Sola SDN 5-24-100P.
2. No Substitute Permitted.

B. General:

1. Power supply shall be fully enclosed, and provide screw terminations. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529. Housing shall be at IP20 or equal minimum.
2. Power Supplies shall have an efficiency of >80% with high efficiency models (>90%) available.
3. The power shall have an MTBF (Mean Time Between Failures) greater than 500,000 hours according to IEC 1709.
4. The power supply shall be able to withstand shock of 30G in all space directions according to IEC 68-2-27 and vibration up to 2.3G 90 min. (<15hz, amplitude = +/-2.5mm/15-150hz) according to IEC 68-2-6.
5. Power supplies shall be UL-508A listed to allow the use of the power supply at full rated output amperage with no "de-rating".

C. Mounting:

1. All power supplies shall have integral metal mounting foot to attach to 35mm DIN-rail conforming to DIN EN50022.

D. Wire Connections:

1. Attach wires to the power supplies by means of a cable-clamping terminal block activated by a screw. Connections shall be gas-tight, and the terminal block shall be fabricated with non-ferrous, non-corrosive materials.
2. Wire connection for currents less than 20A shall use pluggable terminals on both input and output ends.
3. Pluggable terminals shall accept wire sizes 24 through 14 AWG.

E. Equipment:

1. Nominal current rating to be based on an operating temperature of 60°C or higher
2. Power supplies shall have a visible "DC Power OK" indicator. This indicator will flash when the output drops below 10% of the adjusted output voltage.
3. Ambient temperature range for operation shall be at least -25°C to +70°C
4. Residual ripple shall not exceed 100 mV peak to peak at nominal current values
5. Integral "fine" surge suppression shall be incorporated into the power supply
6. Power supplies shall conform to CE electromagnetic compatibility as described in EN61000-6-2 and EN 50081-2.
7. Power supplies shall have means of limiting DC current in case of short circuit or an overload and shall automatically reset themselves when the fault is corrected.
8. Power supplies when wired in parallel will not require external circuitry.
9. Power supplies shall have a voltage monitoring relay contact and signaling output.
10. Input must auto-range between 85 to 264VAC and 90 to 350VDC for 1 phase power supplies with no manual intervention.
11. Input must auto-range between 320 to 575VAC and 450 to 800VDC for 3 phase power supplies with no manual intervention.
12. Power supplies shall have a power factor of at least 0.6, with higher power factor models available as described by EN61000-3-2.

2.01 PANEL ANNUNCIATOR

A. Manufacturers:

1. Edwards Signaling
2. Federal Signal
3. Mallory Sonalert SC.
4. Or Equal

B. Audible, front of panel device for signaling alarms.

C. NEMA 4X rated, waterproof housing suitable for corrosive environments.

D. Panel-mounted with gasket.

E. 2-wire device, 120Vac power.

F. Sustained audible tone rated for 80-95 dB at 10 feet.

2.02 PROCESS INDICATOR

A. Manufacturer:

1. Precision Digital, PD 6600 Loop Leader
2. By Manufacturer of source signal instrument
3. Or Equal

B. Dual-line programmable digital display.

1. Process value on 5-digit alphanumeric top line.
2. Process units on 8-digit alphanumeric bottom line.

C. 24Vdc loop powered.

D. Input: 4-20 mAdc.

E. Output: 4-20 mAdc.

F. Mounting: Front of Panel, NEMA 4X.

G. Operating temperature: -40 to 75ºC.

2.03 ELECTRONIC CURRENT ISOLATOR

A. Manufacturer:

1. Phoenix Contact Model MCR Series.
2. PR Electronics.

B. Solid state instrument to electrically isolate one instrument loop from another instrument loop. Converter to accept 4-20 mAdc input signal and provide equal but isolated and power-boosted output.

C. Mounting: DIN Rail.

D. Temperature compensated, calibration-free.

E. Input: 4-20 mAdc into 50 ohms.

F. Output: 4-20 mAdc into output load up to 500 ohms.

G. Isolation: Common mode up to 700Vac between input and output.

H. Accuracy: 0.5% of span.

I. Provide power supply specific to isolator.

2.04 CURRENT SENSOR

A. Manufacturer:

1. Automation Components Inc, Model A/SCTA.
2. Or Equal.

B. Split-core type 4-20 mA output current sensor.

C. +12 to 30 VDC sensor supply voltage, 2-wire loop powered.

D. +/- 0.5% accuracy from 0-100% full scale output.

E. 2,200 VAC isolation voltage and up to 600 VAC sensing voltage.

F. Minimum 0.75 inch diameter aperture size.

G. Contactor shall select scale to match equipment served.

2.05 SURGE PROTECTORS

A. Manufacturer:

1. SOLA STV25K-10S.
2. No Substitute Permitted.

B. High frequency noise filter/surge protector to protect control panel incoming power supply.

C. Wire to protect specified microprocessor based process control system devices including:

1. PLC
2. Ethernet Switches
3. OIU
4. 2-, 3-, or 4- wire field instrumentation.

D. Input power:

1. 120 or 240Vac, model dependant.
2. 47-63 Hz.

E. Peak surge current: Minimum 10,000 amp line-neutral, line to ground, and neutral to ground.

F. Frequency response:

1. Normal mode: 90 dB max, 100 kHz to 50 MHz.
2. Common mode: 60 dB max, 5 MHz to 50 MHz.

G. Response time:

1. < 0.5 ns normal mode.
2. <5 ns common mode.

H. Transient protection per IEEE C62.41:

1. Category A Ringwave (6kV, 200A, 100 MHz): < 60 V peak.
2. Category B Ringwave (6kV, 500A, 100 MHz): < 100 V peak.

I. LED status indicator.

J. Form C contact for remote status indication.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed adjacent to each device that has Engineer tag number referenced on Drawings.

B. Engrave Engineer tag number as listed in Specifications and on Drawings.

END OF SECTION

SECTION 40 79 00
MISCELLANEOUS INSTRUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this Section shall conform to general requirements of Section 40 61 13.

B. Section includes instrumentation and control devices for Process Instrumentation and Control Equipment.

1.02 REFERENCES

A. NEC: National Electrical Code

B. NEIS: National Electrical Installation Standards

C. NEMA: National Electrical Manufacturers Association

D. NRTL: Nationally Recognized Testing Laboratory

E. OSHA: Occupational Safety and Health Administration

F. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation and control devices specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this Section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

PART 2 – PRODUCTS

2.01 (M31) INTERIOR/EXTERIOR MOUNTED ALARM LIGHT

A. Manufacturers:

1. Federal Signal
2. RAB.
3. Crouse Hinds.
4. Appleton Electric Company.
5. Edwards Signaling

B. 120Vac.

C. Strobe style.

D. LED Bulb – lamp/lens color as listed in Section 40 70 00.

E. Construction: NEMA 4X for general locations. NEMA 7 explosion-proof, UL Listed for Class II, Division 2 service when located in classified area.

1. Cast aluminum housing with epoxy powder coat for corrosion resistance.
2. High-impact glass dome with dome guard.

F. Include mounting hardware as application requires including stanchion, ceiling, pendant, or surface mount.

1. Ceiling mount shall include stainless steel extension rod minimum of 6 inches.
2. Surface mount shall include mounting lugs.

G. 3/4 in. conduit hubs.

2.02 (M34) INTERIOR/EXTERIOR MOUNTED ALARM HORN

A. Manufacturers:

1. Federal Signal
2. RAB.
3. Crouse Hinds.
4. Appleton Electric Company.

B. 120Vac

C. Sustained Tone – 100dBa at 10’ minimum, adjustable

D. Construction: NEMA 4X for general locations, NEMA 7 explosion-proof, UL Listed for Class II, Division 2 service when located in classified area.

E. Surface-mounted, provide mounting lugs. Body to include mounting lugs.

F. Ceiling mounted shall include stainless steel extension rod minimum of 6 inches.

G. 3/4 in. conduit hubs.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed adjacent to each device.

B. Engrave Engineer tag number and title/description as listed in Specifications and on Drawings.

END OF SECTION

DIVISION 43

PROCESS GAS AND LIQUID HANDLING EQUIPMENT

SECTION 43 23 57
PROGRESSING CAVITY PUMP EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Liquid Polymer Circulation Pump (P-8-13-1).
2. Stator thermal element (TE-8-13-1).
3. Polymer Feed Pump 1, 2, 3, and 4 (P-8-9-1, -2, -3, and -4)
4. Stator thermal element (TE-8-9-1, -2, -3, and -4).

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. OSHA: Occupational Safety and Health Act

1.03 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Pump shall be positive displacement, progressing cavity type with gear joint or a positively sealed and lubricated pin joint drive train.
2. Pumping equipment shall comply with the Progressing Cavity Pump Schedule(s) of this Section.
3. Liquid Polymer Circulation Pump equipment shall be suitable for 41% liquid polymer (LPO).
4. Polymer Feed Pump equipment shall be suitable for liquid polymer (LPO) at 0.25% to 0.50% dilution.
5. Equipment shall be free from shock, vibration, cavitation, overheating, and noise while operating at specified conditions.
6. Equipment shall continuously operate without damage while operating under load.
7. Design equipment so parts are readily accessible for inspection and repair, easily duplicated and replaced, and suitable for service specified.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for progressing cavity equipment specified.
2. Motor data. Submit in accordance with Section 26 05 84.
3. Coating systems. Submit in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for progressing cavity equipment.

2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturer's factory production and final test curves indicating compliance of progressing cavity pumping equipment with this section.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of progressing cavity equipment in service.

G. Submit Instructional Services information in accordance with Section 01 79 30.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain progressing cavity equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver progressing cavity equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store progressing cavity equipment in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

1.07 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. One stator for each model of progressive cavity pump.
b. One rotor for each model of progressive cavity pump.
c. One shaft seal for each model of progressive cavity pump.

2. Provide special tools required for checking, testing, parts replacement, and maintenance.
3. Spare parts shall be suitably packaged and clearly labeled and identified with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Moyno Industrial Products.

