

Professional

Engineering

Services

Town Branch  
and West  
Hickman WWTP  
UV Disinfection  
Process  
Replacement  
Project

Contract  
131-2024

**Project Manual**

Lexington-Fayette Urban

County Government

Lexington, Kentucky

Issued for Bid

September 3, 2024



PLAN HOLDER: \_\_\_\_\_

Set No.: \_\_\_\_\_

PROJECT MANUAL

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
LEXINGTON, KENTUCKY  
TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION  
PROCESS REPLACEMENT PROJECT  
CONTRACT 131-2024



Prepared by:

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Issued for Bid  
September 3, 2024



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## **BIDDING AND CONTRACTING REQUIREMENTS**

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## ADVERTISEMENT FOR BIDS

### 1. INVITATION

Sealed proposals for the following work will be received by the Lexington-Fayette Urban County Government (LFUCG) via Ion Wave (<https://lexingtonky.ionwave.net>) until 2:00 p.m., local time, October 15, 2024, for furnishing all labor and/or materials and performing all work as set forth in the Contract Documents prepared by and for Lexington-Fayette Urban County Government, Division of Water Quality (OWNER). All forms and Contract Documents normally filled out and attached with bid submission may be downloaded from Lynn Imaging's Planroom and may be viewed on Ion Wave. All notary requirements are waived for this solicitation. A copy of bid bond must be included with submission. Immediately following the scheduled closing time for reception of Bids, all proposals which have been submitted in accordance with the above will be opened electronically and a bid tab sheet will be posted on Ion Wave within approximately 30 minutes.

**LFUCG will only be accepting bids on-line through Ion Wave for this solicitation. Base bid and alternate totals (if required) should be provided on the appropriate line items tab on Ion Wave. Submissions without line item totals (if required) may be rejected and deemed non-responsive. THESE INSTRUCTIONS SUPERSEDE ALL OTHER BID SUBMISSION INSTRUCTIONS PROVIDED IN THIS PACKAGE. PLEASE SUBMIT ALL QUESTIONS VIA THE Q&A MODULE ON ION WAVE.**

### 2. DESCRIPTION OF WORK

This project includes the following:

- a. Select demolition work at the Town Branch WWTP and West Hickman WWTP.
- b. Installation of complete UV Disinfection System and all related work at Town Branch WWTP and West Hickman WWTP.
- c. Removal and replacement of non-potable water pumps at Town Branch WWTP.
- d. Electrical work at Town Branch WWTP and West Hickman WWTP.
- e. Installation of new chemical feed systems at Town Branch WWTP and West Hickman WWTP.

### 3. OBTAINING PLANS, SPECIFICATIONS, AND BID DOCUMENTS

Plans, Specifications, and Contract Documents may be obtained from Lynn Imaging, 328 Old Vine Street, Lexington, Kentucky 40507, (859) 255-1021 for a non-refundable fee for each full set of plans and documents.

### 4. METHOD OF RECEIVING BIDS

Bids will be received from Prime Contracting firms on a **Lump Sum Basis** as shown in the Form of Proposal. The Bidder must include a price for all bid items to be considered. Bids shall be submitted in the manner and subject to the conditions as set forth and described in the Instruction to Bidders and Special Conditions.

Bids shall be submitted on-line using Ion Wave.

**5. METHOD OF AWARD**

The Contract, if awarded, will be to the lowest, qualified responsible bidder for the total project whose qualifications indicate the award will be in the best interest of the OWNER and whose bid/proposal complies with all the prescribed requirements. No Notice of Award will be given until the OWNER has concluded such investigation as deemed necessary to establish the responsibility, qualifications and financial ability of Bidders to do the work in accordance with the Contract Documents to the satisfaction of the OWNER within the time prescribed. The OWNER reserves the right to reject the Bid of any Bidder who does not pass such investigation to the OWNER's satisfaction. In analyzing Bids, the OWNER may take into consideration alternate and unit prices, if requested by the Bid forms.

**6. BID WITHDRAWAL**

No bidder may withdraw his bid for a period of ninety (90) calendar days after the closing date for receipt of bids. Errors and omissions will not be cause for withdrawal of bid without forfeit of bid bond. Bids may be withdrawn in person prior to the closing date of receipt of bids.

**7. BID SECURITY**

All bids shall be accompanied by a bid bond of not less than five percent (5%) of the amount of the bid executed by a Surety Company authorized to do business in the Commonwealth of Kentucky and countersigned by a licensed Kentucky Resident Agent, representing the Surety Company. Check or bond shall be payable to Lexington-Fayette Urban County Government.

**8. SUBMISSION OF BIDS**

CONTRACTORS shall submit their bids via Ion Wave not later than 2:00 p.m. (local time) **October 15, 2024**. Bids will remain sealed until 2:00 p.m. (local time) **October 15, 2024**, the official bid closure time. Bids received after the scheduled closing time for receipt of Bids will not be considered.

**9. RIGHT TO REJECT**

The Lexington-Fayette Urban County Government reserves the right to reject any and all bids and to waive all informalities and/or technicalities where the best interest of the Lexington-Fayette Urban County Government may be served.

**10. NOTIFICATION TO THE LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT FOR AFFIRMATIVE ACTION PLAN AND CURRENT WORKFORCE**

The successful bidder must submit, within seven (7) calendar days of the bid opening, the following items to the Lexington-Fayette Urban County Government:

1. Affirmative Action Plan for his/her firm.
2. Current Workforce Analysis Form.

Failure to submit these items as required herein may result in disqualification of the Bidder from the award of the contract.

All submissions should be directed to:

Lexington-Fayette Urban County Government  
Division of Purchasing  
200 East Main Street, 3<sup>rd</sup> Floor, Room 338  
Lexington, Kentucky 40507

**11. NOTICE CONCERNING DBE GOAL**

Notice of requirement for Affirmative Action to ensure Equal Employment Opportunities and Disadvantaged Business Enterprises (DBE) contract participation.

The Lexington-Fayette Urban County Government has set a goal that not less than ten percent (10%) of the total value of this contract be subcontracted to Disadvantaged Business Enterprises. The goal for the utilization of Disadvantaged Business Enterprises as subcontractors is a recommended goal. Contractors who fail to meet such goals will be expected to provide written explanations to the EEO Office and the Director of the Division of Purchasing of efforts they have made to accomplish the recommended goals, and the extent to which they are successful in accomplishing the recommended goals will be a consideration in the procurement process.

For assistance in locating Disadvantaged Business Enterprises Subcontractors contact:

Sherita Miller, Division of Central Purchasing  
Lexington-Fayette Urban County Government  
200 East Main Street, 3<sup>rd</sup> Floor, Room 338  
Lexington, Kentucky 40507  
(859) 258-3323

**12. PREBID MEETING**

A prebid meeting will be held at 9:00 a.m. on **September 17, 2024**, at Town Branch WWTP. This will be bidders opportunity to tour Town Branch WWTP and tour West Hickman WWTP directly after.

### 13. **CONSENT DECREE REQUIREMENTS**

The work to be provided through this bid will assist the **LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT** (the “**OWNER**”) in successfully implementing the **PROJECT** and complying with any requirements which are related to the Consent Decree entered in a case styled *United States & Commonwealth of Kentucky v. Lexington Fayette Urban County Government*, United States District Court for the Eastern District of Kentucky, Civil Action No. 5:06-cv-386-KSF (the “**CONSENT DECREE**”). The services provided through this bid are hereinafter referred to as the **PROJECT**. **The primary goal of the PROJECT is to provide the OWNER with the technical support and/or construction services necessary to successfully meet the obligations and deadlines of the CONSENT DECREE.**

The **BIDDER** shall familiarize itself with and shall at all times comply with the **CONSENT DECREE**, and all federal, state and local laws, ordinances, and regulations that in any manner affect the **PROJECT**. Time is of the essence in the performance of this **PROJECT**. **BIDDER** is aware that the **OWNER** is subject to penalties for non-compliance with the **CONSENT DECREE** deadlines.

If delays result solely by reason of acts of the **BIDDER**, the **BIDDER** shall be held liable for any financial penalties incurred by the **OWNER** as a result of the delay, **including but not limited to those assessed pursuant to the CONSENT DECREE**. In the event the parties cannot mutually agree upon the cause(s) associated with delays in completing project deliverables. The **BIDDER** must immediately notify the **OWNER** in the event of such delay, and provide the **OWNER** a written action plan within five (5) business days on how it will attempt to resolve the delay.

In the event that **BIDDER’s** delay or other nonperformance of its obligations hereunder results in the imposition of penalties against the **OWNER** pursuant to the **CONSENT DECREE**, or the **OWNER** otherwise suffers damage as a result of such delay or nonperformance, **BIDDER** shall be solely liable to **OWNER** for any and all such damages, including any costs and attorney’s fees.

An electronic version of the Consent Decree is available on the LFUCG web page for review or to print a copy at no charge.

### 14. **AMERICAN RESCUE PLAN ACT REQUIREMENTS**

#### **AMENDMENT 1 — CERTIFICATION OF COMPLIANCE FOR AMERICAN RESCUE PLAN ACT EXPENDITURES**

The Lexington-Fayette Urban County Government (“**LFUCG**”) may classify the subject matter of this bid as an expenditure under the American Rescue Plan Act of 2021. Expenditures under the American Rescue Plan Act of 2021 require evidence of the contractor’s compliance with Federal law. Therefore, by the signature below of an authorized company representative, you certify that the information below is understood,

agreed, and correct. Any misrepresentations may result in the termination of the contract and/or prosecution under applicable Federal and State laws concerning false statements and false claims.

**The bidder agrees and understands that in addition to all conditions stated within the attached bid documents, the following conditions will also apply to any Agreement entered between bidder and LFUCG, if LFUCG classifies the subject matter of this bid as an expenditure under the American Rescue Plan Act. The bidder further certifies that it can and will comply with these conditions, if this bid is accepted and an Agreement is executed:**

1. Any Agreement executed as a result of acceptance of this bid may be governed in accordance with 2 CFR Part 200 and all other applicable Federal law and regulations and guidance issued by the U.S. Department of the Treasury.
2. Pursuant to 24 CFR 85.43, any Agreement executed as a result of acceptance of this bid can be terminated if the contractor fails to comply with any term of the award. This Agreement may be terminated for convenience in accordance with 24 CFR 85.44 upon written notice by LFUCG. Either party may terminate this Agreement with thirty (30) days written notice to the other party, in which case the Agreement shall terminate on the thirtieth day. In the event of termination, the contractor shall be entitled to that portion of total compensation due under this Agreement as the services rendered bears to the services required. Either party may terminate this Agreement for good cause shown with forty-five (45) days written notice, which shall explain the party's cause for the termination. If the parties do not reach a settlement before the end of the 45 days, then the Agreement shall terminate on the forty-fifth day.
3. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following:
  - (1) Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
  - (2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

- (3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.
- (4) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- (5) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
- (6) The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
- (7) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part, and the contractor may be declared ineligible for further government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
- (8) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such

action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance.

Provided, however, that in the event a contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

4. If fulfillment of the contract requires the contractor to employ mechanic's or laborers, the contractor further agrees that it can and will comply with the following:
  - (1) Overtime requirements: No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such a workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such a workweek.
  - (2) Violation: liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (1) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this section.
  - (3) Withholding for unpaid wages and liquidated damages. LFUCG shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this section.

- (4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower-tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower-tier subcontractor with the clauses set forth in paragraphs (1) through (4) of this section.
5. The contractor shall comply with all applicable standards, orders, or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. § 7401 et seq.
6. The contractor shall report each violation to LFUCG and understands and agrees that LFUCG will, in turn, report each violation as required to assure notification to the Treasury Department and the appropriate Environmental Protection Agency Regional Office.
7. The contractor shall include these requirements in numerical paragraphs 5 and 6 in each subcontract exceeding \$100,000 financed in whole or in part with American Rescue Plan Act funding.
8. The contractor shall comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq.
9. The contractor shall report each violation to LFUCG and understands and agrees that LFUCG will, in turn, report each violation as required to assure notification to the Treasury Department and the appropriate Environmental Protection Agency Regional Office.
10. The contractor shall include these requirements in numerical paragraphs 8 and 9 in each subcontract exceeding \$100,000 financed in whole or in part with American Rescue Plan Act funds.
11. The contractor shall comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq.
12. The contractor shall report each violation to LFUCG and understands and agrees that LFUCG will, in turn, report each violation as required to assure notification to the Treasury Department and the appropriate Environmental Protection Agency regional office.
13. The contractor shall include these requirements in numerical paragraphs 11 and 12 in each subcontract exceeding \$100,000 financed in whole or in part with American Rescue Plan Act funds.
14. The contractor shall include this language in any subcontract it executes to fulfill the terms of this bid: “the sub-grantee, contractor, subcontractor, successor, transferee, and



assignee shall comply with Title VI of the Civil Rights Act of 1964, which prohibits recipients of federal financial assistance from excluding from a program or activity, denying benefits of, or otherwise discriminating against a person on the basis of race, color, or national origin (42 U.S.C. § 2000d et seq.), as implemented by the Department of the Treasury's Title VI regulations, 31 CFR Part 22, which are herein incorporated by reference and made a part of this contract (or agreement). Title VI also includes protection to persons with 'Limited English Proficiency' in any program or activity receiving federal financial assistance, 42 U.S.C. § 2000d et seq., as implemented by the Department of the Treasury's Title VI regulations, 31 CFR Part 22, and herein incorporated by reference and made a part of this contract or agreement."

15. Contractors who apply or bid for an award of \$100,000 or more shall file the required certification that it will not and has not used federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency. Each tier certifies to the tier above that it will not and has not used federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-federal funds that takes place in connection with obtaining any federal award. Such disclosures are forwarded from tier to tier, up to the recipient. The required certification is included here:

- a. The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including

subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

- b. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

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Signature

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Date

**PART II**  
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## **PART II**

### **INFORMATION FOR BIDDERS**

#### **1. RECEIPT AND OPENING OF BIDS**

The Lexington-Fayette Urban County Government (herein called the OWNER) invites bids from firms on the project described in the Advertisement for Bids. The OWNER will receive bids online through Ion Wave (<https://lexingtonky/ionwave.net>) at the time and in the manner set forth in the Advertisement for Bids, at which time the bids will be opened electronically. The OWNER may consider informal any Bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all Bids. Any Bid may be withdrawn prior to the scheduled time for the opening of Bids or authorized postponement thereof. Any Bid received after the time and date specified shall not be considered. No Bidder may withdraw a Bid within ninety (90) days after the actual time and date of the Bid opening, but OWNER may, in its sole discretion, release any Bid and return the Bid Security prior to that date.

The OWNER assumes no responsibility for Bids that are not submitted electronically as indicated above. Bids that are not submitted online by the stated time and date will be rejected.

#### **2. PREPARATION OF BID**

Each bid must be submitted on the prescribed digital Bid Form within Ion Wave. All blank spaces for the Bid prices must be filled in or the bid will be considered incomplete. Each Bid must be submitted online via Ion Wave.

#### **3. SUBCONTRACTS**

The bidder is specifically advised that any person, firm, or other party to whom it is proposed to award a subcontract under this Contract must be acceptable to the OWNER. All proposed subcontractors must be identified on the Form of Proposal. Prior to the award of Contract, the OWNER or the OWNER'S representative will advise the CONTRACTOR of the acceptance and approval thereof or of any action necessary to be taken. Should any Subcontractor be rejected by the OWNER, the CONTRACTOR shall present a new name and/or firm to the OWNER at no change in the Contract Price.

#### **4. QUALIFICATION OF BIDDER**

The OWNER may make such investigations as the OWNER deems necessary to determine the ability of the bidder to perform the Work, and the bidder shall furnish to the OWNER all such information and data for this purpose as the OWNER may request. The OWNER reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the OWNER that such bidder is properly qualified to carry out the obligations of the Contract and to complete the Work contemplated therein. Conditional bids will not be accepted.

In evaluating Bids, OWNER shall consider the qualifications of the BIDDERS, whether or not the Bids comply with the prescribed requirements, and alternatives and unit prices, as requested. OWNER may consider maintenance requirements, performance data, and disruption or damage to private property. It is OWNER'S intent to accept alternatives, if requested by the bid forms, in the order in which they are listed in the Bid Form but OWNER may accept or decline them in any order or combination. The contract, if awarded, will be awarded to the lowest, qualified, responsible BIDDER based upon OWNER'S evaluation which indicates that the award will be in the best interest of OWNER and the general public.