B. Seepex.

C. Netzsch.

2.02 MATERIALS

A. Suitable for application specified in the Progressing Cavity Pump Schedule(s) and as specified below.

1. Suction Housing: thick-walled cast iron.
2. Bearing Housing: thick-walled cast iron.
3. Rotors: 316 stainless steel Duktil Coated (1250 Vickers Hardness)
4. Stator: FPM - Viton
5. Gear joints: Machined of alloy steel, SAE 1045, ASTM 331-90, grade A8620.
6. Pin joints: High speed steel, air hardened to 60-65 HRc.
7. Connecting rod: Machined of alloy steel, SAE 1045, ASTM 331-90, grade A8630.
8. Drive shaft: Machined from carbon steel, SAE 1045, ASTM A519-90, grade MT1020, yield strength of 32,000 pounds per square inch.

2.03 PUMP FABRICATION

A. General:

1. Suction connection shall be flanged for Liquid Polymer Circulation Pump and Polymer Feed Pump Nos. 1, 2, 3, and 4. Suction shall be side-oriented.
2. Discharge connections shall be flanged with bolt hole dimensions and spacing to ANSI standards.
3. Flanges shall be ANSI 16.5B Class 125.

B. Pump:

1. Pump shall have a gland packing seal.
2. Pump shall be direct-coupled to gear reducer.
3. Suction housing shall include two inspection ports, 180 degrees apart, to permit access to the suction housing interior without disconnecting the feed chute.
4. Housing shall include a NPT drain connection.

C. Rotor:

1. Rotor shall be of one-piece construction with integrally machined rotor head.
2. Rotors cut to length with welded rotor heads shall not be acceptable.
3. Rotor shall have single helix design.

D. Stator:

1. Stators shall be double helix design and chemically bonded to the inside of a carbon steel tube.
2. The opening of the stator, on the suction side of the pump, shall be beveled to at least a 30 degree angle from the vertical to lesson entrance losses.

3. Stator shall be rigidly fastened to the suction housing and discharge flange by one of the following methods:

    a. Stator shall be molded with a seal integral to the stator elastomer preventing the metal stator tube and the bonding agent from the elastomer from contacting the pumped liquid.
    b. Fasten stator to pump with four thru-bolts.

4. Stators shall be manufactured to size. Stators made in long lengths and cut to size are not acceptable.
5. Seal ends of stator tube at the suction and discharge to prevent the material being pumped from contacting the stator tube.
6. Integral dry run protection in stator.

E. Bearings:

1. Bearing shall be integral to the pump or gear/motor, designed for all loads imposed by specified service.
2. Bearings shall be grease lubricated, tapered roller or ball bearing type with diverging pressure angles to maximize shaft stability. Bearings located in a gear box shall be oil lubricated.
3. Bearings shall be designed for a minimum B-10 life of 100,000 hours under maximum operating conditions and shall not require periodic lubrication.
4. Bearings shall be protected from contaminates by means of a bearing cover plate bolted to the bearing housing.

F. Drive Components:

1. Drive:

    a. Drive shaft shall be of solid drive shaft design to avoid clocking and / or trapping of solids, which could interrupt movements of connecting rod or disturb seal of rear gear joint or a connecting rod that shall be of the rigid, splined design, connecting the gear joints of the drive shaft and eccentrically moving rotor.
    b. Connecting rod shall be constructed of machined alloy steel.
    c. All diameters of connecting rod are to be concentric to within +/- 0.003 inches TIR.

2. Gear Joints:

    a. Gear joints shall be grease or oil lubricated, crown gear type constructed of machined alloy steel. Sealed gear type joint, factory lubricated with oil and sealed from pumped material is acceptable.
    b. Gear joint shall be totally enclosed and protected by a wire reinforced elastomeric seal.
    c. Mechanical components of gear joint assembly shall be designed to operate for 10,000 hours at manufacturers published maximum speeds and pressures.

3. Bushed Pin Joints:

    a. Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod.
    b. Joint shall be grease or oil lubricated and covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel.
    c. Stainless steel shell shall cover the rotor side universal joint assembly to protect the elastomer sleeve from being damaged by tramp metals or glass.
    d. Universal joints shall carry a separate warranty of 10,000 operating hours.

4. Drive shaft:

a. Shaft shall be of one-piece construction through the bearings and shaft seal area.
b. Drive shaft shall be plated with 0.01-inch of hard chrome.

G. Pump and motor shall be mounted on a common fabricated steel base.

H. Motors:

1. 460 Volt, 3-phase, 60 Hertz.
2. Horsepower and speed as stated in Progressing Cavity Pump Schedule(s).
3. Inverter duty rated.
4. Provide motors Class F insulation, totally enclosed fan cooled (TEFC) motor for each pump to achieve specified capacity and not exceed Code G starting characteristics.
5. Gearbox/Gearmotor shall be coupled to the pump shaft with suitable coupling for torque required.
6. Motor shall conform to requirements of Section 26 05 84.
7. Motors shall be suitable for use with adjustable frequency drives provide under Section 26 29 23. Provide torque, horsepower and speed requirements and additional information required to adjustable frequency drive manufacturer.
8. Size to prevent overheating and damage to motor when operating over entire range of specified operating conditions.
9. Motor shall be direct-coupled to a gear reducer.

2.04 DRY RUN PROTECTION

A. The stator shall be fitted with a sensor sleeve (TE-8-13-1 and TE-8-9-1, -2, -3, and -4) and PT-100 RTD temperature sensor to monitor casing temperature.

2.05 COATING

A. Provide in accordance with Section 09 96 00 unless specified otherwise in this Section.

B. Manufacturer is responsible for surface preparation, prime coat, and second coat of equipment in the factory prior to shipment unless otherwise noted.

C. Manufacturer is responsible for the surface preparation and all motor coatings in the factory prior to shipment.

D. Contractor shall provide final third finish coat for equipment in the field and be responsible for touchup and any additional specified coatings.

E. Final color of exposed equipment and motors shall be selected by Owner.

F. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

G. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install progressing cavity equipment in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

   a. 4 workdays for Installation Services.
   b. 1 workday for Instructional Services.
   c. 1 workday for Post Startup Services.

2. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

PROGRESSING CAVITY PUMP SCHEDULE 1

Name of Pump(s)	Liquid Polymer Circulation Pump
Tag Number(s)	P-8-13-1
Number of Pumps	One
Fluid Pumped	Liquid Polymer
Motor Horsepower	1.5
Full Load Amps	2.02
Maximum RPM	450
Discharge	3"
Suction	3"
Motor	460/3/60
Motor Mounting	Direct Coupled
Constant or Variable Frequency	Constant
Performance Requirement at Rated Speeds	
Maximum Speed (rpm)	450
Design Operating Point	
Capacity (gpm)	10
Total Dynamic Head (psi)	40

Note: Items listed above including horsepower and sizing is for "A" manufacturer. If "B" or "C" manufacturer requires higher horsepower or alternate sizing, then Contractor shall provide at no additional cost all electrical changes and motor.

rpm = revolutions per minute
gpm = gallons per minute
ft = feet

PROGRESSING CAVITY PUMP SCHEDULE 2	
Name of Pump(s)	Polymer Feed Pump 1, 2, 3, and 4
Tag Number(s)	P-8-9-1, -2, -3, and -4
Number of Pumps	Four
Fluid Pumped	Liquid Polymer
Motor Horsepower	7.5
Full Load Amps	9.8
Maximum RPM	275
Discharge	3”
Suction	4”
Motor	460/3/60
Motor Mounting	Direct Coupled
Constant or Variable Frequency	Variable
Performance Requirement at Rated Speeds	
Maximum Speed (rpm)	262
Design Operating Point	
Capacity (gpm)	56
Total Dynamic Head (psi)	75
Note: Items listed above including horsepower and sizing is for “A” manufacturer. If “B” or “C” manufacturer requires higher horsepower or alternate sizing, then Contractor shall provide at no additional cost all electrical changes and motor.	
rpm = revolutions per minute gpm = gallons per minute ft = feet	

END OF SECTION

SECTION 43 41 43
POLYETHYLENE TANKS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Liquid Polymer Tank (T-8-12-1).
2. Polymer Aging Tank 1 and 2 (T-8-16-1 and -2).
3. Flex Connectors.

1.02 SYSTEM DESCRIPTION

A. Provide storage tanks constructed of materials suitable for the chemical contained.

B. Tanks shall have sufficient sidewall and hoop strength to minimize tank deflections between full and empty conditions.

C. Tanks shall have one integrally molded full bottom drain outlet.

D. All tank fittings not integrally molded shall be leak tight.

E. Hardware used for flanged bulkhead fittings shall be suitable for chemical contained.

F. Provide chemical tank equipment pad construction shall be as recommended by manufacturer in addition to accommodating isolation valve, and valve supports.

G. Provide flex connectors suitable for connection to chemical storage tank, compatible with media stored within tank, with vertical and horizontal movement characteristics per chemical tank manufacturer's recommendations

H. Flanges shall be protected from damage. All openings shall be covered to prevent entrance of dirt and debris.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for tanks, fittings, and hardware supplied.
2. Wall thickness calculations per ASTM D1998 using 600 pounds per square inch design hoop stress at 100 degrees Fahrenheit (F).
3. Statement certifying that the tank resin used and fittings and hardware supplied are suitable for intended chemical service.
4. Proposed coating systems and/or liners and compatibility with associated chemical stored.
5. Recommended procedures for job site storage, handling, installation, and start-up.

C. Shop Drawings:

1. Drawings for each tank identifying tank dimensions, tank volume, and location and elevation of all accessories and connections supplied.

2. Drawings for each tank restraint system.

D. Test Results:

1. Upon completion of the tank provide manufacturer's inspection report for each tank containing:

a. Verification of wall thickness for tanks larger than 2,000 gallons.
b. Impact test.
c. Gel test, Type I resin only.
d. Hydrostatic test.
e. Verification of fitting placement.
f. Visual inspection.
g. Verification of materials.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of submersible centrifugal equipment in service.

G. Submit Instructional Services information in accordance with Section 01 79 30.

1.04 QUALITY ASSURANCE

A. The tank furnished under this Section shall be supplied by a manufacturer who has been regularly engaged in the design and manufacturing of rotationally molded chemical storage tanks using cross-linked and high density linear polyethylene tanks for over ten years.

B. Dimensions and Tolerances

1. All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.
2. The tolerance for the outside diameter, including out of roundness, shall be per ASTM D1998.
3. The tolerance for fitting placements shall be +/- 0.5 in. in elevation and 2 degrees radial at ambient temperature.