In the event there is any question as to the bidder's qualifications and ability to complete the work, a final determination will be made in accordance with a fair evaluation by the Urban County Government of the above listed elements.

- A. If the OWNER requires filling out a detailed financial statement, the bidder may provide its current certified financial statement(s) for the required time interval.
- B. Corporate firms are required to be registered and in good standing with the requirements and provisions of the Office of the Secretary of State, Commonwealth of Kentucky.
- C. Good standing with Public Works Act - any CONTRACTOR and/or subcontractors in violation of any wage or work act provisions (KRS 337.510 to KRS 337.550) are prohibited by Statutory Act (KRS 337.990) from bidding on or working on any and all public works contracts, either in their name or in the name of any other company, firm or other entity in which he might be interested. No bid from a prime contractor in violation of the Act can be considered, nor will any subcontractor in violation of the Act be approved and/or accepted. The responsibility for the qualifications of the subcontractor is solely that of the prime contractor.
- D. Documents Required of CONTRACTOR - (1) A sworn statement signed by the President or owner of the Company regarding all current work in progress anywhere; (2) A document showing the percent of completion of each project and the total worth of each project; and (3) Documentation showing the percentage of the DBE employment levels on each project of the Bidder's current work force, and DBE participation levels for Subcontractors.
- E. Optional OWNER Requirements--The OWNER, at its discretion, may require the BIDDER/CONTRACTOR to provide: (1) A current detailed financial statement for a period including up to 3 prior years. (2) Financial security or insurance in amounts and kinds acceptable to the OWNER to meet the financial responsibility requirements for the CONTRACTOR to indemnify the OWNER. (3) Additional information and/or DBE work force data, as well as DBE participation data.
- F. Each bidder agrees to waive any claim it has or may have against the OWNER, the Architect/ENGINEER, and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any bid.

## **5. BID SECURITY**

- A. Each bid must be accompanied by a bid bond prepared on a Form of Bid Bond and attached hereto, duly executed by the bidder as principal and having as surety thereon a surety company approved by the OWNER, in the amount of 5% of the bid. Such bid bond will be returned to the unsuccessful bidder(s) only upon written request to the Director of Central Purchasing within seven (7) days of opening of bids. Bid bond shall be made payable to the Lexington-Fayette Urban County Government. Bid security is not required for projects under \$50,000.
- B. Bonds shall be placed with an agent licensed in Kentucky with surety authorized to do business within the state. When the premium is paid for such coverage, the full commission payable shall be paid to such local agent who shall not divide such commission with any person other than a duly licensed resident local agent.
- C. Electronic, scanned bid bond(s) will be accepted and shall be uploaded to Ion Wave prior to close of bid.

## **6. LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT**

The successful bidder, upon his failure or refusal to execute and deliver the Contract and bonds required within ten (10) days after he has received notice of the acceptance of his bid, shall forfeit to the OWNER, as liquidated damages for such failure or refusal, the security deposited with his bid.

## **7. TIME OF COMPLETION AND LIQUIDATED DAMAGES**

Bidder must agree to commence work on or before a date to be specified in a written "Notice to Proceed" from the OWNER and to fully complete the Project within the time as specified in the Contract. Bidder must agree also to pay \$1,500.00 per day as liquidated damages, or the sum as specified in the Contract for each consecutive calendar day thereafter as hereinafter provided in the General Conditions.

## **8. EXAMINATION OF CONTRACT DOCUMENTS AND SITE**

- A. It is the responsibility of each Bidder before submitting a Bid, to (a) examine the Contract Documents thoroughly, (b) visit the site(s) to become familiar with local conditions that may affect cost, progress, performance or furnishing of the work, (c) consider Federal, State and Local laws and regulations that may affect cost, progress, performance or furnishing of the work, (d) study and carefully correlate Bidder's observations with the Contract Documents, and (e) notify Engineer of all conflicts, errors or discrepancies in the Contract Documents.
- B. Bidders should examine the requirements of Section 4 of the General Conditions for information pertaining to subsurface conditions, underground structures, underground facilities, and availability of lands, easements, and rights-of-way. The completeness of data, presented in the Contract Documents, pertaining to subsurface conditions, underground structures, and underground facilities for the purposes of bidding or construction is not assured. The Bidder will, at Bidder's own expense,

make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data which pertain to the physical conditions (surface and subsurface) which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents. On request in advance, OWNER will provide access to the site to conduct such explorations and tests as each Bidder deems necessary for submission of a bid. Bidder shall fill all holes, clean up and restore the site to its former condition upon completion of such explorations.

- C. The submission of a Bid will constitute an incontrovertible representation by the Bidder that Bidder has complied with every requirement of this paragraph 8; that without exception the Bid is premised upon furnishing and performing the Work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents; and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

## **9. ADDENDA AND INTERPRETATIONS**

No interpretation of the meaning of the Contract Documents will be made to any bidder orally. Every request for such interpretation should be in writing addressed to the Director of Central Purchasing, who in turn will have an addendum issued under signature of the Engineer for the Lexington-Fayette Urban County Government, and to be given consideration must be received prior to the date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the specifications which, if issued, will be mailed by certified mail with return receipt requested or faxed to all prospective bidders. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under his bid as submitted. All addenda so issued shall become part of the Contract Documents.

## **10. SECURITY FOR FAITHFUL PERFORMANCE**

- A. Simultaneously with his delivery of the executed Contracts, the CONTRACTOR shall furnish a surety bond or bonds as security for the faithful performance of this Contract and for payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract, as specified in the General Conditions. The surety on such bond or bonds shall be a duly authorized surety company satisfactory to the OWNER and authorized to do business in the Commonwealth of Kentucky.
- B. All bonds required by this Contract and laws of this State shall be placed with agents licensed in the State of Kentucky. When the premium is paid for such coverage's, the full commission shall be paid to such local agent who shall not divide such commission with any person other than a duly licensed resident local agent.

- C. **CONTRACTOR shall use standard Performance and Payment Bond forms such as documents provided with this contract book or AIA form A312-1984 (or later). Each document shall be for 100% of the Contract Bid Amount.**

**11. POWER OF ATTORNEY**

Attorney-in-fact who signs bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

**12. TAXES AND WORKMEN'S COMPENSATION**

The CONTRACTOR and subcontractor will be required to accept liability for payment of all payroll taxes, sales and use tax, and all other taxes or deductions required by local, state or federal law, such as old age pension, social security, or annuities measured by wages. Each shall carry Workmen's Compensation Insurance to the full amounts as required by Statutes and shall include the cost of all foregoing items in the proposal. The CONTRACTOR will not otherwise be reimbursed or compensated for such tax payments. The CONTRACTOR is urged to ascertain at his own risk his actual tax liability in connection with the execution or performance of his Contract.

**13. LAWS AND REGULATIONS**

The bidder's attention is directed to the fact that all applicable state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the Contract throughout, and they will be deemed to be included in the contract, the same as though herein written out in full.

**14. EROSION AND SEDIMENT CONTROL AND PERMITS**

The CONTRACTOR and Subcontractors performing work on projects on behalf of the OWNER shall also comply with all applicable federal, state, and local environmental regulations and all requirements and conditions set forth in "special" permits including but not limited to Corp of Engineers 404 permits, 401 Water Quality Certifications, Stream Crossing and Floodplain Encroachment Permits as described in Part 4 General Conditions Paragraph 5.17.

**15. PREVAILING WAGE LAW AND MINIMUM HOURLY RATES**

Federal or state wage rates and regulations, if required for this Project, will be as described in the Special Conditions.

**16. AFFIRMATIVE ACTION PLAN**

The successful Bidder must submit with their bid, the following items to the Urban County Government:

1. Affirmative Action Plan for his/her firm – see Part II
2. Current Work Force Analysis Form – see Part III



3. Good Faith Effort Documentation – see Part III
4. List of Disadvantaged Business Enterprise Subcontractors and the Dollar Value of each Subcontract – see Part III

A Work Force Analysis Form shall be submitted for each Contract. Failure to submit these items as required herein may result in disqualification of the Bidder from award of the Contract.

All submissions should be directed to:

Director, Division of Central Purchasing  
Lexington-Fayette Urban County Government  
200 East Main Street, Third Floor  
Lexington, Kentucky 40507

## **17. CONTRACT TIME**

The number of calendar days within which the Work is to be substantially completed and ready for final payment (the Contract Time) is set forth in the Form of Proposal and the Agreement.

## **18. SUBSTITUTE OR "OR-EQUAL" ITEMS**

The Contract, if awarded, will be on the basis of materials and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by the CONTRACTOR if acceptable to the ENGINEER and OWNER, application for such acceptance will not be considered by the ENGINEER and OWNER until after the effective date of the Agreement. The procedure for submission of any such application by the CONTRACTOR and consideration by the ENGINEER and OWNER is set forth in the General Conditions.

## **19. BASIS OF BID–LUMP SUM BASE BID**

**Bidders shall submit a Bid on a lump sum base bid basis.**

## **20. CASH ALLOWANCES**

For cash allowances the Contract Price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents. The final Contract Price will be adjusted to reflect actual costs on account of cash allowances

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

Short Circuit, Coordination and Arc

Section 26 05 73–Power System Study

## **21. ALTERNATE BIDS**

**Bidders shall submit alternate bids/proposals only if and when such alternate bids/proposals have been specifically requested in an Invitation for Bids.** If alternate bids/proposals are requested in an Invitation for Bids, the form of submission of such alternate bid and the conditions under which such alternate bids will be considered for award of a contract will be established in the Invitation.

Any Bidder who submits a bid incorporating an alternate proposal when alternate bids/proposals have not been requested in the Invitation for Bids shall have his/her bid rejected as non-responsive.

Any Bidder who submits a bid incorporating two (2) or more prices for an item or groups of items (unless such method of pricing is requested in the Invitation for Bids), or which imposes conditions for acceptance other than those established in the Invitation for Bids, shall have their bid rejected as non-responsive.

## **22. SIGNING OF AGREEMENT**

When OWNER gives a Notice of Award to the successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within ten days thereafter, CONTRACTOR shall sign and deliver the required number of counterparts of the Agreement and attached documents to OWNER with the required Bonds, Certificate of Insurance, and Power of Attorney. The OWNER will deliver one fully signed counterpart to CONTRACTOR at such time as it has been signed by the Mayor.

## **23. ASSISTANCE TO BE OFFERED TO DISADVANTAGED BUSINESS ENTERPRISE (DBE) CONTRACTORS**

### **I. Outreach**

The Lexington-Fayette Urban County Government (LFUCG) maintains a mailing list of DBE contractors and organizations. When a LFUCG construction project is advertised for bidding, notices are sent to the entire mailing list. The notices describe the project, indicate the deadline for submitting bids, and review the bonding assistance which is available.

If you wish to be added to the LFUCG DBE contractor mailing list, please contact:

Sherita Miller  
Division of Central Purchasing  
Lexington-Fayette Urban County Government  
200 East Main Street, Room 338  
Lexington, Kentucky 40507

## **II. Bid Bond Assistance**

For those DBE contractors who wish to bid on LFUCG project, bid bond assistance is available. This bid bond assistance is in the form of a “Letter of Certification” which is accepted by the LFUCG’s Division of Purchasing, in lieu of a bid bond. The “Letter of Certification” must be included in the bid package when it is submitted to the Division of Purchasing. The “Letter of Certification” will reference the specific project for which the bid is being submitted, and the time and date on which the bid is due. Bid bond assistance must be requested from the Lexington-Fayette Urban County Government’s Division of Central Purchasing.

## **III. Eligibility for Bid Bonding Assistance**

In order to be eligible for any bid bonding assistance, a DBE construction company must be owned or controlled at the level of 51% or more, by a member or members of a minority group or females. Prior to receiving assistance, a statement providing evidence of ownership and control of the company by a member or members of a minority group or females must be signed by the OWNER or corporate officer and by an attorney or accountant and submitted to:

Sherita Miller  
Division of Central Purchasing  
Lexington-Fayette Urban County Government  
200 East Main Street, Room 338  
Lexington, Kentucky 40507

## **IV. Subcontractors**

The LFUCG will, upon request, assist prime contractors in the procurement of eligible DBE subcontractors in an effort to achieve the 10% minimum DBE goal.

For a list of eligible DBE subcontractors please contact:

Sherita Miller  
Division of Central Purchasing  
Lexington-Fayette Urban County Government  
200 East Main Street, Room 338  
Lexington, Kentucky 40507

**V. Questions**

If you have questions or wish to have additional information, please contact:

Brian Marcum  
Division of Central Purchasing  
Lexington-Fayette Urban County Government  
200 East Main Street, 3<sup>rd</sup> Floor  
Lexington, Kentucky 40507  
(859) 258-3320

END OF SECTION

### **PART III**

### **FORM OF PROPOSAL**

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**PART III**  
**FORM OF PROPOSAL**

**LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT**  
**LEXINGTON, KENTUCKY**  
**TOWN BRANCH AND WEST HICKMAN WWTP**  
**UV DISINFECTION PROCESS REPLACEMENT PROJECT**  
**BID NO. 131-2024**

Place: Lexington, Kentucky

Date: 10/15/24

The following Form of Proposal shall be followed exactly in submitting a proposal for this Work.

This Proposal Submitted by Herrick Company, Inc.

780 Enterprise Dr, Lexington, KY 40510  
(Name and Address of Bidding Contractor)

(Hereinafter called "Bidder"), organized and existing under the laws of the State of  
Kentucky, doing business as a corporation  
"a corporation," "a partnership", or an "individual" as applicable.

To: Lexington-Fayette Urban County Government  
(Hereinafter called "OWNER")  
Office of the Director of Purchasing  
200 East Main Street, 3rd Floor  
Lexington, KY 40507

Sir or Madam:

The Bidder, in compliance with your Invitation for Bids for the **TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION PROCESS REPLACEMENT PROJECT** having examined the Plans and Specifications with related documents, having examined the site for proposed Work, and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of materials and labor, hereby proposes to furnish all labor, materials, and supplies, and to construct the Project in accordance with the Contract Documents, within the time set forth therein, and at the lump sum and/or unit prices stated hereinafter. These prices are to cover all expenses incurred in performing the Work required under the Contract Documents, of which this proposal is a part. The OWNER will issue work orders for work to be performed under this Contract.

BIDDER hereby agrees to commence work under this contract on or before a date to be specified in the Notice to Proceed and to fully complete the project within the time provided in the Purchase Order or Work Orders issued by the OWNER. BIDDER further agrees to pay liquidated damages, the sum of **\$1,500.00** for each consecutive calendar day thereafter.

The Bidder hereby acknowledges receipt of the following addenda:

Addendum No. 1 Date 9/24/24

Addendum No. 2 Date 10/2/24

Addendum No. 3 Date 10/8/24

Addendum No.      Date             

Addendum No.      Date             

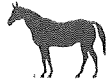
Addendum No.      Date             

Addendum No.      Date             

Addendum No.      Date             

Insert above the number and the date of any Addendum issued and received. If none has been issued and received, the word "NONE" should be inserted.

MAYOR LINDA GORTON



**LEXINGTON**

TODD SLATIN  
DIRECTOR  
CENTRAL PURCHASING

**ADDENDUM #1**

Bid Number: **#131-2024**

Date: September 24 2024

Subject: Town Branch & West Hickman WWTP UV Disinfection Process Replacement Project

Address inquiries to:  
Brian Marcum  
[brianm@lexingtonky.gov](mailto:brianm@lexingtonky.gov)  
(859) 258-3325

**TO ALL PROSPECTIVE SUBMITTERS:**

Please be advised of the following clarifications to the above referenced Bid:

1. Please see the attached information.

Todd Slatin, Director  
Division of Central Purchasing

All other terms and conditions of the Bid and specifications are unchanged.  
This letter should be signed, attached to and become a part of your Bid.

COMPANY NAME: Herrick Company, Inc.

ADDRESS: 780 Enterprise Dr, Lexington, KY 40510

SIGNATURE OF BIDDER: 

Cody M. Lokits





MAYOR LINDA GORTON



**LEXINGTON**

TODD SLATIN  
DIRECTOR  
CENTRAL PURCHASING

**ADDENDUM #2**

Bid Number: **#131-2024**

Date: October 2, 2024

Subject: Town Branch & West Hickman WWTP UV Disinfection Process Replacement Project

Address inquiries to:  
Brian Marcum  
[brianm@lexingtonky.gov](mailto:brianm@lexingtonky.gov)  
(859) 258-3325

**TO ALL PROSPECTIVE SUBMITTERS:**

Please be advised of the following clarifications to the above referenced Bid:

1. Please see the attached information.
2. Geotechnical and original plant drawings are available to download at Lynn Imaging.

Todd Slatin, Director  
Division of Central Purchasing

All other terms and conditions of the Bid and specifications are unchanged.  
This letter should be signed, attached to and become a part of your Bid.

COMPANY NAME: Herrick Company, Inc.

ADDRESS: 780 Enterprise Dr, Lexington, KY 40510

SIGNATURE OF BIDDER: \_\_\_\_\_

Cody M. Lokits



MAYOR LINDA GORTON



**LEXINGTON**

TODD SLATIN  
DIRECTOR  
CENTRAL PURCHASING

**ADDENDUM #3**

Bid Number: **#131-2024**

Date: October 8, 2024

Subject: Town Branch & West Hickman WWTP UV Disinfection Process Replacement Project

Address inquiries to:  
Brian Marcum  
[brianm@lexingtonky.gov](mailto:brianm@lexingtonky.gov)  
(859) 258-3325

**TO ALL PROSPECTIVE SUBMITTERS:**

Please be advised of the following clarifications to the above referenced Bid:

1. Please see the attached information.

Todd Slatin, Director  
Division of Central Purchasing

All other terms and conditions of the Bid and specifications are unchanged.  
This letter should be signed, attached to and become a part of your Bid.

COMPANY NAME: Herrick Company, Inc.

ADDRESS: 780 Enterprise Dr, Lexington, KY 40510

SIGNATURE OF BIDDER:

Cody M. Lokits





# LEXINGTON

## **Bid 131-2024 Addendum 4**

### **Herrick Company, Inc.**

### **Supplier Response**

#### **Event Information**

Number: Bid 131-2024 Addendum 4  
Title: Town Branch and West Hickman WWTP UV Disinfection Process  
Replacement Project  
Type: Competitive Bid  
Issue Date: 9/3/2024  
Deadline: 10/15/2024 02:00 PM (ET)

#### **Contact Information**

Contact: Brian Marcum  
Address: Central Purchasing  
Government Center Building  
200 East Main Street  
Lexington, KY 40507  
Phone: (859) 2583320  
Fax: (859) 2583322  
Email: [brianm@lexingtonky.gov](mailto:brianm@lexingtonky.gov)

## Herrick Company, Inc. Information

Contact: Cody M Lokits  
Address: 780 Enterprise Drive  
Lexington, KY 40510  
Phone: (859) 592-2022  
Fax: (502) 839-0939  
Email: cody@hci96.com

ONLY ONLINE BIDS WILL BE ACCEPTED! By submitting your response, you certify that you are authorized to represent and bind your company and that you agree to all bid terms and conditions as stated in the attached bid/RFP/RFQ/Quote/Auction documents.

Cody M Lokits

Signature

cody@hci96.com

Email

Submitted at 10/15/2024 01:48:29 PM (ET)

## Response Attachments

### Bid Form Complete - LFUCG TB & WH WWTPs UV Replacement.pdf

Required Bid Attachment

## Bid Lines

1	Replace Unsuitable Foundation Material for <b>Structures and Roads</b> (Section 31 23 00—Excavation, Fill, Backfill, and Grading) (Line excluded from response total) Quantity: <u>100</u> UOM: <u>Cubic Yard</u> Price: <u>\$125.00</u> Total: <u>\$12,500.00</u>
2	Replace Unsuitable Foundation Material for <b>Utility Trenches</b> (Section 31 23 00—Excavation, Fill, Backfill, and Grading) (Line excluded from response total) Quantity: <u>100</u> UOM: <u>Cubic Yard</u> Price: <u>\$125.00</u> Total: <u>\$12,500.00</u>
3	Lump Sum Base Bid Quantity: <u>1</u> UOM: <u>Lump Sum</u> Price: <u>\$13,700,000.00</u> Total: <u>\$13,700,000.00</u>

**Response Total: \$13,700,000.00**

2. **LEGAL STATUS OF BIDDER**

Bidder Herrick Company, Inc.

Date 10/15/24

\* 1. A corporation duly organized and doing business under the laws of the State of Kentucky \_\_\_\_\_, for whom Cody M. Lokits \_\_\_\_\_, bearing the official title of President \_\_\_\_\_, whose signature is affixed to this Bid/Proposal, is duly authorized to execute contracts.

~~\* 2. A Partnership, all of the members of which, with addresses are: (Designate general partners as such)~~

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~~\* 3. An individual, whose signature is affixed to this Bid/Proposal (please print name)~~

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\*(The Bidder shall fill out the appropriate form and strike out the other two.)

3. **BIDDERS AFFIDAVIT**

Comes the Affiant, Cody M. Lokits, and after being first duly sworn, states under penalty of perjury as follows:

1. His/her name is Cody M. Lokits and he/she is the individual submitting the bid or is the authorized representative of Herrick Company, Inc., the entity submitting the bid (hereinafter referred to as "Bidder").

2. Bidder will pay all taxes and fees, which are owed to the Lexington-Fayette Urban County Government at the time the bid is submitted, prior to award of the contract and will maintain a "current" status in regard to those taxes and fees during the life of the contract.

3. Bidder will obtain a Lexington-Fayette Urban County Government business license, if applicable, prior to award of the contract.

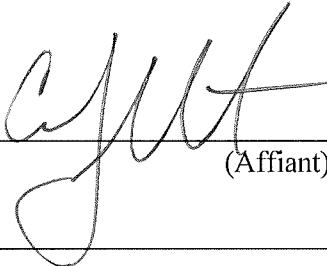
4. Bidder has authorized the Division of Central Purchasing to verify the above-mentioned information with the Division of Revenue and to disclose to the Urban County Council that taxes and/or fees are delinquent or that a business license has not been obtained.

5. Bidder has not knowingly violated any provision of the campaign finance laws of the Commonwealth of Kentucky within the past five (5) years and the award of a contract to the Bidder will not violate any provision of the campaign finance laws of the Commonwealth.

6. Bidder has not knowingly violated any provision of Chapter 25 of the Lexington-Fayette Urban County Government Code of Ordinances, known as the "Ethics Act."

7. Bidder acknowledges that "knowingly" for purposes of this Affidavit means, with respect to conduct or to circumstances described by a statute or ordinance defining an offense, that a person is aware or should have been aware that his conduct is of that nature or that the circumstance exists.


Further, Affiant sayeth naught.

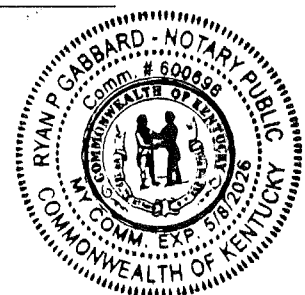
  
\_\_\_\_\_  
(Affiant)

STATE OF Kentucky

COUNTY OF Fayette

The foregoing instrument was subscribed, sworn to and acknowledged before me by  
Cody M. Lokits on this the 15th day of October  
2024.

My Commission expires: 5/8/26  
  
\_\_\_\_\_  
NOTARY PUBLIC, STATE AT LARGE



**4. LUMP SUM BASE BID**

The Bidder agrees to perform all the Work described in the Specifications and shown on the Plans for the following lump sum and/or unit prices which shall include the furnishing of all labor, materials, supplies, services, equipment and/or vehicle usage, all items of cost, overhead, taxes (federal, state, local), and profit for the CONTRACTOR and any Subcontractor involved. The Bidder must make the extensions and additions showing the total amount of bid. The contract, if awarded, will be on the basis of material and equipment specified in the specification without consideration of possible substitute or "Or equal" items. (Per article 18 of the Information for Bidders). The LFUCG reserves the right to award the bid in its best interest and within fiscal constraints.

Amount shall be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.

LUMP SUM BASE BID:

Thirteen Million, Seven Hundred Thousand

	Dollars \$	13,700,000.00
(Words)		(Numbers)

See Section 01 29 00—Contract Considerations for discussion of cash allowances to include in the Bid.

Contract award will be made based on the Lump Sum Base Bid. The price for all Base Bid Equipment items shall be included in the Lump Sum Base Bid.

OWNER reserves the right to accept or reject any Equipment Alternatives to the Lump Sum Base Bid. If Alternatives designated by the OWNER are considered in the Award, the Alternatives shall be accepted in the sequence identified below and the lowest Lump Sum Bid shall be computed on the Base Bid. Consideration of Equipment Alternatives of the selected Bidder will be made by OWNER within 60 days after the Effective Date of the Agreement.

## CASH ALLOWANCES

The following Cash Allowances shall be included in the Lump Sum Base Bid. The Cash Allowances for non Lump Sum items shall be equal to the product of the quantity included in the Lump Sum Base Bid and the Unit Price. The Cash Allowances will be adjusted in the event that estimated quantities to be included in the Lump Sum Base Bid are different from final measured quantities. A single Unit Price shall be bid for each item. Failure to include one or more of the following Unit Price items may result in rejection of the entire Bid as nonconforming. For items with a quantity of 1, the Cash Allowance shall be adjusted based on actual final costs.

Item Number	Description	Estimated Quantity Included in the Lump Sum Base Bid	Unit	Bid Unit Price	Total Bid Price Included in the Lump Sum Base Bid
1.	Replace Unsuitable Foundation Material for Structures and Roads (Section 31 23 00—Excavation, Fill, Backfill, and Grading)	100	CY	\$  125.00	\$  12,500.00
2.	Replace Unsuitable Foundation Material for Utility Trenches (Section 31 23 00—Excavation, Fill, Backfill, and Grading)	100	CY	\$  125.00	\$  12,500.00



Submitted by: Herrick Company, Inc.  
*Firm*

780 Enterprise Dr  
*Address*

Lexington, KY 40510  
*City, State & Zip*

***Bid must be signed:  
(original signature)***  Pres./CEO  
***Signature of Authorized Company Representative – Title***

Cody M Lokits, President  
*Representative/s Name (Typed or Printed)*

859-699-2961 502-839-0939  
*Area Code – Phone – Extension* *Fax #*

cody@hci96.com  
*E-Mail Address*

OFFICIAL ADDRESS:

Herrick Company, Inc.

780 Enterprise Dr

Lexington, KY 40510

\_\_\_\_\_  
(Seal if Bid is by Corporation)

by signing this form you agree to ALL of the terms and associated forms.

## 5. STATEMENT OF BIDDER'S QUALIFICATIONS

The following statement of the Bidder's qualifications is required to be filled in, executed, and submitted with the Proposal:

1. Name of Bidder: Herrick Company, Inc.
2. Permanent Place of Business: 780 Enterprise Dr, Lexington, KY 40510
3. When Organized: January 1996
4. Where Incorporated: Kentucky
5. Construction Plant and Equipment Available for this Project:

See attached.

(Attach Separate Sheet If Necessary)

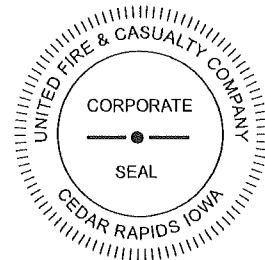
6. Financial Condition:

If specifically requested by the OWNER, the apparent low Bidder is required to submit its latest three (3) years audited financial statements to the OWNER'S Division of Central Purchasing within seven (7) calendar days following the bid opening.

7. In the event the Contract is awarded to the undersigned, surety bonds will be furnished by:

United Fire & Casualty Company (Surety)

Signed: Leigh McCarthy (Representative of Surety)  
Leigh McCarthy, Attorney-in-Fact



8. The following is a list of similar projects performed by the Bidder: (Attach separate sheet if necessary).

<u>NAME</u>	<u>LOCATION</u>	<u>CONTRACT SUM</u>
See attached.		

9. The Bidder has now under contract and bonded the following projects:

<u>NAME</u>	<u>LOCATION</u>	<u>CONTRACT SUM</u>
See attached.		

10. List Key Bidder Personnel who will work on this Project.

<u>NAME</u>	<u>POSITION DESCRIPTION</u>	<u>NO. OF YEARS WITH BIDDER</u>
See attached.		

11. DBE Participation on current bonded projects under contract:

<u>SUBCONTRACTORS</u> <u>(LIST)</u>	<u>PROJECT</u> <u>(SPECIFIC TYPE)</u>	<u>DBE</u>	<u>MAJORITY</u>
See attached.			

(USE ADDITIONAL SHEETS IF NECESSARY)

12. We acknowledge that, if we are the apparent low Bidder, we will submit to the OWNER within seven (7) calendar days following the Bid Opening, a sworn statement on the OWNER'S form regarding all current work on hand and under contract, and a statement on the OWNER'S form of the experience of our officers, office management and field management personnel. Additionally, if requested by the OWNER, we will within seven (7) days following the request submit audited financial statements and loss history for insurance claims for the three (3) most recent years (or a lesser period stipulated by the OWNER)—all in accordance with the Bid Documents.

**6. LIST OF PROPOSED SUBCONTRACTORS**

The following list of proposed subcontractors is required by the OWNER to be executed, completed and submitted with the BIDDER'S FORM OF PROPOSAL. All subcontractors are subject to approval of the Lexington-Fayette Urban County Government. Failure to submit this list completely filled out may be cause for rejection of bid.

<u>BRANCH OF WORK - LIST EACH</u> <u>MAJOR ITEM</u> Such as: Grading, bituminous paving, concrete, seeding and protection, construction staking, etc.	<u>SUBCONTRACTOR</u>	<u>DBE</u> <u>Yes/No</u>	<u>% of Work</u>
1. <u>Electrical</u>	Name: <u>AE Electrical Solutions</u> Address: <u>Frankfort, KY</u>	<u>No</u>	<u>16%</u>
2. <u>HVAC</u>	Name: <u>Bison Services</u> Address: <u>Foster, KY</u>	<u>No</u>	<u>1%</u>
3. <u>Paving</u>	Name: <u>Imperial Asphalt</u> Address: <u>Frankfort, KY</u>	<u>No</u>	<u>2%</u>
4. <u>Painting</u>	Name: <u>McKinney Painting</u> Address: <u>Versailles, KY</u>	<u>Yes</u>	<u>1%</u>
5. _____	Name: _____ Address: _____	_____	_____
6. _____	Name: _____ Address: _____	_____	_____
7. _____	Name: _____ Address: _____	_____	_____

(Attach additional sheet(s) if necessary.)

7. **AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND  
NON-CONFLICT OF INTEREST**

I hereby swear (or affirm) under the penalty for false swearing:

1. That I am the Bidder (if the Bidder is an individual), a partner of the Bidder (if the Bidder is a partnership), or an officer or employee of the bidding corporation having authority to sign on its behalf (if the Bidder is a corporation);
2. That the attached bid has been arrived at by the Bidder independently, and has been submitted without collusion with, and without any agreement, understanding or planned common course of action, with any other contractor, vendor of materials, supplies, equipment or services described in the Invitation to Bid, designed to limit independent bidding or competition;
3. That the contents of the bid or bids have not been communicated by the Bidder or its employees or agents to any person not an employee or agent of the Bidder or its surety on any bond furnished, with the bid or bids, and will not be communicated to any such person, prior to the official opening of the bid or bids;
4. That the Bidder is legally entitled to enter into the contracts with the Lexington-Fayette Urban County Government, and is not in violation of any prohibited conflict of interest;
5. (Applicable to corporation only) That as a foreign corporation, we are registered with the Secretary of State, Commonwealth of Kentucky, and authorized to do business in the State \_\_\_\_\_ or, that as a domestic corporation, we are in good standing with the Secretary of State, Commonwealth of Kentucky X \_\_\_\_\_. Check the statement applicable.
6. This offer is for 60 calendar days from the date this bid is opened. In submitting the above, it is expressly agreed that, upon proper acceptance by the Lexington-Fayette Urban County Government of any or all items bid above, a contract shall thereby be created with respect to the items accepted.
7. That I have fully informed myself regarding the accuracy of the statements made in this statement.

READ CAREFULLY – SIGN IN SPACE BELOW – FAILURE TO SIGN INVALIDATES BID.

Signed by , Pres./CEO  
Cody M. Lokits

Firm Herrick Company, Inc.

Address 780 Enterprise Dr

Lexington, KY 40510

Telephone 859-699-2961

Date 10/15/24

\*See attached

8. **STATEMENT OF EXPERIENCE**  
*(this section must be completed or your bid will be considered as non-responsive)*

NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

BY: Herrick Company, Inc.  
Name of Firm

DATE: 10/15/24

BY:   
Cody M. Lokits

TITLE: President

\* Include all officers, office management's, Affirmative Action officials, and field management personnel. (Attach separate sheets if necessary.)