C. Low Temperature Impact Test.

1. Test specimens shall be taken from fitting location areas.
2. Test specimens shall be conditioned at (- 40) degrees Fahrenheit for a minimum of 2 hours.
3. The test specimens shall be impacted in accordance with the standard testing methods as found in ASTM D1998. Test specimens < ½" thickness shall be tested at 100 ft.-lb. Test specimens > ½" thickness shall be tested at 200 ft.-lb.

D. Degree of Crosslinking Test (% Gel – Type I – Crosslink Resin Only)

1. The test method used is to be the o-xylene insoluble fraction (gel test) per ASTM D2765 Method C. This test method is for determination of the ortho-xlene insoluble fraction (gel) of crosslinked polyethylene.
2. The percent gel level for Type I tanks on the inside 1/8 in. of the wall shall be a minimum of 65%.

E. Ultrasonic Tank Thickness Test

1. Tanks shall be measured for tank wall thickness at 6", 1ft., 2ft. and 3ft. on the tank sidewall height at 0° and 180° around the tank circumference with 0° being the tank manway and going counter-clockwise per ANSI standard drafting specifications.

F. Hydrostatic Water Test

1. The hydrostatic water test shall consist of filling the tank to brim full capacity for a minimum of four hours and conducting a visual inspection for leaks.

G. Workmanship

1. The finished tank wall shall be free, as commercially practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminations that will impair the serviceability of the vessel. Fine bubbles are acceptable with Type II tanks to the degree in which they do not interfere with proper fusion of the resin melt.
2. All cut edges where openings are cut into the tanks shall be trimmed smooth.

1.05 WARRANTY

A. Tanks shall be warranted for three years in regards to defects in materials and workmanship. The warranty on fittings and accessories supplied by the tank manufacturer will be for one year.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver tanks and accessories to their final locations in protective wrappings, containers, and other protection to exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store tanks in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

D. Carefully follow Manufacturer's instructions for moving tanks into final position. Remove all rocks and debris from path of travel and final tank resting place.

E. Tanks damaged beyond repair shall be replaced with undamaged tanks.

F. Store tanks in manner to minimize exposure to ultraviolet radiation.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Poly Processing Co.

B. Snyder Industries

C. Assmann Corporation of America

2.02 SERVICE CONDITIONS

A. Tanks shall be as shown in the Schedule(s) at the end of this Section:

2.03 MATERIALS – RESIN CLASSIFICATION

A. Tanks are classified according to type as follows:

1. Type I – Tanks molded from cross-linkable polyethylene resin.
2. Type II - Tanks molded from linear polyethylene resin (not cross-linkable resin).

B. The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. Type I tanks shall be made from crosslinked polyethylene (XLPE) resin as manufactured by Ingenia Polymers Corp., or resin of equal physical and chemical properties. Type II tanks shall be made from high density linear polyethylene (HDLPE) resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.

C. All polyethylene resin material shall contain a minimum of a U.V. 8 -15 stabilizer as compounded by the resin manufacturer. Pigments may be added at the purchaser's request, but shall not exceed 0.25% (dry blended) of the total weight.

D. Mechanical Properties of Type I tank material: Cross-linked (XLPE)

PROPERTY	ASTM	VALUE
Density (Resin)	D1505	0.942 -0.946 g/cc
Tensile (Yield Stress 2"/min)	D638	2700 - 2900 PSI
Elongation at Break (2.0in/min (50 mm/min)	D638	300-800%
ESCR (100% Igepal, Cond. A, F50)	D1693	>1000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	>1000 hours
Flexural Modulus 1% Secant	D790	110,000 PSI

E. Mechanical Properties of Type II tank material: High density Linear (HDLPE)

PROPERTY	ASTM	VALUE
Density (Resin)	D1505	0.941-0.950 g/cc
Tensile (Yield Stress 2"/min)	D638	2800 - 3500 PSI
Elongation at Break (2"/min.)	D638	>1000%
ESCR (100% Igepal, Cond. A, F50)	D1693	>500 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	40 - 48 hours
Flexural Modulus 1% Secant	D790B	130,000 – 145,000 PSI

2.04 DESIGN REQUIREMENTS

A. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in. thick.

$$T = P \times O.D./2\,SD = 0.433 \times S.G. \times H \times O.D./2\,SD$$

T = wall thickness
SD = hydrostatic design stress, PSI
P = pressure (.433 x S.G. x H), PSI
H = fluid head, ft.
S.G .= specific gravity, g/cm^3
O.D. = outside diameter, in.

1. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress would be ≤ 660 PSI at 73 degrees Fahrenheit for Type I and Type II materials based the resin density. In accordance with the formula in 2.04 A., the tank shall have a stratiform (tapered wall thickness) wall. In no case shall the wall thickness be less than the minimum allowed per calculation of ASTM D1998.
2. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
3. The standard design specific gravity shall be 1.35, 1.5 or 1.9.

B. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support.

C. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of tanks with 2,000 or more gallons of capacity shall be designed to provide a minimum of 1,300 square inches of flat area for fitting locations.

D. Tanks with 2,000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.

2.05 TANK FITTINGS

A. Bolted Flange Fittings

1. Required for below liquid level installation of sizes larger than 2 inches.
2. ANSI/ASME B16.5, 150 pound flanges shall be suitable for contact with media stored in tank.
3. Gasket shall be minimum ¼ inch thick and suitable for media stored in tank.
4. Minimum four full threaded bolts per installation. The bolts shall have bolt heads encapsulated in Type II polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully encapsulate the bolt head. The polyethylene shall be color coded to distinguish bolt material. Each encapsulated bolt shall have a gasket to provide a sealing surface against the inner flange.
5. Bolts and gaskets shall be suitable for contact with media stored in tank.
6. Size, number and locations as specified in Table(s) in this Section and/or shown on Drawings.

B. Molded outlet

1. Fitting shall be located at bottom of sidewall and allow tank to be fully drained.
2. Fitting shall be integrally molded into tank during rotational molding process.
3. Fitting shall be seamless, flanged, and manufactured from same material as tank. Inserts are not acceptable.

4. Provide CPVC companion flange assembly with split backing ring, bolts, and gasket suitable for contained chemical.

C. Self-Aligning Dome Fittings

1. All dome fittings 1 inch and smaller shall be bulkhead universal ball style.
2. All dome fittings larger than 1 inch shall be two-flange universal ball dome style. Gasket material shall be suitable for media stored in vessel.

D. Flange Adapters

1. Provide flange adapter fittings to adapt threaded or socket fitting outlets to 150 lb. flange connections for connection to piping system components as needed. Flange adapter construction shall utilize schedule 80 components.

E. Flexible Connections

1. Provide flex connectors suitable for connection to chemical storage tank, compatible with media stored within tank, with vertical and horizontal movement characteristics per chemical tank manufacturer's recommendations. Flex connectors shall be one of following:

a. PTFE expansion joints, Ethylene Flexijoint or equal, for each tank connection location. Expansion joints shall have a minimum of 3 convolutions, stainless steel limit cables, and FRP composite flanges. Expansion joints shall have the following minimum performance requirements:

1) Axial Compression ≥ 0.67"
2) Axial Extension ≥ 0.67"
3) Lateral Deflection ≥ 0.51"
4) Angular Deflection ≥ 14º
5) Torsional Rotation ≥ 4º

b. Hose connections:

1) Provide Ultra High Molecular Weight (UHMWPE) hose with two King nipples (barbed) and mechanically attached with double stainless steel bands securing hose to nipples.
2) Flex connector size per tank connection.
3) Flanged connections.
4) Fasteners shall be compatible for media stored in tank.

2.06 TANK ACCESSORIES

A. Manways

1. Pressure Relief Manway

a. Provide 24 inch clear opening manways with hinged pressure relief opening.
b. Hinged pressure relief portion shall open at 6-inches of water column. Relief shall close automatically after pressure has been released
c. Manway cover shall be bolt on lid type manufactured out of crosslink polyethylene.
d. Manway bolts shall be polyethylene, nylon or a compatible plastic material.

B. Fill Pipe:

1. Provide fill piping, diameter as specified in Table(s) in this Section and/or as shown on the Drawings to extend down into tank within 1 foot of tank bottom.
2. Pipe shall be supported maximum 5 foot intervals with support structures.

C. Ladders:

1. Ladders shall be constructed of FRP.
2. All ladders shall be designed to meet applicable OSHA standards. Safety cages shall be provided with ladders per OSHA standards.
3. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded-in attachment lugs that allow for tank movement due to temperature and loading changes.

D. Restraint Systems:

1. The restraint system is not required as the tanks sit indoors. Tie down systems are based on requirements for nonbuilding structures and must meet seismic requirements per IBC code with seismic loads ≤ .445g (Seismic Design Category "D" - Fa=1.0, Fv=1.5, Ss=1.4, S1=0.5).

2. Anchor bolts shall be provided by the contractor per the calculations and the base plates for the system.

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install tanks in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

a. 2 workdays for Installation Services.
b. 1 workday for Instructional Services.
c. 1 workday for Post Startup Services.

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

3.04 DEMONSTRATION

A. Testing:

1. After completion of field installation, fill tanks with water and allow to stand full for 48 hours. During testing, nozzles may be plugged by installation of temporary blind flanges on outside of tank.
2. Leaks or indications of leaks in tank or accessory connections may be repaired where permitted by Engineer, in manner recommended by manufacturer. Evidence of leakage may be cause for rejecting tank.
3. Repeat test after leaks are repaired.

Section 43 41 43
Schedule 1 – Tank Schedule

Tank	Chemical Stored	Conc. / Specific Gravity	Location Interior / Exterior	Nominal Capacity	Maximum Diameter/ Height	Tank Resin	Color	Fitting Material	Gasket Material	Bolt Material
Liquid Polymer Tank T-8-12-1	Neat Emulsion Polymer	41% 1.05 SG	Interior	7,300 gallons	10'-2" D 14'-1¾" H	XLPE	Natural	CPVC	EPDM	316SS
Polymer Aging Tank 1, 2 T-8-16-1, -2	Polymer Solution	0.50% 1.0 SG	Interior	960 gallons	5'-4" D 6'-0" H	XLPE	Natural	CPVC	EPDM	316SS

Section 43 41 43
Schedule 2 – Tank Fitting Schedule

Tank Number	Liquid Polymer Tank T-8-12-1	Polymer Aging Tank 1, 2 T-8-16-1, -2
Inlet / Fill	3-inch, top	N/A
Open/Closed Tank Top	Closed	Open
Outlet	4-inch, bottom	4-inch, bottom
Overflow	3-inch, side	3-inch, side
Vent	6-inch, top	N/A
Drain	N/A	4-inch, bottom
Manway	Pressure Relief	N/A
Level Fitting	3-inch, top	N/A
Ladder	Yes	No
Restraint System	Anchor Bolts	No

END OF SECTION

DIVISION 44

POLLUTION AND WASTE CONTROL EQUIPMENT

SECTION 44 31 16
ACTIVATED CARBON ADSORPTION ODOR CONTROL EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. This specification describes the upflow, activated carbon odor control system to be furnished. The Contractor shall be responsible for providing a complete working system. This system shall be installed to treat odors from the cake dryer condensate sump.