## 9. EQUAL OPPORTUNITY AGREEMENT

### The Law

- \* Title VII of the Civil Rights Act of 1964 (amended 1972) states that it is unlawful for an employer to discriminate in employment because of race, color, religion, sex, age (40-70 years) or national origin.
- \* Executive Order No. 11246 on Nondiscrimination under Federal contract prohibits employment discrimination by contractor and subcontractor doing business with the Federal Government or recipients of Federal funds. This order was later amended by Executive Order No. 11375 to prohibit discrimination on the basis of sex.
- \* Section 503 of the Rehabilitation Act of 1973 States:  
*The Contractor will not discriminate against any employee or applicant for employment because of physical or mental handicap.*
- \* Section 2012 of the Vietnam Era Veterans Readjustment Act of 1973 requires Affirmative Action on behalf of disabled veterans and veterans of the Vietnam Era by contractors having Federal Contracts.
- \* Section 206 (A) of Executive Order 12086, Consolidation of Contract Compliance Functions for Equal Employment Opportunity, states:

*The Secretary of Labor may investigate the employment practices of any Government contractor or sub-contractor to determine whether or not the contractual provisions specified in Section 202 of this order have been violated.*

The Lexington-Fayette Urban County Government practices Equal Opportunity in recruiting, hiring and promoting. It is the Government's intent to affirmatively provide employment opportunities for those individuals who have previously not been allowed to enter into the mainstream of society. Because of its importance to the local Government, this policy carries the full endorsement of the Mayor, Commissioners, Directors, and all supervisory personnel. In following this commitment to Equal Employment Opportunity and because the Government is the benefactor of the Federal funds, it is both against the Urban County Government policy and illegal for the Government to let contracts to companies which knowingly or unknowingly practice discrimination in their employment practices. Violation of the above mentioned ordinances may cause a contract to be canceled and the contractor may be declared ineligible for future consideration.

Please sign this statement in the appropriate space acknowledging that you have read and understand the provisions contained herein. Return this document as part of your application packet.

### Bidders

I/We agree to comply with the Civil Rights Laws listed above that govern employment rights of minorities, women, Vietnam veterans, handicapped, and aged persons.

Signature

Cody M. Lokits

Herrick Company, Inc.

Name of Business

The Entity (regardless of whether construction contractor, non-construction contractor or supplier) agrees to provide equal opportunity in employment for all qualified persons, to prohibit discrimination in employment because of race, color, creed, national origin, sex or age, and to promote equal employment through a positive, continuing program from itself and each of its sub-contracting agents. This program of equal employment opportunity shall apply to every aspect of its employment policies and practices.

The Kentucky equal Employment Opportunity Act of 1978 (KRS 45.560-45.640) requires that any count, city, town, school district, water district, hospital district, or other political subdivision of the state shall include in directly or indirectly publicly funded contracts for supplies, materials, services, or equipment hereinafter entered into the following provisions:

During the performance of this contract, the contractor agrees as follows:

- (1) *The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age or national origin;*
- (2) *The contractor will state in all solicitations or advertisements for employees placed by or on behalf of the contractors that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age or national origin;*
- (3) *The contract will post notices in conspicuous places, available to employees and applicants for employment, setting forth the provisions of the non-discrimination clauses required by this section; and*
- (4) *The contractor will send a notice to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding advising the labor union or workers' representative of the contractor's commitments under the nondiscrimination clauses.*

The Act further provides:

KRS 45.610. Hiring minorities – Information required

- a. *For the length of the contract, each contractor shall hire minorities from other sources within the drawing area, should the union with which he has collective bargaining agreements be unwilling to supply sufficient minorities to satisfy the agreed upon goals and timetable.*
- b. *Each contractor shall, for the length of the contract, furnish such information as required by KRS 45.560 to KRS 45.640 and by such rules, regulations and orders issued pursuant thereto and will permit access to all books and records pertaining to his employment practices and work sites by the contracting agency and the department for purposes of investigation to ascertain compliance with KRS 45.560 to 45.640 and such rules, regulations and orders issued pursuant thereto.*

KRS 45.620. Action against contractor – Hiring of minority contractor or subcontractor

- (1) *If any contractor is found by the department to have engaged in an unlawful practice under this chapter during the course of performing under a contract or subcontract covered under KRS 45.560 to 45.640, the department shall so certify to the contracting agency and such certification shall be binding upon the contracting agency unless it is reversed in the course of judicial review.*
- (2) *If the contractor is found to have committed an unlawful practice under KRS 45.560 to 45.640, the contracting agency may cancel or terminate the contract, conditioned upon a program for future compliance approved by the contracting agency and the department. The contracting agency may declare such a contractor ineligible to bid on further contracts with that agency until such time as the contractor complies in full with the requirements of KRS 45.560 – 45.640.*
- (3) *The equal employment provisions of KRS 45.560 to 45.640 may be met in part by a contractor by subcontracting to a minority contractor or subcontractor. For the provisions of KRS 45.560 to 45.640, a minority contractor or subcontractor shall mean a business that is owned and controlled by one or more persons disadvantaged by racial or ethnic circumstances.*

KRS 45.630 Termination of existing employee not required, when

*Any provision of KRS 45.560 to 45.640 notwithstanding, no contractor shall be required to terminate an existing employee upon proof that that employee was employed prior to the date of the contract.*

KRS 45.640 Minimum skills

*Nothing in KRS 45.560 to 45.640 shall require a contractor to hire anyone who fails to demonstrate the minimum skills required to perform a particular job.*

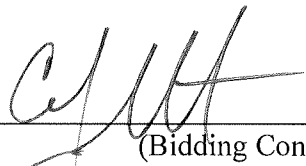
It is recommended that all of the provisions quoted above to be included as special conditions in each contract. In the case of a contract exceeding \$250,000, the contractor is required to furnish evidence that his work-force in Kentucky is representative of the available work-force in the area from which he draws employees, or to supply an Affirmative Action plan which will achieve such representation during the life of the contract.

10. **EQUAL EMPLOYMENT OPPORTUNITY AFFIRMATIVE ACTION POLICY**

It is the policy of Herrick Company, Inc.  
to assure that all applicants for employment and all employees are treated on a fair and equitable basis without regard to their race, religion, sex, color, handicap, natural origin or age.

Such action shall include employment, promotion, demotion, recruitment or recruitment advertising, layoff or termination, rates of pay and other forms of compensation, and selection for training, whether apprenticeship and/or on-the-job-training.

Furthermore, this company agrees to make special recruitment efforts to hire the protected class whenever feasible. This company also agrees to adhere to all applicable federal, state, and local laws relating to Equal Employment Opportunity for all individuals.

Signature:   
(Bidding Contractor) Cody M. Lokits

Title: President

Date: 10/15/24

# 11. WORKFORCE ANALYSIS FORM

Name of Organization: Herrick Company, Inc.

Date: 10 / 15 / 24

Categories	Total	White		Black		Other		Total	
		M	F	M	F	M	F	M	F
Administrators	4	4						4	
Professionals									
Superintendents	5	5						5	
Supervisors									
Foremen	2	2						2	
Technicians									
Protective Service									
Para-Professionals									
Office/Clerical	2		2						2
Skilled Craft	26	21				5		26	
Service/Maintenance									
Total:	39							37	2

Prepared By: Kayla J. Lokits

12. EVIDENCE OF INSURABILITY

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT CONSTRUCTION PROJECT  
(Use separate form for each Agency or Brokerage agreeing to provide coverage)

Names Insured: Herrick Company, Inc.

Employee ID: \_\_\_\_\_

Address: 780 Enterprise Dr

Phone: 502-839-3484

Lexington, KY 40510

Umbrella Policy Limit \$5,000,000  
Cincinnati Casualty Co  
004289 A+

Project to be insured: TB & WH WWTP UV Disinfection Process Replacement Project

In lieu of obtaining certificates of insurance at this time, the undersigned agrees to provide the above Named Insured with the minimum coverage listed below. These are outlined in the Insurance and Risk Management of Part V (Special Conditions), including all requirements, and conditions:

Section Items	Coverage	Minimum Limits and Policy Requirements	Limits Provided To Insured	Name of Insurer	A.M. Best's Code	Rating
SC 1.3.D.1 – see provisions	CGL	\$1,000,000 per occ. And \$2,000,000 aggregate	\$ \$2,000,000 Aggregate \$1,000,000 Occurrence	Selective Ins Company of America	000826	A+
SC 1.3.D.1 – see provisions	AUTO	\$2,000,000/per occ.	\$ \$1,000,000 Combined Single Limit	Selective Ins Co of America	000826	A+
SC 1.3.D.1 – see provisions	WC	Statutory w/endorsement as noted	\$ \$4,500,000 ea accident \$4,500,000 ea employee	KY Assoc of General Contractors	055002	A-

Section 2 includes required provisions, statements regarding insurance requirements, and the undersigned agrees to abide by all provisions of the coverage's checked above unless stated otherwise when submitting.

Marsh McLennan Agency

Sandy Q Black

Agency or Brokerage  
360 East Vine Street Ste 200

Name of Authorized Representative  
Senior Account Manager

Street Address  
Lexington KY 40507

Title  
Sandy Q Black

City  
859-254-8023

Authorized Signature  
10/09/2024

Telephone Number

Date

NOTE: Authorized signatures may be the agent's if agent has placed insurance through an agency agreement with the insurer. If insurance is brokered, authorized signature must be that of authorized representative of insurer.

**13. DEBARRED FIRMS**

**PROJECT NAME:** Town Branch and West Hickman WWTP UV Disinfection Process Replacement Project

**BID NUMBER:** 131-2024

**LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
LEXINGTON, KY**

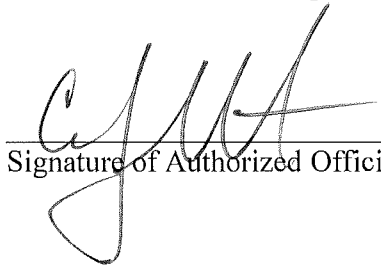
All prime Contractors shall certify that Subcontractors have not and will not be awarded to any firms that has been debarred for noncompliance with the Federal Labor Standards, Title VI of the Civil Rights Act of 1964 As Amended, Executive Order 11246 As Amended or any other Federal Law.

All bidders shall complete the attached certification in duplicate and submit both copies to the Owner with the bid proposal. The Owner (grantee) shall transmit one copy to the Lexington-Fayette Urban County Government, Division of Community Development, within fourteen (14) days after bid opening.

The undersigned hereby certifies that the firm of Herrick Company, Inc. has not and will not award a subcontract, in connection with any contract award to it as the result of this bid, to any firm that has been debarred for noncompliance with the Federal labor Standards, Title VI of the civil Rights Act of 1964, Executive Order 11246 as amended or any Federal Law.

Herrick Company, Inc.

Name of Firm Submitting Bid



Signature of Authorized Official      Cody M. Lokits

President

Title

10/15/24

Date

#### 14. DEBARMENT CERTIFICATION

All contractors/subcontractors shall complete the following certification and submit it with the bid proposal.


The contractor/subcontractor certifies in accordance with Executive Order 12549 (Debarment and Suspension 2/18/86) that to the best of its knowledge and belief, that it and its principals:

- 1) Are not presently debarred, suspended, proposed for debarment, declared negligible, or voluntarily excluded from covered transactions or contract by any Federal department or agency for noncompliance with the Federal Labor Standards, Title VI of the Civil Rights Act of 1964 as amended, Executive Order 11246 as amended or any other Federal law;
  - a) Have not within a three year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
  - b) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(a) of this certification; and
  - c) Have not within a three year period preceding this bid has one or more public (Federal, State or local) transactions or contracts terminated for cause or default.
- 2) Where the contractor is unable to certify to any of the statements in this certification, such prospective contractors shall attach an explanation to this certification form.

Firm Name: Herrick Company, Inc.

Project: TB & WH WWTP UV Disinfection Process Replacement Project

Printed Name and Title of Authorized Representative: Cody M Lokits, President

Signature: 

Date: 10/15/24

END OF SECTION



# Document A310™ – 2010

Conforms with The American Institute of Architects AIA Document 310

## Bid Bond

### CONTRACTOR:

(Name, legal status and address)

Herrick Company, Inc.  
780 Enterprise Dr  
Lexington, KY 40510

### SURETY:

(Name, legal status and principal place of business)

United Fire & Casualty Company  
PO Box 73909  
Cedar Rapids, IA 52407-3909

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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

### OWNER:

(Name, legal status and address)

Lexington-Fayette Urban County Government  
200 East Main Street  
Lexington, KY 40507

**BOND AMOUNT:** \$ 5%

Five Percent of Amount Bid

### PROJECT:

(Name, location or address, and Project number, if any)

Town Branch and West Hickman WWTP UV Disinfection Process Replacement Project, Lexington, KY

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, 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.

Signed and sealed this 15th day of October, 2024

  
(Witness) RYAN P GABBARD

Herrick Company, Inc.

(Principal)

(Seal)

By:

(Title)

PRESIDENT

CODY M. LOKITS

United Fire & Casualty Company

(Surety)

(Seal)

By:

(Title) Leigh McCarthy

Attorney-in-Fact

  
(Witness) Suzanna Knight





UNITED FIRE & CASUALTY COMPANY, CEDAR RAPIDS, IA  
UNITED FIRE & INDEMNITY COMPANY, WEBSTER, TX  
FINANCIAL PACIFIC INSURANCE COMPANY, LOS ANGELES, CA

Inquiries: Surety Department  
118 Second Ave SE  
Cedar Rapids, IA 52401

**CERTIFIED COPY OF POWER OF ATTORNEY**  
(original on file at Home Office of Company – See Certification)

KNOW ALL PERSONS BY THESE PRESENTS, That UNITED FIRE & CASUALTY COMPANY, a corporation duly organized and existing under the laws of the State of Iowa; UNITED FIRE & INDEMNITY COMPANY, a corporation duly organized and existing under the laws of the State of Texas; and FINANCIAL PACIFIC INSURANCE COMPANY, a corporation duly organized and existing under the laws of the State of California (herein collectively called the Companies), and having their corporate headquarters in Cedar Rapids, State of Iowa, does make, constitute and appoint Leigh McCarthy their true and lawful Attorney-in-Fact with power and authority hereby conferred to sign, seal and execute in its behalf all lawful bonds, undertakings and other obligatory instruments of similar nature provided that no single obligation shall exceed \$100,000,000.00

Surety Bond Number: Bid Bond  
Principal: Herrick Company, Inc.  
Obligee: Lexington-Fayette Urban County Government

and to bind the Companies thereby as fully and to the same extent as if such instruments were signed by the duly authorized officers of the Companies and all of the acts of said Attorney, pursuant to the authority hereby given and hereby ratified and confirmed.

The Authority hereby granted is continuous and shall remain in full force and effect until revoked by UNITED FIRE & CASUALTY COMPANY, UNITED FIRE & INDEMNITY COMPANY, AND FINANCIAL PACIFIC INSURANCE COMPANY.

This Power of Attorney is made and executed pursuant to and by authority of the following bylaw duly adopted by the Boards of Directors of UNITED FIRE & CASUALTY COMPANY, UNITED FIRE & INDEMNITY COMPANY, and FINANCIAL PACIFIC INSURANCE COMPANY.

**“Article VI – Surety Bonds and Undertakings”**

Section 2, Appointment of Attorney-in-Fact. “The President or any Vice President, or any other officer of the Companies may, from time to time, appoint by written certificates attorneys-in-fact to act in behalf of the Companies in the execution of policies of insurance, bonds, undertakings and other obligatory instruments of like nature. The signature of any officer authorized hereby, and the Corporate seal, may be affixed by facsimile to any power of attorney or special power of attorney or certification of either authorized hereby; such signature and seal, when so used, being adopted by the Companies as the original signature of such officer and the original seal of the Companies, to be valid and binding upon the Companies with the same force and effect as though manually affixed. Such attorneys-in-fact, subject to the limitations set forth in their respective certificates of authority shall have full power to bind the Companies by their signature and execution of any such instruments and to attach the seal of the Companies thereto. The President or any Vice President, the Board of Directors or any other officer of the Companies may at any time revoke all power and authority previously given to any attorney-in-fact.

IN WITNESS WHEREOF, the COMPANIES have each caused these presents to be signed by its vice president and its corporate seal to be hereto affixed this 21st day of September, 2023

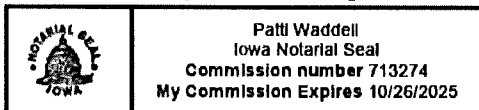


UNITED FIRE & CASUALTY COMPANY  
UNITED FIRE & INDEMNITY COMPANY  
FINANCIAL PACIFIC INSURANCE COMPANY

By: *Kyanna M. Saylor* Vice President

State of Iowa, County of Linn, ss:

On 21st day of September, 2023, before me personally came Kyanna M. Saylor to me known, who being by me duly sworn, did depose and say; that she resides in Cedar Rapids, State of Iowa; that she is a Vice President of UNITED FIRE & CASUALTY COMPANY, a Vice President of UNITED FIRE & INDEMNITY COMPANY, and a Vice President of FINANCIAL PACIFIC INSURANCE COMPANY the corporations described in and which executed the above instrument; that she knows the seal of said corporations; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said corporations and that she signed her name thereto pursuant to like authority, and acknowledges same to be the act and deed of said corporations.



*Patti Waddell* Notary Public  
My commission expires: 10/26/2025

I, Mary A. Bertsch, Assistant Secretary of United Fire & Casualty Company and Assistant Secretary of United Fire & Indemnity Company, and Assistant Secretary of Financial Pacific Insurance Company, do hereby certify that I have compared the foregoing copy of the Power of Attorney and affidavit, and the copy of the Section of the bylaws and resolutions of said Corporations as set forth in said Power of Attorney, with the ORIGINALS ON FILE IN THE HOME OFFICE OF SAID CORPORATIONS, and that the same are correct transcripts thereof, and of the whole of the said originals, and that the said Power of Attorney has not been revoked and is now in full force and effect.

In testimony whereof I have hereunto subscribed my name and affixed the corporate seal of the said Corporations  
this 15th day of October 2024.



By: *Mary A. Bertsch*

Assistant Secretary,  
UF&C & UF&I & FPIC

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**GENERAL CONDITIONS**  
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**PART IV**  
**GENERAL CONDITIONS**

**1. DEFINITIONS**

Wherever used in these General Conditions or the other Contract Documents, the following terms have the meanings indicated which are applicable to both the singular and plural thereof.

**1.1 Addenda**

Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bid Documents or the Contract Documents.

**1.2 Agreement**

The written agreement between the OWNER and the CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

**1.3 Application for Payment**

The form accepted by the ENGINEER which is to be used by the CONTRACTOR in requesting progress or final payments and which is to include such supporting documentation as is required by the Contract Documents.

**1.4 Bid**

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

**1.5 Bidder**

An individual, partnership, or corporation, who submit a Bid for a prime contract with the OWNER, for the Work described in the proposed Contract Documents.

**1.6 Bonds**

Bid, performance and payment bonds and other instruments of security.

**1.7 Calendar Day**

A calendar day of twenty-four hours measured from midnight to the next midnight shall constitute a day.

**1.8 Change Order**

A document recommended by the ENGINEER, which is signed by the CONTRACTOR and the OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.



**1.9 Contract Documents**

The Agreement, Addenda (which pertain to the Contract Documents), the CONTRACTOR's Bid (including documentation accompanying the Bid and any post-bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Bonds, these General Conditions, the Special Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all amendments, modifications and supplements.

**1.10 Contract Unit Price**

The monies payable by the OWNER to the CONTRACTOR under the Contract Documents as stated in the Agreement. Unit Prices are to be firm for the term of this Contract. Price Increase will only be allowed at Contract Renewal.

**1.11 Contract Time**

The number of consecutive calendar days between the date of issuance of the Notice to Proceed and the contract completion date.

**1.12 CONTRACTOR**

The person, firm or corporation with whom the OWNER has entered into the Agreement.

**1.13 Defective**

An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to the ENGINEER'S recommendation of final payment (unless responsibility for the protection thereof has been assumed by the OWNER).

**1.14 Drawings**

The Drawings which show the character and scope of the Work to be performed and which have been prepared or approved by the ENGINEER and are referred to in the Contract Documents.

**1.15 Effective Date of the Agreement**

The date indicated in the Agreement on which it becomes effective.

**1.16 ENGINEER**

The Lexington-Fayette Urban County Government Division of Water Quality or its authorized representative.

**1.17 Field Order**

A documented order issued by the ENGINEER which orders minor changes in the Work, but which does not involve a change in the Contract Price or the Contract Time.

**1.18 Giving Notice**

Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

**1.19 Laws and Regulations**

Laws, rules, regulations, ordinances, codes and/or orders.

**1.20 Notice of Award**

The written notice by the OWNER to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions enumerated therein, within the time specified, the OWNER will sign and deliver the Agreement.

**1.21 Notice to Proceed**

A written notice given by the OWNER to the CONTRACTOR fixing the date on which the Contract Time will commence to run and on which the CONTRACTOR shall start to perform the CONTRACTOR's obligations under the Contract Documents.

**1.22 OWNER**

The Lexington-Fayette Urban County Government.

**1.23 Partial Utilization**

Placing a portion of the Work in service for the purpose for which it is intended (or related purpose) before reaching Completion for all the Work.

**1.24 Project**

The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

**1.25 Inspector**

The authorized representative of the ENGINEER who is assigned to the site or any part thereof.

**1.26 Shop Drawings**

All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for the CONTRACTOR to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a Supplier and submitted by the CONTRACTOR to illustrate material or equipment for some portion of the Work.

**1.27 Specifications**

Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

**1.28 Standard Specifications**

The "Standard Specifications for Road and Bridge Construction", Transportation Cabinet, Department of Highways, Commonwealth of Kentucky, current edition. MUTCD shall refer to the "Manual of Uniform Traffic Control Devices.

**1.29 Subcontractor**

An individual, firm or corporation having a direct contract with the CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

**1.30 Special Conditions**

The part of the Contract Documents which amends or supplements these General Conditions.

**1.31 Supplier**

A manufacturer, fabricator, supplier, distributor, material man or vendor.

**1.32 Underground Facilities**

All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

**1.33 Unit Price Work**

Not Applicable

**1.34 Work**

The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

**1.35 Time Period**

When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

## **2. PRELIMINARY MATTERS**

### **2.1 Delivery of Bonds**

When the CONTRACTOR delivers the executed Agreements to the OWNER, the CONTRACTOR shall also deliver to the OWNER, such Bonds, Insurance Certificate, and Power of Attorney as the CONTRACTOR may be required to furnish.

### **2.2 Copies of Documents**

The OWNER shall furnish to the CONTRACTOR up to three copies (unless otherwise specified in the Special Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

### **2.3 Commencement of Contract Time; Notice to Proceed**

The Contract Time will commence to run on the day specified in the Notice to Proceed.

### **2.4 Starting the Project**

The CONTRACTOR shall start to perform the Work on the date when the Contract Time commences to run, but no Work shall be done at the site prior to the date on which the Contract Time commences to run.

### **2.5 Before Starting Construction**

Before undertaking each part of the Work, the CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. The CONTRACTOR shall promptly report in writing to the ENGINEER any conflict, error or discrepancy which the CONTRACTOR may discover and shall obtain a written interpretation or clarification from the ENGINEER before proceeding with any Work affected thereby; however, the CONTRACTOR shall not be liable to the OWNER or the ENGINEER for failure to report any conflict, error or discrepancy in the Contract Documents, unless the CONTRACTOR had actual knowledge thereof or should reasonably have known thereof.

### **2.6 Submittal of Schedules**

Within ten days after the effective date of the Agreement (unless otherwise specified) the CONTRACTOR shall submit to the ENGINEER for review:

**2.6.1** an estimated progress schedule indicating the starting and completion dates of the various stages of the Work;

**2.6.2** a preliminary schedule of Shop Drawing submissions; and

**2.6.3** a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the

basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work which will be confirmed in writing by the CONTRACTOR at the time of submission.

## **2.7 Preconstruction Conference**

Before the CONTRACTOR starts the Work at the proposed site, a conference attended by the CONTRACTOR, the ENGINEER, EEO-Affirmative Action Officer, and other appropriate parties will be held to discuss the following issues: (1) The scheduling of the Work to be completed; (2) The procedures for handling shop drawings and other submittals; (3) The processing of applications for payment; (4) The establishment of an understanding among the involved parties in regard to the proposed project; and (5) The establishment of procedures for effectively implementing the LFUCG's 10% minimum DBE goals.

## **2.8 Finalizing Schedules**

At least ten days before submission of the first Application for Payment a conference attended by the CONTRACTOR, the ENGINEER and others as appropriate will be held to finalize the schedules submitted in accordance with paragraph 2.6. The finalized progress schedule will be acceptable to the ENGINEER as providing orderly progression of the Work to completion within the Contract Time, but such acceptance will neither impose on the ENGINEER responsibility for the progress or scheduling of the Work nor relieve the CONTRACTOR from full responsibility thereof. The finalized schedule of Shop Drawing submissions will be acceptable to the ENGINEER as providing a workable arrangement for processing the submissions. The finalized schedule of values will be acceptable to the ENGINEER as to form and substance.

# **3. CONTRACT DOCUMENTS: INTENT, CONFLICTS, AMENDING AND REUSE**

## **3.1 General**

The Contract Documents comprise the entire agreement between the OWNER and the CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

## **3.2 Intent**

It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result will be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe Work, materials or equipment such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall

mean the latest standard specification, manual, code or laws or regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of the OWNER, the CONTRACTOR or the ENGINEER, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor shall it be effective to assign to the ENGINEER, or any of the ENGINEER's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 8.12.3 or 8.12.4. Clarifications and interpretations of the Contract Documents shall be issued by the ENGINEER as provided in paragraph 8.4.

### **3.3 Conflicts**

If, during the performance of the Work, the CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, the CONTRACTOR shall so report to the ENGINEER in writing at once and before proceeding with the Work affected thereby shall obtain a written interpretation or clarification from the ENGINEER; however, the CONTRACTOR shall not be liable to the OWNER or the ENGINEER for failure to report any conflict, error or discrepancy in the Contract Documents unless the CONTRACTOR had actual knowledge thereof or should reasonably have known thereof.

In resolving such conflicts, errors and discrepancies, the documents shall be given precedence in the following order:

1. Agreement
2. Field and Change Orders
3. Addenda
4. Special Conditions
5. Instruction to Bidders
6. General Conditions
7. Specifications and Drawings

Figure dimension on drawings shall govern over scale dimensions and detailed Drawings shall govern over general Drawings.

### **3.4 Amending and Supplementing Contract Documents**

The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof by means of a Change Order or a Field Order. Contract Price and Contract Time may only be changed by a Change Order.

### **3.5 Reuse of Documents**

Neither the CONTRACTOR nor any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect

contract with the OWNER shall 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 the ENGINEER; and they shall not reuse any of them on extensions of the Project or any other project without written consent of the OWNER and the ENGINEER and specific written verification or adaptation by the ENGINEER.

#### **4. AVAILABILITY OF LANDS; PHYSICAL CONDITIONS, REFERENCE POINTS**

##### **4.1 Availability of Lands**

The OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of the CONTRACTOR. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by the OWNER, unless otherwise provided in the Contract Documents. If the CONTRACTOR believes that any delay in the OWNER's furnishing these lands, rights-of-way or easements entitles the CONTRACTOR to an extension of the Contract Time, the CONTRACTOR may make a claim therefore as provided in Article 11. The ENGINEER shall determine if the claim is legitimate or not. The CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

##### **4.2 Physical Conditions**

###### **4.2.1 Explorations and Reports**

Reference is made to the Special Conditions for identification of those reports of explorations and tests of subsurface conditions at the site that have been utilized by the ENGINEER in preparation of the Contract Documents. The CONTRACTOR may rely upon the accuracy of the technical data contained in such reports, but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof for the CONTRACTOR's purposes. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, the CONTRACTOR shall have full responsibility with respect to subsurface conditions at the site.

###### **4.2.2 Existing Structures**

Reference is made to the Special Conditions for identification of those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities referred to in paragraph 4.3 which are at or contiguous to the site that have been utilized by the ENGINEER in preparation of the Contract Documents. The CONTRACTOR may rely upon the accuracy of the technical data contained in such drawings, but not for the completeness thereof for the CONTRACTOR's purposes. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, the CONTRACTOR shall have full responsibility with respect to physical conditions in or relating to such structures.

4.2.3 Report of Differing Conditions

If the CONTRACTOR believes that:

4.2.3.1 any technical data on which the CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is inaccurate, or

4.2.3.2 any physical conditions uncovered or revealed at the site differ materially from that indicated, reflected or referred to in the Contract Documents,

The CONTRACTOR shall, promptly after becoming aware thereof and before performing the WORK in connection therewith (except in an emergency) notify the OWNER and the ENGINEER in writing about the inaccuracy or difference.

4.2.4 ENGINEER's Review

The ENGINEER will promptly review the pertinent conditions, determine the necessity of obtaining additional explorations or tests with respect thereto and advise the CONTRACTOR of the ENGINEER's findings and conclusions.

4.2.5 Possible Document Change

If the ENGINEER concludes that there is a material error in the Contract Documents or that because of newly discovered conditions a change in the Contract Documents is required, a Change Order will be issued as provided in Article 10 to reflect and document the consequences of the inaccuracy or difference.

4.2.6 Possible Price and Time Adjustments

In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are attributable to any such inaccuracy or difference.

**4.3 Physical Conditions-Underground Facilities**

4.3.1 Shown or Indicated

The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to the OWNER or the ENGINEER by the owners of such underground facilities or by others. Unless it is otherwise expressly provided in the Special Conditions:

4.3.1.1 The OWNER and the ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and,

4.3.1.2 The CONTRACTOR shall have full responsibility for reviewing and checking all such information and data; for locating all underground



facilities shown or indicated in the Contract Documents; for coordination of the Work with the owners of such underground facilities during construction; and for the safety and protection thereof and repairing any damage thereto resulting from the Work, the cost of all of which will be considered as having been included in the Contract Price.

**4.3.2 Not Shown or Indicated**

If an underground facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents and which the CONTRACTOR could not reasonably have been expected to be aware of, the CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work affected thereby (except in an emergency), identify the owner of such Underground Facility and give written notice thereof to that owner and to the OWNER and the ENGINEER. The ENGINEER will promptly review the underground facility to determine the extent to which the Contract Documents should be modified to reflect and document the consequences of the existence of the Underground Facility, and the Contract Documents will be amended or supplemented to the extent necessary. During such time, the CONTRACTOR shall be responsible for the safety and protection of such underground facility. The CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, to the extent that they are attributable to the existence of any underground facility that was not shown or indicated in the Contract Documents and which the CONTRACTOR could not reasonably have been expected to be aware of.

**4.4 Reference Points**

The OWNER shall provide engineering surveys to establish reference points for construction which in the ENGINEER's judgment are necessary to enable the CONTRACTOR to proceed with the Work. The CONTRACTOR shall be responsible for laying out the Work (unless otherwise specified), shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of the OWNER. The CONTRACTOR shall report to the ENGINEER whenever any reference point 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 by a Registered Land Surveyor.

**5. CONTRACTOR'S RESPONSIBILITIES**

**5.1 Supervision**

The CONTRACTOR shall supervise 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. The CONTRACTOR shall assure that all the CONTRACTOR personnel (including subcontractors, etc.) conduct themselves in a courteous and respectful manner

toward the ENGINEER and the general public. Failure to comply with this condition of the Contract will result in immediate suspension of the Work. Following a review by the Commissioner of Public Works, the Contract may be terminated (see GC section 14). The CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but the CONTRACTOR shall not be responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the Contract Documents. The CONTRACTOR shall be responsible to see that the finished Work complies accurately with the Contract Documents.

### **5.2 Superintendence**

The CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to the OWNER and the ENGINEER except under extraordinary circumstances. The superintendent will be the CONTRACTOR's representative at the site and shall have authority to act on behalf of the CONTRACTOR. All communications given to the superintendent shall be as binding as if given to the CONTRACTOR.

### **5.3 Labor**

The CONTRACTOR shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. The CONTRACTOR shall at all times maintain good discipline and order at the site. Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours, and the CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without the OWNER's written consent given after prior written notice to the ENGINEER.

### **5.4 Start-Up and Completion of Work**

Unless otherwise specified, the CONTRACTOR shall furnish and assume full responsibility for all 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 furnishing, performance, testing, start-up and completion of the Work.

### **5.5 Materials and Equipment**

All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by the ENGINEER, the CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable supplier except as otherwise provided in the Contract Documents; but no provision of any such instructions will be effective to assign to the ENGINEER, or any of the

ENGINEER's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 8.12.3 or 8.12.4.