B. The prefilter, carbon vessel, media, associated instruments, and system accessories shall be provided.

C. The system shall include the following components:

1. Upflow Carbon Adsorber Vessel (M-11-23-1).
2. Odorous Air Blower (M-11-23-2).
3. Media.
4. Prefilter.
5. Instruments.
6. System Accessories.

1.02 REFERENCES

The following is a list of standards which may be referenced in this section (unless otherwise stated, use of the latest code/standard edition is required):

A. ASTM International

1. D2563, Standard Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts.
2. D2584, Standard Test Method for Ignition Loss of Cured Reinforced Resins.
3. D3299, Standard Specifications for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.
4. D4097, Standard Specification for contact-molded glass-fiber-reinforced Thermoset Resin Corrosion-Resistant Tanks.
5. D3982, Standard Specification for Contact Molded “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Ducts
6. ASTM E679: “Standard Practice of Odor and Taste Thresholds By a Forced-Choice Ascending Concentration Series Method of Limits”.

B. PS 15-69: National Bureau of Standards Voluntary Product Standard “Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment”.

1.03 SUBMITTALS

A. Shop drawings shall be submitted to the engineer for evaluation and approval in accordance with Section 01 33 00 Submittal Procedures. Fabrication of equipment and

ordering of system components shall not begin until the Engineer has approved the shop drawings.

B. Submittals shall include:

1. All documentation required to prove that the manufacturer meets all of the Quality Assurance requirements. Manufacturers who do not meet all of these requirements will not be considered as acceptable.
2. A copy of this specification with a notation beside each line item confirming compliance or any deviations / exceptions. Any deviations or exceptions should be clearly explained in a separate section of the submittal.
3. Dimensional drawings showing elevation and plan views of the system and all applicable connections.
4. Vessel and Anchorage:

    a. Vessel fabrication details, laminate sequences, and materials of the components shall be included in shop drawings and submitted for approval before fabrication.
    b. The origin for the laminate physical properties used for design shall be stated. Accepted methods for establishing physical properties are: Tabled filament wound properties in an accepted code or standard or via laminate physical properties testing outlined in an industry accepted code or standard. All physical property testing is required to be conducted by an independent third-part testing lab with all reported results signed by a registered professional engineer licensed in the state of Illinois.
    c. All design calculations stamped by a professional engineer.
    d. Resin manufacturer's certificate listing the nomenclature, composition, and characteristics of the resin shall be furnished for all major components including the vessel, dampers and ductwork. This should include a letter from the resin manufacturer stating recommended corrosion liner for service outlined in this specification.
    e. Vessel fabricator's certificate of compliance with fabrication requirements.
    f. Description of interior slope bottom.
    g. Allowable design Factors of Safety for filament wound laminate when compared to ultimate physical properties are as follows:

        1). Operating loads from design internal pressure = 10:1
        2). Operating loads from design external pressure = 5:1
        3). Buckling from wind/seismic or upset loads = 5:1

5. Prefilter

    a. Detailed drawings showing wall construction, pad construction details, end connections and access configuration.
    b. Installation instructions and O&M Data.
    c. Detailed removal and performance calculations.

6. Media:

    a. Furnish a certificate from the media manufacturer certifying that the proposed media will meet the specifications.
    b. Statement of origin and manufacturers test data noting lot numbers. Submitted lot numbers shall be confirmed with actual material delivered.
    c. Media manufacturer's certificate to include statement of origin and test results.

7. Catalog information, descriptions, specifications, layouts, sketches and other information sufficient to clearly and readily demonstrate compliance with all parts of the specifications and drawings.
8. Dimensional and weight information. Include empty weight and operating weight with carbon.
9. Resin manufacturer's certificate listing the nomenclature, composition, and characteristics of the resin shall be furnished for all major components including the vessel, dampers and ductwork. This should include a letter from the resin manufacturer stating recommended corrosion liner for service outlined in this specification.
10. Special shipping, storage, and protection, and handling instructions.
11. Suggested spare parts list to maintain the equipment in service for a period of 1 year.

C. O&M Manual

1. Operating and maintenance manuals shall be furnished to the engineer in accordance with Section 01 33 00 - Submittals. The manuals shall be prepared specifically for this installation and shall include detailed operating and maintenance instructions and specifications relative to the assembly, alignment, lubrication, adjustment and maintenance of the unit furnished under this contract, together with complete parts lists of shop drawings, certified dimension drawings and design calculations. The manual shall be approved by the Engineer, prior to equipment start-up and testing.
2. At a minimum the following shall be included in the O&M Manual.

    a. Process description
    b. Design criteria
    c. Process and instrumentation drawings
    d. As-built vessel drawing
    e. Media sampling and replacement procedures. H_2S breakthrough description
    f. Start-up and Shutdown procedures
    g. Media specifications and MSDS's for each type
    h. Fan drawings, operation and fan curve
    i. Preventive Maintenance
    j. Bill of Materials
    k. Recommended spare parts
    l. Manufacturer's Service Department contact information

1.04 QUALITY ASSURANCE

A. The system supplier shall have a minimum of ten (10) consecutive years of experience in the design and manufacture of radial flow dry media systems and have at least ten (10) systems equal or larger to the specified airflow in operation in the United States. Multiple systems installed at the same location shall be considered as one (1) installation. References and contacts shall be provided for each installation. Experience shall be based on the company and not any individual. Additionally, if experience is based on acquisition, at least ten (10) direct employees of the company shall have been retained and demonstrate experience qualifications.

B. Designer: Registered professional engineer with a minimum of ten (10) consecutive years of experience in the design of odor control systems in the United States.

C. Vessel Fabrication: System supplier shall ensure that the fabrication of the vessel shall meet or exceed all requirements in this specification. The vessel shall be warranted by system supplier. Fabrication facility shall be based in United States and have a minimum

of ten (10) years' experience in the fabrication of odor control vessels of similar size. Fabricator shall employ a full time QA supervisor with a minimum of ten (10) consecutive years' experience in fabrication of fiberglass structures.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall unload, store, and handle all equipment as per manufacturers recommendations.

1.06 WARRANTY

A. The carbon adsorber Manufacturer shall warrant the vessel, and internal structural components against defects in material and workmanship for ten (10) years from equipment startup. In the event that it is determined that a defect exists, the Manufacturer shall repair or replace the defective components at 100% of cost (no prorating shall be allowed), provided that any such defect was not the result of misuse of the component by the Owner or his agents.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. The system shall be the end products of one responsible system supplier to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services. Acceptable suppliers of the full packaged system shall be one of the following:

1. ECS Environmental Solutions.
2. Perry Fiberglass.

2.02 GENERAL

A. The system supplier shall furnish the items required to provide a properly functioning system for the service conditions listed herein, including but not limited to the vessel, carbon media, mist eliminator, outlet damper and all appurtenances necessary for a complete system.

2.03 SERVICE CONDITIONS

A. The odor control system shall be located outside and be designed to remove the odorous constituents from the process air stream under the following operating conditions:

Process Parameter	Value
Duty	Continuous
Elevation above sea level	705 ft
Location	Indoor
Inlet Hydrogen Sulfide (H_2S), Average	10 ppm range
Inlet Hydrogen Sulfide (H_2S), Peak	100 ppm
Ambient Air Temp	(-)20 to 120 degrees F
Inlet Air Temp	50 to 80 degrees F
Inlet Relative Humidity	30% to 90%
Designed system airflow	100 cfm

Removal Required	H_2S: 99.5% removal or less than 0.05 ppm in outlet air, whichever is less stringent

B. The vessel shall conform to the following parameters:

Process Parameter	Value
Vessel Type	Single Bed / Top Mounted Fan
Vessel Material of Construction	FRP
Vessel Pressure Rating	+/- 10" w.c.
Pressure Drop	Vessel (Inlet to Outlet): 4.5" w.c. maximum
Carbon Residence Time	8.5 seconds minimum
Media Volume	15 ft^3 minimum
Maximum Bed Velocity	20 ft/min
Vessel Inside Diameter	2.5 ft

2.04 ADSORBER VESSEL AND DUCTWORK

A. The FRP adsorber vessel shall be filament-wound, manufactured in accordance with ASTM D3299. The visual defects, per ASTM D2563, shall not exceed Level II on the vessel interior and Level III on the vessel exterior. The resin used shall be Dow 510, AOC K022, or approved equal suitable for continuous exposure to saturated water vapor, hydrogen sulfide gas, and their associated acidic products. The resin system should provide a Class 1 flame spread rating. Antimony, Nyacol or any other additives are not allowed. A permanent wax containing resin coating, formulated according to the resin manufacturer's most recent recommendations (or other Engineer-approved method) shall be used for surface protection and to prevent air inhibition of resin curing. Contact molded accessories shall be manufactured in accordance with NBS PS15. The completed vessel shall be translucent until it is gel coated. The final gel coat color shall be selected by the Owner or engineer. A certificate from the resin manufacturer listing the nomenclature, composition, and characteristics of the resin shall be furnished with the vessel. Stainless, PVC, HDPE, PP or other non-reinforced plastic vessels will not be acceptable.

1. An inner corrosion barrier shall be provided consisting of no less than three laminated layers. The inner corrosion layer shall be resin rich, not to exceed 20 percent plus or minus 5 percent glass by weight, and a minimum thickness of 10 to 15 mils. The inner corrosion layer shall be followed by at least two layers of chopped-strand mat or two passes of chopped roving to a total of 3 ounces per foot. Should the chopped roving technique be employed, the chopped fibers shall be 1/2 inch to 2 inches in length. The total corrosion barrier shall total 100 mils minimum and be 27 percent plus or minus 5 percent glass by weight.
2. The structural aspects of the vessel shall be sufficient to meet recommended requirements, including seismic requirements for all conditions during the design life. Manufacturer shall include with the shop drawings, detailed calculations illustrating the seismic characteristics of the proposed vessels. Calculations shall be signed and stamped by a registered mechanical engineer. See Drawing 999-S-1 for structural design criteria.
3. In addition to the above requirements, the adsorber vessel shall have an average glass content of 55 percent plus or minus 5 percent by weight per ASTM D2584.