**5.5.1 Not Clearly Specified or Indicated**

In all instances where materials specified are obtainable in different sizes, weights, trade grades, qualities or finishes, etc., whose weights, trade grades, qualities or finishes, etc., are not clearly specified or indicated on the Drawings, the CONTRACTOR shall notify the ENGINEER of all such instances at least five (5) days in advance of receiving the proposals. The Engineer will then determine which size, weight, trade grade, quality, finish, etc., is required.

**5.5.2 Coordination of Work**

The CONTRACTOR shall see that for his own Work and for the work of each subcontractor, proper templates and patterns necessary for the coordination of the various parts of the Work are prepared. The CONTRACTOR shall furnish or require the Subcontractor to furnish such duplicates as will enable the Subcontractors to fit together and execute fully their respective portions of the Work.

**5.6 Adjusting Progress Schedule**

The CONTRACTOR shall submit to the ENGINEER for acceptance (to the extent indicated in paragraph 2.8) adjustments in the progress schedule to reflect the impact thereon of new developments; these will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the Contract Documents applicable thereto

**5.7 Substitutes or "Or-Equal" Items**

**5.7.1 General**

Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the naming of the item is intended to establish the type, function, and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of other Suppliers may be accepted by the OWNER/ENGINEER if sufficient information is submitted by the CONTRACTOR to allow the OWNER/ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named. The procedure for review by the OWNER/ENGINEER will include the following. Requests for review of substitute items of material and equipment will not be accepted by the OWNER/ENGINEER from anyone, other than the CONTRACTOR. If the CONTRACTOR wishes to furnish or use a substitute item of material or equipment, the CONTRACTOR shall make written application to the OWNER/ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results

called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. The application will state that the evaluation and acceptance of the proposed substitute will not prejudice the CONTRACTOR's achievement of completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with the OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by the OWNER/ENGINEER in evaluating the proposed substitute. The OWNER/ENGINEER may require the CONTRACTOR to furnish at the CONTRACTOR's expense additional data about the proposed substitute.

#### 5.7.2 Substitutes

If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, the CONTRACTOR may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to the OWNER/ENGINEER, if the CONTRACTOR submits sufficient information to allow the OWNER/ENGINEER to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents. The procedure for review by the OWNER/ENGINEER will be similar to that provided in paragraph 5.7.1 as applied by the OWNER/ENGINEER.

#### 5.7.3 The OWNER/ENGINEER's Approval

The OWNER/ENGINEER will be allowed a reasonable time within which to evaluate each proposed substitute. The OWNER/ENGINEER will be the sole judge of acceptability, and no substitute will be ordered, installed or utilized without the OWNER/ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. The OWNER may require the CONTRACTOR to furnish at the CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute. The OWNER/ENGINEER will record time required by the OWNER/ENGINEER and the OWNER/ENGINEER's consultants in evaluating substitutions proposed by the CONTRACTOR and in making changes in the Contract Documents occasioned thereby. Whether or not the OWNER/ENGINEER accepts a proposed substitute, the CONTRACTOR shall reimburse the OWNER for the charges of the OWNER/ENGINEER and the OWNER/ENGINEER'S consultants for evaluating each proposed substitute.

## **5.8 Subcontractors, Suppliers, and Others**

### **5.8.1 Acceptable to the ENGINEER**

The CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to the OWNER and the ENGINEER as indicated in paragraph 5.8.2), whether initially or as a substitute, against whom the OWNER or the ENGINEER may have reasonable objection. The CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom the CONTRACTOR has reasonable objection.

### **5.8.2 Objection After Due Investigation**

If the Contract Documents require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials and equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by the OWNER and the ENGINEER and if the CONTRACTOR has submitted a list thereof, the OWNER's or the ENGINEER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case the CONTRACTOR shall submit an acceptable substitute. No acceptance by the OWNER or the ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of the OWNER or the ENGINEER to reject defective Work.

### **5.8.3 Contractor Responsible for Acts of Subcontractors**

The CONTRACTOR shall perform on the site, and with its own organization, work equivalent to at least fifty (50) percent of the total amount of Work to be performed under the Contract. This percentage may be reduced by a supplemental agreement to this Contract if, during performing the Work, the CONTRACTOR requests a reduction and the Urban County Engineer determines that the reduction would be to the advantage of the Urban County Government.

The CONTRACTOR shall, at the time he submits his proposal for the Contract, notify the OWNER in writing of the names of Subcontractors proposed for the Work. He shall not employ any Subcontractor without the prior written approval of the OWNER.

CONTRACTOR shall be fully responsible to OWNER and the ENGINEER for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with the CONTRACTOR just as the CONTRACTOR is responsible for the

CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create any contractual relationship between the OWNER or the ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of the OWNER or the ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by Laws and Regulations.

**5.8.4 Division of Specifications**

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

**5.8.5 Agreement Between Contractor and Subcontractors**

All Work performed for the CONTRACTOR by a Subcontractor will be pursuant to an appropriate agreement between the CONTRACTOR and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents for the benefit of the OWNER and the ENGINEER.

**5.8.6 Statements and Comments by CONTRACTOR**

Neither the CONTRACTOR, his employees, nor his subcontractors shall at any time make any statement or comment as to the Project scope, nature, intention, design, or construction method to any third party or parties without the explicit written consent of the OWNER.

Any third party requesting such information shall be referred to the OWNER or his representative.

Should there be any change from the original intent of the Project as a result of any statement or comment by the CONTRACTOR, his employees or subcontractors, CONTRACTOR shall be held liable for any change in the scope, nature, design, or construction method and shall bear the full cost for the previously mentioned changes.

**5.9 Patent Fees and Royalties**

The 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.

**5.10 Permits**

Unless otherwise provided in the Special conditions, the CONTRACTOR shall obtain and pay for all construction permits and licenses. The OWNER shall assist the CONTRACTOR, when necessary, in obtaining such permits and licenses. The CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids,

or if there are no Bids on the Effective Date of the Agreement. The CONTRACTOR shall pay all charges of utility owners for connections to the Work, and the OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

## **5.11 Laws and Regulations**

### **5.11.1 CONTRACTOR to Comply**

The CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither the OWNER nor the ENGINEER shall be responsible for monitoring the CONTRACTOR'S compliance with any Laws and Regulations.

### **5.11.2 Specifications and Drawings at Variance**

If CONTRACTOR observes that the Specifications or Drawings are at variance with any Laws or Regulations, the CONTRACTOR shall give the ENGINEER prompt written notice thereof, and any necessary changes will be authorized by one of the methods indicated in paragraph 3.4. If the CONTRACTOR performs any Work knowing or having reason to know that it is contrary to such Laws, or Regulations, and without such notice to the ENGINEER, the CONTRACTOR shall bear all costs arising there from; however, it shall not be the CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with such Laws and Regulations.

Any party, firm or individual submitting a proposal pursuant to invitation must have paid all taxes owed to the Lexington-Fayette Urban County Government at the time the proposal is submitted, and must maintain a "current" status in regard to those taxes throughout the Contract. If applicable, business must be licensed in Fayette County.

## **5.12 Taxes**

The CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by the CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work. Any party, firm or individual submitting a proposal pursuant to invitation must have paid all taxes owed to the Lexington-Fayette Urban County Government at the time the proposal is submitted and must maintain a "current" status in regard to those taxes throughout the Contract. If applicable, business must be licensed in Fayette County.

## **5.13 Use of Premises**

### **5.13.1 Project Site**

The CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the staging areas

or work site areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. The CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work. Should any claim be made against the OWNER or the ENGINEER by any such owner or occupant because of the performance of the Work, the CONTRACTOR shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or at law. The CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold the OWNER and the ENGINEER harmless from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any such other party against the OWNER or the ENGINEER to the extent based on a claim arising out of the CONTRACTOR's performance of the Work.

#### 5.13.2 Clean Up

During the progress of the Work, the CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work, the CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by the OWNER. The CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

#### 5.13.3 Loading of Structures

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

### **5.14 Record Drawings**

The CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Change Orders, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved samples and a counterpart of all approved Shop Drawings will be available to the ENGINEER for reference. Upon completion of the Work, these record documents, samples and Shop Drawings will be delivered to the ENGINEER for the OWNER.



## **5.15 Shop Drawings and Samples**

### **5.15.1 Shop Drawing Submittals**

After checking and verifying all field measurements and after complying with applicable procedures specified, the CONTRACTOR shall submit to the ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawing submissions (see paragraph 2.8), or for other appropriate action if so indicated in the Special Conditions, five copies (unless otherwise specified) of all Shop Drawings, which will bear a stamp or specific written indication that the CONTRACTOR has satisfied the CONTRACTOR's responsibilities under the Contract Documents with respect to the review of the submission. All submissions will be identified as the ENGINEER may require. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to enable the ENGINEER to review the information as required.

### **5.15.2 Sample Submittals**

The CONTRACTOR shall also submit to the ENGINEER for review and approval with such promptness as to cause no delay in Work, all samples required by the Contract Documents. All samples will have been checked by and accompanied by a specific written indication that the CONTRACTOR has satisfied the CONTRACTOR's responsibilities under the Contract Documents with respect to the review of the submission and will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended.

### **5.15.3 Review by CONTRACTOR**

Before submission of each Shop Drawing or sample the CONTRACTOR shall have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each Shop Drawing or sample with other Shop Drawings and samples and with the requirements of the Work and the Contract Documents.

### **5.15.4 Notice of Variation**

At the time of each submission, the CONTRACTOR shall give the ENGINEER specific written notice of each variation that the Shop Drawings or samples may have from the requirements of the Contract Documents, and, in addition, shall cause a specific notation to be made on each Shop Drawing submitted to the ENGINEER for review and approval of each such variation.

### **5.15.5 The ENGINEER's Approval**

The ENGINEER will review and approve with reasonable promptness Shop Drawings and samples, but the ENGINEER's review and approval will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall

not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. The CONTRACTOR shall make corrections required by the ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit, as required, new samples for review and approval. The CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by the ENGINEER on previous submittals.

**5.15.6 Responsibility for Errors and Omissions**

The ENGINEER's review and approval of Shop Drawings or samples shall not relieve the CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless the CONTRACTOR has in writing called the ENGINEER's attention to each such variation at the time of submission as required by paragraph 5.15.4 and the ENGINEER has given written approval of each such variation by a specific written notation thereof incorporated in or accompanying the Shop Drawing or sample approval; nor will any approval by the ENGINEER relieve the CONTRACTOR from responsibility for errors or omissions in the Shop Drawings or from responsibility for having complied with the provisions of paragraph 5.15.3.

**5.15.7 Cost of Related Work**

Where a Shop Drawing or sample is required by the Specifications, any related Work performed prior to the ENGINEER's review and approval of the pertinent submission will be the sole expense and responsibility of the CONTRACTOR.

**5.16 Continuing the Work**

The CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with the OWNER. No Work shall be delayed or postponed pending resolutions of any disputes or disagreements, except as permitted by paragraph 14.5 or as the CONTRACTOR and the OWNER may otherwise agree in writing.

**5.17 Erosion and Sediment Control**

**5.17.1 General Environmental Requirements**

The CONTRACTOR and Subcontractors performing work on projects on behalf of the OWNER shall comply with all applicable federal, state, and local environmental regulations and all requirements and conditions set forth in "special" permits including but not limited to Corp of Engineers 404 permits, 401 Water Quality Certifications, Stream Crossing and Floodplain Encroachment Permits.

Any fines or penalties resulting from the failure to comply with the terms of the federal, state or local permits or perform necessary corrective action are solely the obligation of the CONTRACTOR.

5.17.2 Stormwater Pollution Prevention

- A. The CONTRACTOR shall exercise due care to prevent or minimize any damage to any stream or wetland from pollution by debris, sediment or other material. The operation of equipment and/or materials in a jurisdictional wetland is expressly prohibited. Water that has been used for washing or processing, or that contains oils, sediments or other pollutants shall not be discharged from the job site. Such waters shall be collected and properly disposed of by the CONTRACTOR in accordance with applicable local, state and federal law.
- B. The CONTRACTOR is solely responsible for securing all required state and local permits associated with stormwater discharges from the project including, but not necessarily limited to the Kentucky Notice of Intent to Disturb (NOI) for Coverage of Storm Water Discharges Associated with Construction Activities under the KPDES Storm Water General Permit KYR100000 and the LFUCG, Land Disturbance Permit. Permit application preparation and all required documentation are the responsibility of the CONTRACTOR. The CONTRACTOR is solely responsible for maintaining compliance with the stormwater pollution prevention plan or erosion and sediment control plan and ensuring the following:
  - a. That the Stormwater Pollution Prevention Plan (SWPPP) or erosion control plan is current and available for review on site;
  - b. That any and all stormwater inspection reports required by the permit are conducted by qualified personnel and are available for review onsite; and
  - c. That all best management practices (BMPs) are adequately maintained and effective at controlling erosion and preventing sediment from leaving the site.
- C. The CONTRACTOR shall provide the necessary equipment and personnel to perform any and all emergency measures that may be required to contain any spillage or leakage and to remove materials, soils or liquids that become contaminated. The collected spill material shall be properly disposed at the Contractor's expense.
- D. Upon completion of the work and with the concurrence of the OWNER, the CONTRACTOR must file a Notice of Termination (NOT) of Coverage Under the KPDES General Permit for Storm Water Discharges Associated with Construction Activity with the appropriate local and state authorities.

- E. Any fines or penalties resulting from the failure to comply with the terms of the state or local stormwater permits or perform necessary corrective action are solely the obligation of the CONTRACTOR.

## **6. OTHER WORK**

### **6.1 Related Work at Site**

OWNER may perform other work related to the Project at the site by the OWNER's own forces, have other work performed by utility owners or let other direct contracts therefore which shall contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contract Documents, written notice thereof will be given to the CONTRACTOR prior to starting any such other work; and, if such performance will involve additional expense to the CONTRACTOR or requires additional time, a Change Order to the Contract will be negotiated.

### **6.2 Other Contractors or Utility Owners**

The CONTRACTOR shall afford each utility owner and other contractor who is a party to such a direct contract (or the OWNER, if the OWNER is performing the additional work with the OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such work, and shall properly connect and coordinate the Work with theirs. The CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. The CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of the ENGINEER and the others whose work will be affected. The duties and responsibilities of the CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of the CONTRACTOR in said direct contracts between the OWNER and such utility owners and other contractors.

### **6.3 Delays Caused by Others**

If any part of the CONTRACTOR's Work depends for proper execution or results upon the work of any such other contractor or utility owner (or the OWNER), the CONTRACTOR shall inspect and promptly report to the ENGINEER in writing any delays, defects or deficiencies in such work that render it unavailable or unsuitable for such proper execution and results. The CONTRACTOR's failure so to report will constitute an acceptance of the other work as fit and proper for integration with the CONTRACTOR's Work except for latent or non-apparent defects and deficiencies in the other work.

### **6.4 Coordination**

If the OWNER contracts with others for the performance of other work on the Project at the site, the person or organization who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified in

the Special Conditions, and the specific matters to be covered by such authority and responsibility will be itemized, and the extent of such authority and responsibilities will be provided, in the Special Conditions.

## **7. OWNER'S RESPONSIBILITIES**

### **7.1 Communications**

The OWNER shall issue all communications to the CONTRACTOR through the ENGINEER.

### **7.2 Data and Payments**

The OWNER shall furnish the data required of the OWNER under the Contract Documents promptly after they are due.

### **7.3 Lands, Easements, and Surveys**

The OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to the OWNER's identifying and making available to the CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and in existing structures which have been utilized by the ENGINEER in preparing the Drawings and Specifications.

### **7.4 Change Orders**

The OWNER is obligated to execute Change Orders as indicated in paragraph 9.4.

### **7.5 Inspections, Tests and Approvals**

The OWNER's responsibility in respect to certain inspections, tests and approvals is set forth in paragraph 13.3.

### **7.6 Stop or Suspend Work**

In connection with the OWNER's right to stop Work or suspend Work, see paragraph 12.4 and 14.1 Paragraph 14.2 deals with the OWNER's rights to terminate services of the CONTRACTOR under certain circumstances.

## **8. ENGINEER'S STATUS DURING CONSTRUCTION**

### **8.1 The OWNER's Representative**

The ENGINEER will be the OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of the ENGINEER as the OWNER's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of the OWNER and the ENGINEER.