4. Tie down lugs and lifting lugs shall be 316 stainless steel. Quantity and design shall be determined in the PE stamped vessel calculations.
5. The adsorber vessel shall be complete with integral carbon support structure, air inlet connection, pressure differential assembly and gauge, air outlet, drain connection, sample port nozzles, 316 stainless grounding rod and all necessary accessories as shown on the Drawings and/or specified within. All exhaust air shall leave the vessel at the top. Provide sufficient access manways so that carbon and all internal parts can be easily removed from the vessel. All metal parts shall be Type 316 stainless steel with no metallic parts contacting the carbon except for grounding purposes. No pultruded components shall be used on the interior of the vessel unless they are completely coated with the specified 100-mil corrosion barrier and manufactured using the specified resin systems.
6. Removable top shall be airtight at the pressure equal to or higher than the corresponding fan static pressure.
7. The upflow vessel shall have an internal slope bottom. Bottom shall be sloped to a drain nozzle at 1/8" per foot in diameter. Low point of the slope shall be raised to ensure full drainage.
8. Vessels shall have a flanged top section to facilitate complete removal of all internal components. Flange shall be designed for 12" positive pressure and full hydrostatic loading.
9. Vessel design and airflow configuration shall be furnished to accommodate a cylindrical, vertical carbon bed. Vessel shall include a removable top.
10. The bed shall be grounded with a 316 stainless steel rod to prevent static electricity from accumulating. A predrilled and tapped copper grounding pad shall be located on external vessel walls.
11. All cut-walls from tank wall nozzle cutouts shall be reinforced as required by service conditions. Press molded or compression molded flanged nozzles are not acceptable.
12. Add ultraviolet absorbers to surfacing to improve weather resistance.
13. No dyes, pigments or colorants except in exterior gel coating.

2.05 CARBON

A. The vessel shall include a single media bed.

B. High Capacity Carbon

1. Sufficient activated carbon shall be provided to fill the reactor vessel to the height of the vessel. The activated carbon shall be a high capacity activated carbon with enhanced H2S capacity. The activated carbon shall be suitable for the vapor phase adsorption of sewage treatment odors. No chemical impregnation of the activated carbon is permitted. The activated carbon shall have the following specifications:

Iodine Number	1,200 mg/g min
Moisture, weight % as packed	5% max
Hardness No.	95 min
Apparent Density, g/ml	0.45 min
Surface to Volume Ratio m^2/g	1250
H_2S Breakthrough Capacity, g H2S removed/cc Carbon[1]	0.30
CTC by Weight	60% min

2.06 INSTRUMENTATION

A. Pressure differential instruments shall be provided and include Magnehelic style pressure gauges allowing determination of the pressure loss in inches of water column across the carbon and prefilter.

1. The range shall be 0-10 inches of water.
2. Gauge shall be 4" diameter Magnehelic by Dwyer or equal. Wetted materials inside of gauge shall be suitable for a saturated air stream containing up to 100-ppm H2S. Copper or copper based alloys will not be accepted.

B. Sampling Ports: The adsorption unit shall have three 2-inch diameter sample ports which extend into the carbon bed 1 foot minimum, suitable for extracting carbon samples. Provide one grain thief that can extract a core sample of the in-place carbon through the sample ports. Ports shall be adequate to provide suitable extraction of air samples from the carbon bed and be nonbinding. Each port nozzle shall extend outside the vessel wall and be blocked off with a 2-inch ball valve. One additional air sampling port shall be provided above the carbon bed.

2.07 SYSTEM ACCESSORIES

A. 16-gauge SST name plate attached to the vessel mounted in a readily visible location. Name plate shall include the following information at a minimum:

1. Manufacturer and Model #
2. Date Manufactured
3. Equipment tag number securely
4. Design Air Flow Rate
5. Carbon Volume

B. 316 SST or FRP encapsulated lifting and anchor lugs.

2.08 PRE-FILTER

A. Pre-filter: Remove moisture, aerosol grease and particulates.

B. Housing: Housing shall be manufactured using fiberglass reinforced plastic. Stainless or alternate plastic materials are not acceptable. Manufacturer shall have a minimum of 10 years experience in the design and supply of similar equipment. Manufacturer shall retain the services of an independent inspector who is responsible to confirm the prefilter has been manufactured in accordance with this specification and all FRP work meets or exceeds ASME RTP-1 level 2 visual inspection criteria.

1) Construction to match that of the carbon vessel.
2) Housing shall have machined UMHW guides to prevent stainless frame on filter pad from scratching or damaging the corrosion liner.
3) Filter housing shall be designed for 12" positive and negative pressure with a maximum of 1/8" deflection.
4) Housing shall have an access door for pad removal complete with EPDM gasket and 316 Stainless hardware.
5) Filter pad shall be designed to remove moisture and grease and particulates. Pad shall be suitable for airstream.

C. Dimensions / Design:

1. End connections shall be sized for a maximum air velocity of 2,500 ft/min. Flange dimensions shall match the connecting ductwork. Flange thickness shall not be less than that listed in ASTM 3982.
2. Inlet cone shall be designed so that the airstream can spread evenly over the pad surface. Cone angle shall be no more than 60 deg.
3. Housing shall be sized so that air velocity through the filter pad is 400 ft/min.
4. Particle removal efficiency shall be 99% of particles 10 microns or larger.
5. Maximum initial pressure loss of 0.75 in wc and velocity of 400 fpm.

2.09 FRP Exhaust Fans

A. Manufacturers:

Fiberglass reinforced plastic (FRP) fans shall be one of the following, with all appurtenances as described herein. Fans shall be suitable for moving humid air. Fan shall be fabricated in accordance with ASTM D4167 97. Fan shall be mounted integral to carbon vessel on top.

1. New York Blower.
2. Hartzell.
3. Verantis.

B. Design Criteria:

Table 1 – Fan Design Criteria	
Tag	M-11-23-2
Wheel Type	Open Radial
Design Air Flow Rate (acfm)	100
Design Static Pressure (in. w.c.)	7 (Vessel, media, and filter, ductwork 1.5)
Vessel, media, and filter losses: Ductwork losses: (in. w.c.)	5.5 1.5
Drive Type	Direct
Housing size, percent diameter	9, 96.5%
Motor HP	0.75
Motor Rating	TEFC- Class I/Div 2
Motor Voltage	460V, 3Ø, 60 Hz.
Motor Efficiency	Premium

Air Density (lbs/ft3)	0.0748
Max. Fan RPM	3,500
Max. Outlet Velocity (ft/min)	1300
Arrangement	4V
Location	Mounted on vessel lid
Radiated Sound Pressure	78 dB
Radiated Sound Pressure after Attenuation	55 dB

C. Fan Materials:

1. All parts that come in contact with the air stream shall be FRP or FRP encapsulated. The fans shall be constructed in strict accordance with ASTM D-4167 standard specification for FRP fans and blowers to ensure structural integrity. Fans shall be statically and dynamically balanced at design operating speed prior to shipment.
2. Fan housing shall be constructed of a fire-retardant vinyl ester resin with an ASTM E84 Class I rating. Housing laminate construction shall conform to ASTM Standard C-582. Airstream surfaces shall be smooth. Fan inlet and outlet shall be flanged. Inlet assembly shall be bolted to allow wheel removal.
3. The fan wheel shall be backwardly-inclined design. Wheel shall be fabricated of a fire-retardant vinyl ester resin with an ASTM E84 Class I rating. Wheel hub shall be permanently bonded to the shaft and completely encapsulated in FRP to ensure corrosion-resistant integrity. Steel wheels coated with FRP are not acceptable.
4. All parts of the fan that may come in contact with the air being handled shall be made of nonferrous material for spark resistance.
5. FRP fan shall have a gel coating with a minimum thickness of 20 mils. Gel coat shall be applied using a 2-coat application process. The final layer shall be a pigmented gel coating containing UV inhibitor.
6. Welded steel unitary base coated with epoxy enamel to 2-3 mils dry film thickness.
7. 316 stainless steel anchor bolts and hardware.
8. Bearings are to be grease lubricated, precision anti-friction ball or spherical roller, self aligning, pillow block design. Bearings shall be designed for a minimum L-10 life of 30,000 hours when rated at the fan's maximum cataloged operating speed. Fan bearings must be easily accessible for inspection and maintenance.

D. Fan Motors:

1. Fan motors shall be TEFC, premium efficiency, 460V, 3-phase. Motor shall be suitable for installation in a Class I, Division 2, Group D hazardous Environment
2. Provided in accordance with Section 26 05 84.

E. Accessories: Each fan shall be provided with the following accessories:

1. Flanged and drilled inlet and outlet
2. Flanged flexible connectors on the connection to fan outlet

3. All hardware shall be 316 stainless steel with nylok fittings
4. Lubricated double lip Teflon shaft seals
5. 316 SS shaft and hardware
6. Double-lip Teflon shaft seals
7. Lube lines extended to outside of belt guard
8. Inlet and outlet flanged, flexible connector.
9. Outlet damper.

F. Finishes:

1. The fan base and support fan structure shall be shop prime painted and finish coated at the factory with industrial grade two-coat epoxy enamel system to a thickness of 2-3 mil dry film thickness.
2. Any defects in painting shall be corrected in the field by the supplier, as required.
3. All external fasteners shall be plated for extra corrosion protection.

G. Grounding:

1. All fans shall have a “carbon rich” resin coat on all interior airstream surfaces.
2. Provide grounding straps secured from side of fan housing to steel base.

H. Sound attenuation enclosure

1. A FRP fan enclosure shall be provided by the system supplier. Construction and performance shall be as follows:
   a) Walls shall be vacuum-formed construction with two layers of FRP over a honey comb core.
   b) Resin, liner, color and exterior coating system shall be the same as specified for the adsorber vessel.
   c) Enclosure shall have four ventilation louvers installed.
   d) Enclosure shall be manufactured so that it can be easily removed for maintenance.
   e) Enclosure shall be single-piece construction. No seams or joints are allowed. Bolt-together kit enclosures are not acceptable.
   f) Enclosure shall have 2” of sound-adsorb lining all internal surfaces.