### **8.2 Visits to Site**

The ENGINEER will make visits to the site at intervals appropriate to the various stages of construction 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. The ENGINEER will not be required to make exhaustive or

continuous on-site inspections to check the quality or quantity of the Work. The ENGINEER's efforts will be directed toward providing for the OWNER a greater degree of confidence that the completed Work will conform to the Contract Documents. On the basis of such visits and on-site observations, the ENGINEER will keep the OWNER informed of the progress of the Work and will endeavor to guard the OWNER against defects and deficiencies in the Work.

**8.3 Project Representation**

The ENGINEER will provide an Inspector to assist the ENGINEER in observing the performance of the Work. If OWNER designates another agent to represent the OWNER at the site who is not the ENGINEER's agent or employee, the duties, responsibilities and limitations of authority of such other person will be as provided in the Special Conditions.

**8.4 Clarifications and Interpretations**

The ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as the ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

**8.5 Authorized Variations in Work**

The ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order.

**8.6 Rejecting Defective Work**

The ENGINEER will have authority to disapprove or reject Work which the ENGINEER believes to be defective, and will also have authority to require special inspection or testing of the Work as provided in paragraph 12.3, whether or not the Work is fabricated, installed or completed.

**8.7 Shop Drawings**

In connection with the ENGINEER's responsibility for Shop Drawings and samples, see paragraphs 5.15.1 through 5.16 inclusive.

**8.8 Change Orders**

In connection with the ENGINEER's responsibilities as to Change Orders, see Articles 10, 11 and 12.

**8.9 Payments**

In connection with the ENGINEER's responsibilities with respect to Applications for Payment, etc., see Article 13.

#### **8.10 Determinations for Unit Prices**

The ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by the CONTRACTOR.

The ENGINEER will review with the CONTRACTOR ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise).

#### **8.11 Decision on Disputes**

The ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and claims under Articles 10 and 11 in respect of changes in the Contract Price or Contract Time will be referred initially to the ENGINEER in writing with a request for a formal decision in accordance with this paragraph, which the ENGINEER will render in writing within a reasonable time. Written notice of each such claim, dispute and other matter will be delivered to the ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise thereto, and written supporting data will be submitted to the ENGINEER within sixty days after such occurrence unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.

#### **8.12 Limitations on Engineer's Responsibilities**

##### **8.12.1 CONTRACTOR, Supplier, or Surety**

Neither the ENGINEER's authority to act under this Article 8 or elsewhere in the Contract Documents nor any decision made by the ENGINEER in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of the ENGINEER to the CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization performing any of the Work, or to any surety for any of them.

##### **8.12.2 To Evaluate the Work**

Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed", "as approved" or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper", or "satisfactory" or adjectives or like "effect" or "import" are used to describe a requirement, direction, review or judgment of the ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the Work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign the ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 8.12.3 or 8.12.4.

8.12.3 The CONTRACTOR's Means, Methods, Etc.

The ENGINEER will not be responsible for the CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and the ENGINEER will not be responsible for the CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

8.12.4 Acts of Omissions of the CONTRACTOR

The ENGINEER will not be responsible for the acts or omissions of the CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

**9. CHANGES IN THE WORK**

**9.1 The OWNER May Order Change**

Without invalidating the Agreement and without notice to any surety, the OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work; these will be authorized by a Change Order. Upon receipt of such notice, the CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

**9.2 Claims**

Claims for an increase or decrease in the Contract Price or an extension or shortening of the Contract Time that should be allowed as a result of a Change Order will be settled as provided for in Article 10 or Article 11.

**9.3 Work Not in Contract Documents**

The CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraph 3.4, except in the case of an emergency and except in the case of uncovering Work as provided in paragraph 12.3.4.

**9.4 Change Orders**

The OWNER and the CONTRACTOR shall execute appropriate Change Orders covering:

9.4.1 changes in the Work which are ordered by OWNER pursuant to paragraph 9.1, are required because of acceptance of defective Work under paragraph 12.7 or corrective defective Work under paragraph 12.8, or are agreed to by the parties;

9.4.2 changes in the Contract Price or Contract Time which are agreed to by the parties; and



9.4.3 changes in the Contract Price or Contract Time which embody the substance of any written decision rendered by the ENGINEER pursuant to paragraph 8.11; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and REGULATIONS, but during any such appeal, the CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 5.16.

**9.5 Notice of Change**

If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Time) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be the CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

**10. CHANGE OF CONTRACT PRICE**

**10.1 Total Compensation**

The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to the CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by the CONTRACTOR shall be at his expense without change in the Contract Price.

**10.2 Claim for Increase or Decrease in Price**

The Contract Price may only be changed by a Change Order. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after such occurrence (unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the CONTRACTOR's written statement that the amount claimed covers all known amounts (direct, indirect, and consequential) to which the CONTRACTOR is entitled as a result of the occurrence of said event.

**10.3 Value of Work**

The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:

**10.3.1 Unit Prices**

Where the Work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved (subject to the provisions of paragraphs 10.9.1. through 10.9.3, inclusive).

#### 10.3.2 Lump Sum

By mutual acceptance of a lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 10.6.2.1).

#### 10.3.3 Cost Plus Fee

On the basis of the Cost of the Work (determined as provided in paragraphs 10.4 and 10.5) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraphs 10.6 and 10.7).

### **10.4 Cost of the Work**

The term Cost of the Work means the sum of all costs necessarily incurred and paid by the CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by the OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project; shall include only the following items; and shall not include any of the costs itemized in paragraph 10.5:

#### 10.4.1 Payroll Costs

Payroll costs for employees in the direct employ of the CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by the OWNER and the CONTRACTOR. 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' or workmen's compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. Such employees shall include superintendents and foremen at the site. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by the OWNER.

#### 10.4.2 Materials and Equipment Costs

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 the CONTRACTOR unless the OWNER deposits funds with the CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and all returns from sale of surplus materials and equipment shall accrue to the OWNER, and the CONTRACTOR shall make provisions so that they may be obtained.

#### 10.4.3 Subcontractor Costs

Payments made by the CONTRACTOR to the Subcontractors for Work performed by Subcontractors. If required by the OWNER, the CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to the CONTRACTOR and shall deliver such bids to the

OWNER who will then determine, with the advice of the ENGINEER, which bids will be accepted. If a 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 shall be determined in the same manner as the CONTRACTOR's Cost of the Work. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

#### 10.4.4 Special Consultant Costs

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.

#### 10.4.5 Supplemental Costs

10.4.5.1 The proportion of necessary transportation, travel and subsistence expenses of the CONTRACTOR's employees incurred in discharge of duties connected with the Work.

10.4.5.2 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 the CONTRACTOR.

10.4.5.3 Rentals of all construction equipment and machinery and the parts thereof whether rented from the CONTRACTOR or others in accordance with rental agreements approved by the OWNER with the advice of the ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal shall be in accordance with 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.

10.4.5.4 Sales, consumer, use or similar taxes related to the Work, and for which the CONTRACTOR is liable, imposed by Laws and Regulations.

10.4.5.5 Deposits lost for causes other than negligence of the 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.

- 10.4.5.6 Losses and damages (and related expenses), not compensated by insurance or otherwise, to the Work or otherwise sustained by the CONTRACTOR in connection with the performance and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by the OWNER), provided they have resulted from causes other than the negligence of the 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 the OWNER. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining the CONTRACTOR's fee. If, however, any such loss or damage requires reconstruction and the CONTRACTOR is placed in charge thereof, the CONTRACTOR shall be paid a fee proportionate to that stated in paragraph 10.6.2 for services.
- 10.4.5.7 The cost of utilities, fuel and sanitary facilities at the site.
- 10.4.5.8 Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.
- 10.4.5.9 Cost of premiums for additional Bonds and insurance required because of changes in the Work and premiums for property insurance coverage within the limits of the deductible amounts established by the OWNER.

## **10.5 Not to Be Included in Cost of the Work**

The term Cost of the Work shall not include any of the following:

### **10.5.1 Costs of Officers and Executives**

Payroll costs and other compensation of the CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks and other personnel employed by the CONTRACTOR whether at the site or in the CONTRACTOR's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 10.4.1 or specifically covered by paragraph 10.4.4 - all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

### **10.5.2 Principal Office**

Expenses of the CONTRACTOR's principal and branch offices other than the CONTRACTOR's office at the site.

10.5.3 Capital Expense

Any part of the CONTRACTOR's capital expenses, including interest on the CONTRACTOR's capital employed for the Work and charges against the CONTRACTOR for delinquent payments.

10.5.4 Bonds and Insurance

Cost of premiums for all Bonds and for all insurance whether or not the CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 10.4.5.9 above).

10.5.5 Costs Due to Negligence

Costs due to the negligence of the 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.

10.5.6 Other Costs

Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 10.4.

**10.6 CONTRACTOR's Fee**

The CONTRACTOR's Fee allowed to the CONTRACTOR for overhead and profit shall be determined as follows:

10.6.1 a mutually acceptable fixed fee; or if none can be agreed upon,

10.6.2 a fee based on the following percentages of the various portions of the Cost of the Work:

10.6.2.1 for costs incurred under paragraphs 10.4.1 and 10.4.2, the CONTRACTOR's fee shall be fifteen percent;

10.6.2.2 for costs incurred under paragraph 10.4.3, the CONTRACTOR's fee shall be five percent; and if a subcontract is on the basis of Cost of the Work Plus a fee, the maximum allowable to the CONTRACTOR on account of overhead and profit of all Subcontractors shall be fifteen percent;

10.6.2.3 no fee shall be payable on the basis of costs itemized under paragraphs 10.4.4, 10.4.5 and 10.5;

10.6.2.4 the amount of credit to be allowed by the CONTRACTOR to the OWNER for any such change which results in a net decrease in cost will be the amount of the actual net decrease

plus a deduction in the CONTRACTOR's Fee by an amount equal to ten percent of the net decrease; and

- 10.6.2.5 when both additions and credits are involved in any one change, the adjustment in the CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 10.6.2.1 through 10.6.2.4, inclusive.

## **10.7 Itemized Cost Breakdown**

Whenever the cost of any Work is to be determined pursuant to paragraph 10.4 or 10.5, the CONTRACTOR will submit in form acceptable to the ENGINEER an itemized cost breakdown together with supporting data.

## **10.8 Cash Allowances**

It is understood that the CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be done by such Subcontractors or Suppliers and for such sums within the limit of the allowances as may be acceptable to the ENGINEER, the CONTRACTOR agrees that:

### **10.8.1 Materials and Equipment**

The allowances include the cost to the 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

### **10.8.2 Other Costs**

The CONTRACTOR's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances. No demand for additional payment on account of any thereof will be valid.

### **10.8.3 Change Order**

Prior to final payment, an appropriate Change Order will be issued as recommended by the ENGINEER to reflect actual amounts due the CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

## **10.9 Unit Price Work**

### **10.9.1 General**

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 established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for

the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by the CONTRACTOR will be made by the ENGINEER in accordance with Paragraph 8.10.

**10.9.2 Overhead and Profit**

Each unit price will be deemed to include an amount considered by the CONTRACTOR to be adequate to cover the CONTRACTOR's overhead and profit for each separately identified item.

**10.9.3 Claim for Increase in Unit Price**

Where the quantity of any item of Unit Price Work performed by the CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement and there is no corresponding adjustment with respect to any other item of Work and if the CONTRACTOR believes that the CONTRACTOR has incurred additional expense as a result thereof, the CONTRACTOR may make a claim for an increase in the Contract Price in accordance with Article 10.

**11. CHANGE OF CONTRACT TIME**

**11.1 Change Order**

The Contract Time may only be changed by a Change Order. Any claim for an extension or shortening of the Contract Time shall be based on written notice delivered to the ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence (unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by the ENGINEER in accordance with paragraph 8.11. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this paragraph 11.1.

**11.2 Justification for Time Extensions**

The Contract Time will be extended in an amount equal to time lost due to delays beyond the control of the CONTRACTOR if a claim is made therefore as provided in paragraph 11.1. Such delays shall include, but not be limited to, acts or neglect by the OWNER or others performing additional work as contemplated by Article 6, or to fires, floods, labor disputes, epidemics, abnormal weather conditions or acts of God.

### **11.3 Time Limits**

All time limits stated in the Contract Documents are of the essence of the Agreement. The provisions of this Article 11 shall not exclude recovery for damages (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court costs) for delay by either party.

## **12. WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK**

### **12.1 Warranty and Guarantee**

The CONTRACTOR warrants and guarantees to the OWNER and the ENGINEER that all Work will be in accordance with the Contract Documents and will not be defective. All defective Work, whether or not in place, may be rejected, corrected or accepted as provided in this Article 12.

### **12.2 Access to Work**

The ENGINEER and the ENGINEER's representatives, other representatives of the OWNER, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. The CONTRACTOR shall provide proper and safe conditions for such access.

### **12.3 Tests and Inspections**

#### **12.3.1 Timely Notice**

The CONTRACTOR shall give the ENGINEER timely notice of readiness of the Work for all required inspections, tests or approvals.

#### **12.3.2 Requirements and Responsibilities**

The ENGINEER may require such inspection and testing during the course of the Work as he/she deems necessary to ascertain and assure the integrity and acceptable quality of the materials incorporated and the work performed.

Inspection presence may be either full-time or intermittent, and neither the presence nor absence at any time of the ENGINEER or the INSPECTOR shall relieve the CONTRACTOR of sole responsibility for the acceptability and integrity of the Work or any part thereof.

The costs of sampling, testing, and inspection on-site to ascertain acceptability of the Work and materials will be borne by the OWNER except as otherwise provided. The OWNER will select a testing laboratory to perform such sampling and testing. Sampling and/or testing required by the CONTRACTOR or necessitated by failure of Work or materials to meet the above acceptability test shall be at the expense of the CONTRACTOR.

Inspection services may be performed by the employees of the OWNER or by others selected or designated by the OWNER or the ENGINEER.



Sampling and/or testing required for manufacturing quality and/or process control, for certification that raw mineral materials or manufactured products are the quality specified in the contract, or to assure the acceptability for incorporation into the Work shall be borne by the CONTRACTOR or the material supplier.

Cost for inspection, sampling, testing, and approvals required by the laws or regulations of any public body having competent jurisdiction shall be borne by the CONTRACTOR or the material supplier.

Sampling and testing will be in accord with pertinent codes and regulations and with appropriate standards of the American Society of Testing Materials or other specified standards.

#### **12.3.3 On-site Construction Test and Other Testing**

All inspections, tests or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by organizations acceptable to the OWNER and the CONTRACTOR (or by the ENGINEER if so specified).

#### **12.3.4 Covered Work**

If any Work (including the work of others) that is to be inspected, tested or approved is covered without written concurrence of the ENGINEER, it must, if requested by the ENGINEER, be uncovered for observation. Such uncovering shall be at the CONTRACTOR's expense unless the CONTRACTOR has given the ENGINEER timely notice of the CONTRACTOR's intention to cover the same and the ENGINEER has not acted with reasonable promptness in response to such notice.

#### **12.3.5 CONTRACTOR'S Obligation**

Neither observations by ENGINEER nor inspections, tests or approvals by others shall relieve the CONTRACTOR from the CONTRACTOR's obligations to perform the Work in accordance with the Contract Documents.

### **12.4 OWNER May Stop the Work**

If the Work is defective, or the CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, the OWNER may order the CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the OWNER to stop the Work shall not give rise to any duty on the part of the OWNER to exercise this right for the benefit of the CONTRACTOR or any other party.

### **12.5 Correction or Removal of Defective Work**

If required by the ENGINEER, the CONTRACTOR shall promptly, as directed, either correct all defective Work, whether or not fabricated, installed or completed,

or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with non-defective Work. The CONTRACTOR shall bear all direct, indirect and consequential costs of such correction or removal (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) made necessary thereby.

#### **12.6 One Year Correction Period**

If within one year after the date of Completion or such longer period of time as may be prescribed by Laws or Regulations or 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, the CONTRACTOR shall promptly, without cost to the OWNER and in accordance with the OWNER's written instructions, either correct such defective Work, or, if it has been rejected by the OWNER, remove it from the site and replace it with non-defective Work. If the CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, the OWNER may have the defective Work corrected or the rejected Work removed and replaced, and all direct, indirect and consequential costs of such removal and replacement (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) will be paid by the CONTRACTOR. In special circumstances where a particular item of equipment is placed in continuous service before 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 or by Change Order.

#### **12.7 Acceptance of Defective Work**

If, instead of requiring correction or removal and replacement of defective Work, the OWNER prefers to accept it, the OWNER may do so. The CONTRACTOR shall bear all direct, indirect and consequential costs attributable to the OWNER's evaluation of and determination to accept such defective Work (such costs to be approved by the ENGINEER as to reasonableness and to include but not be limited to fees and charges of engineers, architects, attorneys and other professionals).