PART 3 – EXECUTION

3.01 FACTORY TESTING

A. All equipment shall be factory tested for compliance with the requirements specified herein. In addition, a full hydrostatic atmospheric leak test (zero leakage allowed). Hydro test shall be witnessed by an independent inspector.

3.02 FUNCTIONAL TESTING

A. Functional testing shall be conducted after the installation of the carbon vessels and all appurtenances and the equipment has been operated for a sufficient period to make any corrections or adjustments. The carbon vessel shall be subject to field functional tests under actual operating conditions to determine that operation is satisfactory and in compliance with the Specifications.

B. The Contractor will provide, calibrate, and install all temporary gauges and meters, and install all temporary piping and wiring required for the functional tests.

C. The functional tests shall include the following:

1. Alignment: Test complete assemblies for correct and proper alignment and connection, and quiet operation
2. Flow Throughput: Measured by system or temporary instrumentation.
3. Discharge and Inlet Static Pressure: Measured by system instrumentation or temporary measurement devices.
4. Test all system components for proper adjustment and operation in both manual and automatic operating modes.

D. System Start-up

1. Shall be performed by qualified representative of the manufacturer.

3.03 MANUFACTURER'S SERVICES

A. In addition to being available by phone to assist the Contractor during the off-loading, installation, and startup of the equipment, the following Manufacturer's services shall be provided with the number of trips to the site as a minimum.

Startup Assistance	one trip, minimum 4 hours on site
Follow-up Adjustments/Training	one trip, minimum 2 hours on site

Notwithstanding the above, the Manufacturer shall continue to assist the Contractor with questions, issues and remote assistance until the system is properly installed and operating successfully according to the design criteria.

B. The manufacturer shall provide complete training of the Owner's Operations and Maintenance personnel on the system. Provide classroom and hands-on training to satisfaction of the Owner.

3.04 EQUIPMENT NAME PLATES

A. Each separate piece of equipment shall be furnished with a unique name plate identifying the Manufacturer, model and serial number, date of manufacture and, if applicable, capacity and any performance limitations. The nameplates shall be in accordance with 40 05 97.

END OF SECTION

DIVISION 46

WATER AND WASTEWATER EQUIPMENT

SECTION 46 33 33
POLYMER FEED EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Polymer Mixing System 1 and 2 (M-8-15-1 and -2).
2. Polymer Mixing System 1 and 2 Local Control Panels (90-LCP-8-15-1 and -2).
3. Provide ancillary equipment and controls required for a complete and operable system.
4. Spare parts and accessories.

1.02 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Polymer Mixing Systems shall be designed to continuously feed emulsion polymer from the polymer storage tank via a skid mounted assembly consisting of a progressing cavity pump with variable speed drive, mix chamber assembly, paddlewheel flowmeters, valves, calibration column, static mixer, and controls designed to dilute emulsion polymer solution to 0.25 to 0.50 percent and feed it to the aging tanks (by others).
2. Components requiring adjustment or maintenance shall be mounted for ease of accessibility. Systems shall be pre-plumbed and pre-wired mounted on a common skid frame. Skid shall be 304 stainless steel and fork truck compatible.
3. Polymer Mixing System 1 and 2 Local Control Panels shall be remote mounted. Panels shall be mounted above chemical containment wall with ease of accessibility for operation and maintenance.
4. Polymer metering pumps shall be progressing cavity type. Diaphragm pumps are not acceptable.
5. Systems shall produce a completely homogenous diluted polymer, fully activated, without “fish-eyes” and without degradation of the polymer molecules.
6. Polymer mixing/feed units shall automatically meter, dilute, activate, and feed liquid polymer.
7. Skids shall be fully pre-plumbed and pre-wired to the control panel.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for equipment specified.
2. Motor data in accordance with Section 26 05 84.
3. Coating system in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for polymer feed equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Submittals shall be in accordance with Section 01 33 00.

E. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of equipment in service.

F. Submit Instructional Services information in accordance with Section 01 79 30.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 DELIVERY, STORAGE, AND HANDLING

A. All equipment and parts shipped to the job site shall be properly protected from the elements so that no damage or deterioration occurs from the time of delivery to the time when the installation is complete and the units are placed into operation.

B. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site, during storage, and during installation.

1.06 MAINTENANCE

A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

1. Furnish the following per each model system provided:
   a. Two mixing system polymer pump stators.
   b. Two mixing chamber mechanical seals.
   c. Two sets of mixing chamber o-rings.
   d. Two injection check valves.

2. Provide special tools required for checking, testing, parts replacement, and maintenance.
3. Spare parts shall be suitably packaged and clearly labeled and identified with name and number of equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. UGSI

B. Prominent

C. Velodyne

2.02 POLYMER MIXING SYSTEMS

A. Multi-Zone Mixing Chamber and Post-Dilution

1. Polymer and water shall be mixed in a chamber designed to create sufficient mixing energy.

    a. High shear zone of the mixing chamber shall have a mechanical mixing impeller for successful initial activation and the low shear zone shall not have a mixing impeller to avoid damaging polymer molecules.
    b. Solution shall undergo a tapered mixing intensity slope as it exits the initial high sheer zone and passes through a second low shear zone, isolated by a baffle.
    c. The design shall have primary mixing and post-dilution to maximize the value of breaker surfactant present in emulsion polymer, as per the AWWA Standard for Polyacrylamide (ANSI/AWWA B453-06).
    d. Polymer activation efficiency shall be consistent over the dilution water range.
    e. The volume of the mixing chamber shall be a minimum of 1.0 gallon to provide sufficient residence time for activating and disentangling polymer molecules.

2. Impeller shall be driven by a 1-1/2 HP maximum washdown duty motor.

    a. Motor shall be TEFC.
    b. Impeller speed shall be 3450 rpm, maximum.
    c. Motor shall be direct-coupled to impeller shaft.

3. Mixing chamber shall include a stainless steel injection check valve.
4. Mixing impeller shall be cast brass or 316 stainless steel construction with holes drilled on the backside of the impeller. The impeller, when rotating, shall pull fluid from around the mechanical seal pocket to eliminate the need for a separate mechanical seal flushing system.
5. In order to quantify the mixing intensity in the mix chamber, the applied horsepower shall be defined by measuring the difference in torque when the mix chamber is empty versus being full of water. This value shall be the basis of determining the mixing intensity defined as "G" value.
6. The G-value in the high shear mixing zone shall exceed 14,000 sec-1 to effectively disperse polymer gels to prevent fisheye formation.
7. The G-value in the low shear mixing zone shall be lowered to 3,500 sec-1 to avoid damaging polymer chains.

B. Dilution Water Control

1. Dilution water shall be split into two streams.

    a. Primary water flow shall supply the mixing chamber.
    b. Secondary water flow shall be used to post dilute the activated polymer stream.
    c. These two streams shall be completely blended by a static mixer prior to exiting the unit.
    d. Each stream shall have an electronic flow sensor with immersed in-line element capable of transmitting a signal to the PLC for display of flow rate.
    e. Element shall be removable without plumbing disassembly.
    f. Each stream shall have a modulating rate control valve for isolation of or throttling of water flow.

2. Unit shall have an electric solenoid valve for on/off control of total dilution water flow. Valve shall have brass body with NBR seals and NEMA 4X rated coil enclosure.
3. Dilution water and solution output connections shall include 304 stainless steel unions connected to the chassis.

C. Pump

1. Unit shall have one neat polymer metering pump.

    a. Pump shall be positive displacement, progressing cavity type.
    b. Rotor shall be 316 stainless steel.
    c. Stator shall be Viton.
    d. Pump shall have mechanical seal. Pumps supplied with packing seals shall not be considered equal.
    e. Rotor speed shall not exceed 500 rpm.

2. Pump shall be driven by a ½ HP, TEFC, AC or DC motor.

    a. Variable speed shall be provided by a VFD controller.
    b. Motor shall be direct-coupled to a gear reducer.
    c. Pump shall be direct-coupled to gear reducer.

3. Pump shall include a pressure relief valve and pressure gauge located on the discharge side of the pump and piped to the pump suction. Pressure relief valve shall be PVC construction with Viton seals. Systems utilizing pressure relief on the mix chamber discharge and requiring a connection to drain shall not be considered equal.
4. A suitably-sized calibration cylinder shall be mounted to the frame with PVC isolation ball valves. Cylinder shall be calibrated in mL, and be constructed of clear PVC with slip on cap and ½ inch NPT vent connection.

2.03 CONTROL PANELS

A. Provide remote mounted control panel for polymer skid. Skid mounted devices shall be factory wired to skid mounted junction box. Field wiring between skid junction box and remote mounted control panel shall be provided by Contractor.

B. Unit shall be operated with an Allen Bradley CompactLogix programmable controller (PLC) and Allen Bradley PanelView Plus 7 operator interface unit (OIU).

    1. Control panel shall include door mounted 10-inch high resolution color touch screen OIU with PLC inside the cabinet for sequencing control.
    2. A power-on light, rotary power disconnect and a mushroom head emergency stop pushbutton shall be installed on the front of the panel.
    3. Enclosure shall be NEMA 4X FRP construction with quick release latches.

C. PLC shall pace polymer metering pump based on operator programmed data and on a remote 4-20 mA analog input signal.

    1. Operator shall be able to determine mode of operation at the OIU, local or remote.
    2. Local mode will allow the Operator to set system water flows and polymer pump pacing manually or set water flow and make-up concentration setpoints, as well as start and stop the system.
    3. Remote mode will have the Operator set the make-up concentration setpoint, with total flow being set by remote 4-20mA input.
    4. PLC will compute the ratio of polymer to water from total water flow rate signal generated by flow element.
    5. PLC will generate signal to pace pump accordingly.
    6. As the total flow target changes, setpoint concentration will be automatically maintained by the PLC.

D. System shall be controlled through an on-off-remote circuit.

1. In the remote mode, the PLC shall accept a run signal.
2. System is manually controlled in the on mode.
3. OIU shall indicate the mode of operation.

E. OIU shall include the following functionality:

1. Setup Screens for entry of sensor and system data
2. Control, Configuration and Calibration screens for manual operation of motors and dilution water valve, adjusting analog outputs, calibrating polymer pump capacity and configuring water flow sensors
3. Entry of polymer concentration, loss of water set point and flush time
4. Status screen to include the following:

    a. On/Off/Remote status
    b. System mode; maintenance, calibration and run modes
    c. System running
    d. Loss of water flow
    e. Alarm status
    f. Make-up concentration readout in %
    g. Feed concentration readout in %
    h. Polymer flow readout in selected units
    i. Primary water flow readout
    j. Post dilution water flow readout
    k. System flush indicator
    l. Pump capacity exceeded indicator

5. Help screens to assist startup
6. Alarm screen with history
7. A No-Action clean screen for wiping down the OIT screen.
8. On screen touch and membrane function key navigation buttons allowing surfing between screens.

F. An integral timer shall monitor loss of flow and energize contacts indicating alarm after 15 seconds of continuous loss. OIU shall indicate loss of water alarm.

G. Controller shall have an end-user adjustable flush cycle which will disable polymer pump yet allow dilution water to flow through system for a pre-set time at each shutdown.

H. Programmable controller shall have Ethernet communications capability and the control panel shall include a five (5) port Ethernet switch inside the enclosure. IP addresses for data to be supplied by Systems Integrator – see Section 40 61 13.

I. PLC shall include the following inputs:

1. E-Stop pushbutton
2. Motor overloads
3. Pump protection
4. Remote alarm
5. Remote start
6. Loss of Polymer Flow Switch (thermal flow switch for loss of neat polymer flow alarm).
7. Primary water flow sensor
8. Post dilution water flow sensor
9. At least three (3) available inputs for future customization.

J. PLC shall have at least 2 spare analog input channels for connection of external flow meters, scales, or other devices.

K. PLC shall have the following outputs available over the network:

1. System running
2. Loss of polymer flow
3. Loss of water flow
4. System in remote mode
5. Dilution water open/close
6. Polymer pump run
7. Mixer motor run
8. Polymer pump alarm
9. Mixer motor alarm
10. Total flow customer feedback signal
11. Three (3) additional outputs for future customization.

2.04 TECHNICAL DATA

A. Connections – Plumbing

1. Dilution water inlet, 2” FNPT
2. Neat polymer inlet, 1” FNPT
3. Solution discharge, 3” FNPT

B. Connections – Electrical

1. Hardwired – 120 V / 1 phase / 60 Hz, 21 amp power connection
2. 24Vdc terminal blocks – 4-20 mA signal input
3. 120Vac terminal blocks – dry contact input for remote start
4. 120Vac terminal blocks – dry contact system ready (in remote) output
5. 120Vac terminal blocks – dry contact run output

C. Materials of Construction

1. Structural frame – 304 stainless steel
2. Plumbing – Sch 80 PVC
3. Mixing chamber – PVC, acrylic

D. Performance

1. Dilution water – 665 – 5,015 gph.
2. Polymer pump – 3.0 – 25.5 gph neat polymer.

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install polymer feed equipment in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at

jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

a. 1 workdays for Installation Services.
b. 1 workday for Instructional Services.
c. 1 workday for Post Startup Services.

2. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

END OF SECTION

SECTION 46 41 17
INLINE STATIC MIXERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Static Mixer 1, 2, 3, and 4 (M-8-17-1, -2, -3, and -4).

1.02 SYSTEM DESCRIPTION

A. General

1. The Contractor shall furnish and install the following static mixer(s) complete with elements, pipe housing with flanges and any other appurtenances required at the locations shown on the Drawings and as specified herein.

a. Four (4) 2-1/2” diameter static mixer for in-line mixing of liquid polymer and W3 dilution water.

B. Design Criteria:

1. Chemical: Polymer
2. Process Pipe Material: CPVC
3. Pipeline Diameter: 2-1/2 inches
4. Application

a. Minimum Flow Rate: 11 gpm
b. Maximum Flow Rate: 112 gpm
c. Polymer Flow: 11 to 56 gpm

5. Maximum Process Pipe Pressure: 75 psi
6. Maximum Pressure Drop: 16.4 psig @ 112 gpm
7. Maximum Coefficient of Variation at Mixer Discharge: 0.05
8. Length of Unit: 16 inches

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Shop Drawings and Product Data:

1. Catalog cuts and product specifications for each system component specified in 1.03.A.
2. Installation and assembly drawings and specifically prepared technical data for equipment.
3. List of materials of construction.
4. Detailed dimensions on Drawings.
5. Manufacturer’s product data.
6. Maximum operating pressure in piping system.

C. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of submersible mixing equipment in service.

E. Submit Instructional Services information in accordance with Section 01 79 30.

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain in-line static mixers from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver in-line static mixer to their final location in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store static mixer in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Koflo Corporation.

B. Komax Systems Inc.

2.02 MIXER FABRICATION

A. Mixer Body:

1. The static mixer shall be manufactured of schedule 80 CPVC with 2-1/2-inch diameter ANSI B16.5 Class 150 flanges.
2. The static mixer housing shall be designed to withstand a maximum of 150 psig at 100˚ F.

B. Mixing Elements:

1. Each mixer shall have three mixing elements.
2. Elements shall be constructed from 316SS.
3. Elements shall be removable from the mixer body and constructed from 316L stainless steel.
4. The static mixer elements shall be of the blade design with all mixing elements directed downstream. Mixing elements shall be smoothly contoured with a large radius. The intersections of element ends with the wall shall be at oblique angles.

2.03 GASKETS AND HARDWARE

A. Gaskets material shall be suitable for service and maximum operating temperature and pressure of connected piping. Torque requirement of gaskets shall be less than torque rating of flange, bolt, and nuts.

B. Gasket shall be ring or full face, 1/8 thick and conform to dimensions shown in Appendices to AWWA C110 and AWWA C115.

C. Bolts and nuts shall be 316 stainless steel. Dimensions: ANSI B18.2.2, heavy hex.

PART 3 – EXECUTION

3.02 INSTALLATION

A. Install static mixer equipment in accordance with manufacturer's written instructions.

3.03 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.04 FIELD QUALITY CONTROL

A. Provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

END OF SECTION

APPENDIX

APPENDIX

TABLE OF CONTENTS

Contractor's Application for Payment

Owner:		**Owner's Project No.:**	
Engineer:		**Engineer's Project No.:**	
Contractor:		**Contractor's Project No.:**	
Project:			
Contract:			
Application No.:		**Application Date:**	
Application Period:	**From**	**to**	

1. Original Contract Price				$ -
2. Net change by Change Orders				$ -
3. Current Contract Price (Line 1 + Line 2)				$ -
4. Total Work completed and materials stored to date (Sum of Column G Lump Sum Total and Column J Unit Price Total)				$ -
5. Retainage				
a.	X	$ -	Work Completed	$ -
b.	X	$ -	Stored Materials	$ -
c. Total Retainage (Line 5.a + Line 5.b)				$ -
6. Amount eligible to date (Line 4 - Line 5.c)				$ -
7. Less previous payments (Line 6 from prior application)				
8. Amount due this application				$ -
9. Balance to finish, including retainage (Line 3 - Line 4)				$ -

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:
(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;
(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such liens, security interest, or encumbrances); and
(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor: _____

Signature: _____ **Date:** _____

Recommended by Engineer		**Approved by Owner**	
By:		**By:**	
Title:		**Title:**	
Date:		**Date:**	
Approved by Funding Agency			
By:		**By:**	
Title:		**Title:**	
Date:		**Date:**	

Progress Estimate - Lump Sum Work

Contractor's Application for Payment

Owner:		**Owner's Project No.:**	
Engineer:		**Engineer's Project No.:**	
Contractor:		**Contractor's Project No.:**	
Project:			
Contract:			

Application No.: _____ **Application Period:** **From** _____ **to** _____ **Application Date:** _____

A	B	C	D	E	F	G	H	I
			Work Completed					
Item No.	Description	Scheduled Value ($)	(D + E) From Previous Application ($)	This Period ($)	Materials Currently Stored (not in D or E) ($)	Work Completed and Materials Stored to Date (D + E + F) ($)	% of Scheduled Value (G / C) (%)	Balance to Finish (C - G) ($)
	Original Contract							
			-			-		-
						-		-
						-		-
						-		-
						-		-
						-		-
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						-		-
						-		-
						-		-
	Original Contract Totals	$ -	$ -	$ -	$ -	$ -		$ -

Progress Estimate - Lump Sum Work

Contractor's Application for Payment

Owner:		**Owner's Project No.:**	
Engineer:		**Engineer's Project No.:**	
Contractor:		**Contractor's Project No.:**	
Project:			
Contract:			

Application No.: _____ **Application Period:** **From** _____ **to** _____ **Application Date:** _____

A	B	C	D	E	F	G	H	I
			Work Completed					
Item No.	Description	Scheduled Value ($)	(D + E) From Previous Application ($)	This Period ($)	Materials Currently Stored (not in D or E) ($)	Work Completed and Materials Stored to Date (D + E + F) ($)	% of Scheduled Value (G / C) (%)	Balance to Finish (C - G) ($)
Change Orders								
						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
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						-		-
						-		-
						-		-
						-		-
	Change Order Totals	$ -	$ -	$ -	$ -	$ -		$ -
Original Contract and Change Orders								
	Project Totals	$ -	$ -	$ -	$ -	$ -		$ -

Progress Estimate - Unit Price Work | **Contractor's Application for Payment**

Owner: ____________________ **Owner's Project No.:** __________
Engineer: ____________________ **Engineer's Project No.:** __________
Contractor: ____________________ **Contractor's Project No.:** __________
Project: ____________________
Contract: ____________________

Application No.: __________ **Application Period:** From __________ to __________ **Application Date:** __________

A	B	C	D	E	F	G	H	I	J	K	L
		Contract Information				Work Completed					
Bid Item No.	Description	Item Quantity	Units	Unit Price ($)	Value of Bid Item (C X E) ($)	Estimated Quantity Incorporated in the Work	Value of Work Completed to Date (E X G) ($)	Materials Currently Stored (not in G) ($)	Work Completed and Materials Stored to Date (H + I) ($)	% of Value of Item (J / F) (%)	Balance to Finish (F - J) ($)
Original Contract											
					-		-		-		-
					-		-		-		-
					-		-		-		-
					-		-		-		-
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					-		-		-		-
					-		-		-		-
				Original Contract Totals	$ -		$ -	$ -	$ -		$ -

Progress Estimate - Unit Price Work | **Contractor's Application for Payment**

Owner: ______________________ **Owner's Project No.:** ____________
Engineer: ______________________ **Engineer's Project No.:** ____________
Contractor: ______________________ **Contractor's Project No.:** ____________
Project: ______________________
Contract: ______________________

Application No.: ____________ **Application Period:** **From** ____________ **to** ____________ **Application Date:** ____________

A	B	C	D	E	F	G	H	I	J	K	L
		Contract Information				Work Completed					
Bid Item No.	Description	Item Quantity	Units	Unit Price ($)	Value of Bid Item (C X E) ($)	Estimated Quantity Incorporated in the Work	Value of Work Completed to Date (E X G) ($)	Materials Currently Stored (not in G) ($)	Work Completed and Materials Stored to Date (H + I) ($)	% of Value of Item (J / F) (%)	Balance to Finish (F - J) ($)
					Change Orders						
					-		-		-		-
					-		-		-		-
					-		-		-		-
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					-		-		-		-
					-		-		-		-
					-		-		-		-
				Change Order Totals	$ -		$ -	$ -	$ -		$ -
					Original Contract and Change Orders						
				Project Totals	$ -		$ -	$ -	$ -		$ -

Stored Materials Summary | **Contractor's Application for Payment**

Owner:		**Owner's Project No.:**
Engineer:		**Engineer's Project No.:**
Contractor:		**Contractor's Project No.:**
Project:		
Contract:		

Application No.: ______ **Application Period:** **From** ______ **to** ______ **Application Date:** ______

A	B	C	D	E	F	G	H	I	J	K	L	M
						Materials Stored			Incorporated in Work			
Item No. (Lump Sum Tab) or Bid Item No. (Unit Price Tab)	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Description of Materials or Equipment Stored	Storage Location	Application No. When Materials Placed in Storage	Previous Amount Stored ($)	Amount Stored this Period ($)	Amount Stored to Date (G+H) ($)	Amount Previously Incorporated in the Work ($)	Amount Incorporated in the Work this Period ($)	Total Amount Incorporated in the Work (J+K) ($)	Materials Remaining in Storage (I-L) ($)
								-			-	-
								-			-	-
								-			-	-
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								-			-	-
								-			-	-
								-			-	-
					Totals	$ -	$ -	$ -	$ -	$ -	$ -	$ -

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:
Engineer:
Contractor:
Project:
Contract Name:

Owner's Project No.:
Engineer's Project No.:
Contractor's Project No.:

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

[Describe the portion of the work for which Certificate of Substantial Completion is issued]

Date of Substantial Completion: **[Enter date, as determined by Engineer]**

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☐ None ☐ As follows:

[List amendments to Owner's Responsibilities]

Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

[List amendments to Contractor's Responsibilities]

The following documents are attached to and made a part of this Certificate:

[List attachments such as punch list; other documents]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

WORK CHANGE DIRECTIVE NO.: [Number of Work Change Directive]

Owner: Owner's Project No.:
Engineer: Engineer's Project No.:
Contractor: Contractor's Project No.:
Project:
Contract Name:
Date Issued: Effective Date of Work Change Directive:

Contractor is directed to proceed promptly with the following change(s):

Description:

[Description of the change to the Work]

Attachments:

[List documents related to the change to the Work]

Purpose for the Work Change Directive:

[Describe the purpose for the change to the Work]

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Notes to User—Check one or both of the following

☐ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: $ _____ **[increase] [decrease] [not yet estimated]**.

Contract Time: _____ days **[increase] [decrease] [not yet estimated]**.

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

	Recommended by Engineer	Authorized by Owner
By:		
Title:		
Date:		

FIELD ORDER NO.: [Number of Field Order]

Owner:	Owner's Project No.:
Engineer:	Engineer's Project No.:
Contractor:	Contractor's Project No.:
Project:	
Contract Name:	
Date Issued:	Effective Date of Field Order:

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with Paragraph 11.04 of the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:

[Description of the change to the Work]

Attachments:

[List documents supporting change]

Issued by Engineer

By: _____ *(signature)*

Title: _____ *(printed name)*

Date: _____

CERTIFICATE OF INSTALLATION SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify the equipment supplier/manufacturer has inspected this equipment and that it has been properly installed, adjusted, and calibrated. I further certify this equipment may now be operated for test purposes and/or normal use.

MANUFACTURER'S REPRESENTATIVE

Signature	Date

Name (print)

Title

Representing

CONTRACTOR

Signature	Date

Name (print)

Title

Comments:

This form shall be completed and submitted to ENGINEER prior to training of OWNER'S personnel in accordance with Section 01 61 00.

CERTIFICATE OF INSTRUCTIONAL SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify the equipment supplier/manufacturer has instructed OWNER'S personnel in the startup, operation, and maintenance of this equipment as required in the Specifications.

CONTRACTOR

Signature	Date

Name (print)

Title

I hereby certify that my operating personnel received _____ days instruction from

_____

for startup, operation, and maintenance of this equipment.

OWNER

Signature	Date

Name (print)

Title

Comments:

This form shall be completed and submitted to ENGINEER after training of OWNER'S personnel in accordance with Section 01 61 00.

CERTIFICATE OF POST STARTUP SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify the equipment supplier/manufacturer has inspected this equipment, made adjustments and calibrations, and that it is operating in conformance with the design, Specification, and manufacturer's requirements. Notation of improper operation shall be detailed and recommendations made and attached to this form.

MANUFACTURER'S REPRESENTATIVE

Signature | Date

Name (print)

Title

Representing

CONTRACTOR

Signature | Date

Name (print)

Title

OWNER

Signature | Date

Name (print)

Title

Comments:

This form shall be completed and submitted to OWNER upon completion of the 1-year reinspection as required by the Specifications.

CONTRACTOR'S REQUEST FOR SUBSTITUTION

(Include With Submittal)

Provisions requiring submittal of this form are described in Specification Sections 01 33 00 and 01 61 00 and paragraph 6.05 of the General and Supplementary Conditions.

Substitution Request No.: _____

Project: _____

Contract: _____

We hereby apply for consideration of _____
(*Proposed Substitute Manufacturer*)
as a substitute manufacturer to the manufacturer(s) named in Specification Section _____

Paragraph/Drawing No. _____ for the following reasons. (*Check one or more.*)

_____ The specified equipment or material is unavailable or the time of delivery will substantially delay the construction of the project, but not as result of CONTRACTOR'S failure to pursue Work promptly or coordinate various activities. (*Provide supporting information.)*

_____ The proposed equipment or material will provide for packaging and coordination with other equipment from a single source supplier. *(Submit name of source supplier and other equipment to be packaged.)*

_____ The proposed equipment or material is a "Substitute Item" to that specified and the CONTRACTOR will provide the OWNER with a credit of $_____ if the equipment or material is accepted.

We certify that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to the specified, be suited to the same use as that specified, and will not prejudice CONTRACTOR'S achievement of Substantial Completion on time.

Contractor: _____

Signature: _____ Date: _____

Name (print): _____

Title: _____

NOTE: ENGINEER may require CONTRACTOR to furnish, at CONTRACTOR'S expense, additional data about the proposed substitute including but not limited to, an analysis by CONTRACTOR of the equivalency of the proposed substitute to the named item.

A. Physical Characteristics of Proposed Substitute (if applicable).

Operating Weight:_____ Height:_____ Width:_____ Depth:_____

Voltage:_____ Hertz:_____ KW or HP:_____

B. Will acceptance of the proposed substitute by the OWNER:

1. Require a change in the Drawings or Specifications: Yes_____ No_____
   If yes, attach an explanation and detailed drawings or specifications.

2. Require payment of any license fee or royalty: Yes_____ No_____
   If yes, attach an explanation.

3. Result in a change of contract time: Yes_____ No_____
   If yes, attach an explanation.

C. Variations of proposed substitute from specified material, equipment, methods or procedures include: *(If none, state none. Attach separate listing if more space is needed.)*

1. _____

2. _____

3. _____

4. _____

D. Service Source (Maintenance, Repair, and Replacement) Availability:

1. Name of Business:_____

   Address:_____

   Years in Business:_____ Factory Authorized: Yes_____ No_____

   Parts Stocked: Major: Yes_____ No_____ Minor: Yes_____ No_____

   Field Service Staff Available: Yes_____ No____

2. Name of Business:_____

   Address:_____

   Years in Business:_____ Factory Authorized: Yes_____ No_____

   Parts Stocked: Major: Yes_____ No_____ Minor: Yes_____ No_____

   Field Service Staff Available: Yes_____ No_____

E. Identify costs, direct or indirect, if any, associated with acceptance of this proposed substitute.
   (If none, state none.)

_____

_____

INSTALLATION LIST

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

*****

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

*****

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

*****

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

REQUEST FOR INFORMATION

Request No.	Date:
Contractor:	Specification Section / Drawing No.:
Project:	
Contract:	
This is a request for a information on the following:	
Prepared By:	Date Response Needed:
Response:	
Prepared By:	Date:
Response Returned to Contractor On:	
cc: Owner:_____ Resident Project Representative:_____	

CONTRACTOR'S SUBMITTAL TRANSMITTAL

CONTRACT: _____

DONOHUE	**[NTU: INSERT CONTRACTOR OF OWNER LOGO]**
To: Nathan Cassity Donohue & Associates, Inc. 3311 Weeden Creek Road Sheboygan, WI 53081 Phone: 920-803-7370 Email: ncassity@donohue-associates.com	**From:** //INSERT CONTRACTOR NAME, ADDRESS, PHONE NUMBER, AND EMAIL//

Specification Section:	<<Section Number>> (same as selected in eCommunication database)
Donohue Title:	<<Section Title from TOC>> (same as selected in eCommunication database)
Description:	Xxxx xxxx xxxx (same as entered in eCommunication database)
Type:	(same as selected in eCommunication database)

Applicable Contract Clarification / Interpretation Request(s) were submitted and response(s) received:

_X_ No ___ Yes If Yes, List RFI Numbers:_____

Submittal includes variations from the requirements of the Contract Documents:

_X_ No ___ Yes If Yes, Variations are identified below and in accordance with paragraph 7.16 of the General Conditions:

Variations are as follows:

1. <<None>>

Contractor certifies that this submittal has been prepared in accordance with paragraph 7.16 of the General Conditions and Contractor has reviewed and approved this submittal in accordance with paragraph 7.16 of the General Conditions:

_X_ Yes ___ No