#### **12.8 OWNER May Correct Defective Work**

If the CONTRACTOR fails within a reasonable time after written notice of the ENGINEER to proceed to correct and to correct defective Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 12.5, or if the CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if the CONTRACTOR fails to comply with any other provision of the Contract Documents, the OWNER may, after seven days' written notice to the CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph the OWNER shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, the OWNER may exclude the CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend the CONTRACTOR's services related thereto, take possession of the CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which the OWNER has paid the

CONTRACTOR but which are stored elsewhere. The CONTRACTOR shall allow the OWNER, the OWNER's representatives, agents and employees such access to the site as may be necessary to enable the OWNER to exercise the rights and remedies under this paragraph. All direct, indirect and consequential costs of the OWNER in exercising such rights and remedies will be charged against the CONTRACTOR in an amount approved as to reasonableness by the ENGINEER, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and the OWNER shall be entitled to an appropriate decrease in the Contract Price. Such direct, indirect and consequential costs will include but not be limited to fees and charges of engineers, architects, attorneys and other professionals, all court costs and all costs of repair and replacement of work of others destroyed or damaged by correction, removal or replacement of the CONTRACTOR's defective Work. The CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by the OWNER of the OWNER's rights and remedies hereunder.

### **13. PAYMENTS TO CONTRACTOR AND COMPLETION**

#### **13.1 Schedule of Values**

The schedule of values established as provided in paragraph 2.8 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to the ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

#### **13.2 Application for Progress Payment**

At least ten days before each progress payment is scheduled (but not more often than once a month), the CONTRACTOR shall submit to the ENGINEER for review an Application for Payment filled out and signed by the 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 the OWNER has received the materials and equipment free and clear of all liens, charges, security interests and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER'S interest therein, all of which will be satisfactory to the OWNER. The OWNER shall, within thirty (30) calendar days of presentation to him of an approved Application for Payment, pay the CONTRACTOR the amount approved by the ENGINEER.

##### **13.2.1 Retainage**

Monthly progress payments shall be ninety (90) percent of the sum obtained by applying the respective bid unit prices to the approved estimated quantities of work completed by the CONTRACTOR during the preceding month. The remaining ten

(10) percent will be held by the OWNER, as retainage. At such time as the ENGINEER deems appropriate - based on the quality of work performed, progress of cleanup, and other pertinent factors - the rate of retainage, or the total amount retained, may be reduced; although, any reduction in retainage, below the ten (10) percent level, is made solely at the ENGINEER's discretion. All remaining retainage held will be included in the final payment to the CONTRACTOR.

### **13.3 The CONTRACTOR's Warranty of Title**

The CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to the OWNER no later than the time of payment free and clear of all Liens.

### **13.4 Review of Applications for Progress Payment**

#### **13.4.1 Submission of Application for Payment**

The ENGINEER will, after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to the OWNER, or return the Application to the CONTRACTOR indicating in writing the ENGINEER's reasons for refusing to recommend payment. In the latter case, the CONTRACTOR may make the necessary corrections and resubmit the Application.

#### **13.4.2 The ENGINEER's Recommendation**

The ENGINEER may refuse to recommend the whole or any part of any payment, if, in the ENGINEER's opinion, it would be incorrect to make such representations to the OWNER. The ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in the ENGINEER's opinion to protect the OWNER from loss because:

- 13.4.2.1 the Work is defective, or completed Work has been damaged requiring correction or replacement;
- 13.4.2.2 the Contract Price has been reduced by Written Amendment or Change Order;
- 13.4.2.3 The OWNER has been required to correct defective Work or complete Work in accordance with paragraph 12.8; or
- 13.4.2.4 of the ENGINEER's actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.2.1 through 14.2.9 inclusive.

### **13.5 Partial Utilization**

The OWNER at any time may request the CONTRACTOR in writing to permit the OWNER to use any such part of the Work which the OWNER believes to be ready for its intended use and has been completed. If the CONTRACTOR agrees, the CONTRACTOR will certify to the OWNER that said part of the Work is complete and request that a Certificate of Completion be issued for that part of the Work.

### **13.6 Final Inspection**

Upon written notice from the CONTRACTOR that the entire Work or an agreed portion thereof is complete, the ENGINEER will make a final inspection with the CONTRACTOR and will notify the CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. The CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

### **13.7 Final Application for Payment**

After the CONTRACTOR has completed all such corrections to the satisfaction of the ENGINEER and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents (as provided in paragraph 5.14) and other documents - all as required by the Contract Documents, and after the ENGINEER has indicated that the Work is acceptable (subject to the provisions of paragraph 13.10), the CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents, together with complete and legally effective releases or waivers (satisfactory to the OWNER) of all Liens arising out of or filed in connection with the Work. In lieu thereof and as approved by the OWNER, the CONTRACTOR may furnish receipts or releases in full; an affidavit of the CONTRACTOR that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which the OWNER or the OWNER's property might in any way be responsible, have been paid or otherwise satisfied; and consent of the surety, if any, to final payment. If any Subcontractor or Supplier fails to furnish a release or receipt in full, the CONTRACTOR may furnish a Bond or other collateral satisfactory to the OWNER to indemnify the OWNER against any Lien.

### **13.8 Final Payment and Acceptance**

#### **13.8.1 The ENGINEER's Approval**

If, on the basis of the ENGINEER's observation of the Work during construction and final inspection, and the ENGINEER's review of the final Application for Payment and accompanying documentation - all as required by the Contract Documents, the ENGINEER is satisfied that the Work has been completed and the CONTRACTOR's other obligations under the Contract Documents have been fulfilled, the ENGINEER will, after receipt of the final Application for Payment, indicate in writing the ENGINEER's

recommendation of payment and present the Application to the OWNER for payment. Thereupon the ENGINEER will give written notice to the OWNER and the CONTRACTOR that the Work is acceptable, subject to the provisions of paragraph 13.10. Otherwise, the ENGINEER will return the Application to the CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case the CONTRACTOR shall make the necessary corrections and resubmit the Application.

#### **13.8.2 Delay in Completion of Work**

If, through no fault of the CONTRACTOR, final completion of the Work is significantly delayed, the OWNER shall, upon receipt of the CONTRACTOR's final Application for Payment and recommendation of the ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by the OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 10 of Part II, Information for Bidders, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the CONTRACTOR to the ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

### **13.9 The CONTRACTOR'S Continuing Obligation**

The CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the ENGINEER, nor the issuance of a certificate of Completion, nor any payment by the OWNER to the CONTRACTOR under the Contract Documents, nor any use or occupancy of the Work or any part thereof by the OWNER, nor any act of acceptance by the OWNER nor any failure to do so, nor any review and approval of a Shop Drawing or sample submission, nor any correction of defective Work by the OWNER will constitute an acceptance of Work not in accordance with the Contract Documents or a release of the CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents (except as provided in paragraph 13.10).

### **13.10 Waiver of Claims**

The making and acceptance of final payment will constitute:

- 13.10.1** a waiver of all claims by the OWNER against the CONTRACTOR, except claims arising from unsettled Liens, from defective Work appearing after final inspection or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; however, it will not constitute a waiver by the OWNER of any rights in respect of the CONTRACTOR's continuing obligations under the Contract Documents; and

- 13.10.2** a waiver of all claims by the CONTRACTOR against the OWNER other than those previously made in writing and still unsettled.

## **14. SUSPENSION OF WORK AND TERMINATION**

### **14.1 The OWNER May Suspend Work**

The OWNER may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to the CONTRACTOR and the ENGINEER which will fix the date on which Work will be resumed. The CONTRACTOR shall resume the Work on the date so fixed. The CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if the CONTRACTOR makes an approved claim therefore as provided in Articles 10 and 11.

### **14.2 The OWNER May Terminate**

The OWNER may terminate the Work upon the occurrence of any one or more of the following events:

- 14.2.1** if the CONTRACTOR commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if the CONTRACTOR takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time relating to the bankruptcy or insolvency;
- 14.2.2** if a petition is filed against the CONTRACTOR under any chapter of the Bankruptcy Code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against the CONTRACTOR under any other federal or state law in effect at the time relating to bankruptcy or insolvency;
- 14.2.3** if the CONTRACTOR makes a general assignment for the benefit of creditors;
- 14.2.4** if a trustee, receiver, custodian or agent of the CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge of property of the CONTRACTOR is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of the CONTRACTOR's creditors;
- 14.2.5** if the CONTRACTOR admits in writing an inability to pay its debts generally as they become due;
- 14.2.6** if the CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to

adhere to the progress schedule established under paragraph 2.8 as revised from time to time);

**14.2.7** if the CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction;

**14.2.8** if the CONTRACTOR disregards the authority of the ENGINEER, or

**14.2.9** if the CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents;

The OWNER may, after giving the CONTRACTOR (and the surety) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of the CONTRACTOR, exclude the CONTRACTOR from the site and take possession of the Work and of all the CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by the CONTRACTOR (without liability to the CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which the OWNER has paid the CONTRACTOR but which are stored elsewhere, and finish the Work as the OWNER may deem expedient. In such case the CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct, indirect and consequential costs of completing the Work (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) such excess will be paid to the CONTRACTOR. If such costs exceed such unpaid balance, the CONTRACTOR shall pay the difference to the OWNER. Such costs incurred by the OWNER will be approved as to reasonableness by the ENGINEER and incorporated in a Change Order, but when exercising any rights or remedies under this paragraph the OWNER shall not be required to obtain the lowest price for the Work performed.

**14.2.10** If safety violations are observed and brought to the CONTRACTOR's attention and the CONTRACTOR fails to take immediate corrective measures any repeat of similar safety violations, the OWNER will order an immediate termination of contract. Note: it is the CONTRACTOR's responsibility to know proper safety measures as they pertain to construction and OSHA.

**14.2.11** This contract may be canceled by either party thirty (30) days after delivery by canceling party of written notice of intent to cancel to the other contracting party.

**14.2.12** This contract may be canceled by the Lexington-Fayette Urban County Government if it is determined that the Bidder has failed to perform under



the terms of this agreement, such cancellation to be effective upon receipt of written notice of cancellation by the Bidder.

**14.3 CONTRACTOR'S Services Terminated**

Where the CONTRACTOR's services have been so terminated by the OWNER, the termination will not affect any rights or remedies of the OWNER against the CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due the CONTRACTOR by the OWNER will not release the CONTRACTOR from liability.

**14.4 Payment After Termination**

Upon seven days' written notice to the CONTRACTOR, the OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the Work and terminate the Agreement. In such case, the CONTRACTOR shall be paid for all Work executed and any expense sustained plus reasonable termination expenses, which will include, but not be limited to, direct, indirect and consequential costs (including, but not limited to, fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs).

**14.5 CONTRACTOR May Stop Work or Terminate**

If, through no act or fault of the CONTRACTOR, the Work is suspended for a period of more than ninety days by the OWNER or under an order of court or other public authority, or the ENGINEER fails to act on any Application for Payment within sixty days after it is submitted, or the OWNER fails for sixty days to pay the CONTRACTOR any sum finally determined to be due, then the CONTRACTOR may, upon seven days' written notice to the OWNER and the ENGINEER, terminate the Agreement and recover from the OWNER payment for all Work executed and any expense sustained plus reasonable termination expenses. In addition, and in lieu of terminating the Agreement, if the ENGINEER has failed to act on an Application for Payment or the OWNER has failed to make any payment as aforesaid, the CONTRACTOR may upon seven days' written notice to the OWNER and the ENGINEER stop the Work until payment of all amounts then due. The provisions of this paragraph shall not relieve the CONTRACTOR of the obligations under paragraph 5.16 to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with the OWNER.

**15. MISCELLANEOUS**

**15.1 Claims for Injury or Damage**

Should the OWNER or the CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 15.1 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

## **15.2 Non-Discrimination in Employment**

The CONTRACTOR shall comply with the following requirements prohibiting discrimination:

**15.2.1** That no person (as defined in KRS 344.010) shall bid on Lexington-Fayette Urban County Government construction projects, or bid to furnish materials or supplies to the Lexington-Fayette Urban County Government, if, within six months prior to the time of opening of bids, said person shall have been found, by declaratory judgment action in Fayette Circuit Court, to be presently engaging in an unlawful practice, as hereinafter defined. Such declaratory judgment action may be brought by an aggrieved individual or upon an allegation that an effort at conciliation pursuant to KRS 344.200 has been attempted and failed, by the Lexington-Fayette County Human Rights Commission.

**15.2.2** That it is an unlawful practice for an employer:

**15.2.2.1** to fail or refuse to hire, or to discharge any individual or otherwise to discriminate against an individual, with respect to his compensation, terms, conditions, or privileges of employment, because of such individual's race, color, religion, sex, age, or national origin; or

**15.2.2.2** to limit, segregate or classify his employees in any way which would deprive or tend to deprive an individual of employment opportunities or otherwise adversely affect his status as an employee because of such individual's sex, race, color, religion, age, or national origin.

**15.2.3** That it is an unlawful practice for an employer, labor organization, or joint-labor management committee controlling apprenticeship or other training or retraining, including on-the-job training programs to discriminate against an individual because of his race, color, religion, sex, age, or national origin in admission to, or employment in, any program established to provide apprenticeship or other training.

**15.2.4** That a copy of this Ordinance shall be furnished all suppliers and made a part of all bid specifications.

**15.2.5** This Ordinance shall take effect after it is signed, published and recorded, as required by law.

## **15.3 Temporary Street Closing or Blockage**

The CONTRACTOR will notify the ENGINEER at least 72 hours prior to making any temporary street closing or blockage. This will permit orderly notification to all concerned public agencies. Specific details and restrictions on street closure or blockage are contained in the Special Conditions.

**15.4 Percentage of Work Performed by the Prime CONTRACTOR**

The CONTRACTOR shall perform on site, and with its own organization, Work equivalent to at least fifty (50%) percent of the total amount of Work to be performed under the Contract. This percentage may be reduced by a supplemental agreement to this Contract if, during performing the Work, the CONTRACTOR requests a reduction and the ENGINEER determines that the reduction would be to the advantage of the OWNER.

**15.5 Clean-up**

Cleanup shall progress, to the greatest degree practicable, throughout the course of the Work. The Work will not be considered as completed, and final payment will not be made, until the right-of-way and all ground occupied or affected by the Contractor in connection with the Work has been cleared of all rubbish, equipment, excess materials, temporary structures, and weeds. Rubbish and all waste materials of whatever nature shall be disposed of, off of the project site, in an acceptable manner. All property, both public and private, which has been damaged in the prosecution of the Work, shall be restored in an acceptable manner. All areas shall be draining, and all drainage ways shall be left unobstructed, and in such a condition that drift will not collect or scour be induced.

**15.6 General**

The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon the CONTRACTOR by paragraphs 12.1, 12.3.5, 13.3, and 15.2 and all of the rights and remedies available to the OWNER and the ENGINEER thereunder, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee or by other provisions of the Contract Documents, and 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. All representations, warranties and guarantees made in the Contract Documents will survive final payment and termination or completion of the Agreement.

**15.7 Debris Disposal**

For all LFUCG projects any trash, construction demolition debris, yard waste, dirt or debris of any kind that is removed from the project site must be disposed of in accordance with local, state, and federal regulations. The disposal site or facility must be approved in advance by the LFUCG and disposal documentation is required. The Contractor will be responsible for payment of any fines associated with improper disposal of material removed from the project site.

END OF SECTION

**PART V**  
**SPECIAL CONDITIONS**  
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## **1.0 RISK MANAGEMENT PROVISIONS INSURANCE AND INDEMNIFICATION**

### **A. DEFINITIONS**

1. The CONTRACTOR understands and agrees that the Risk Management Provisions of this Contract define the responsibilities of the CONTRACTOR to the OWNER.
2. As used in these Risk Management Provisions, the terms "CONTRACTOR" and "OWNER" shall be defined as follows:
  - a. "CONTRACTOR" means the contractor and its employees, agents, servants, owners, principals, licensees, assigns and subcontractors of any tier.
  - b. "OWNER" means the Lexington-Fayette Urban County Government (LFUCG) and its elected and appointed officials, employees, agents, boards, consultants, assigns, volunteers and successors in interest.
  - c. OWNER/ENGINEER's Consultant means Strand Associates, Inc.<sup>®</sup>

Strand Associates, Inc.<sup>®</sup> provided design services for the Project, which included preparation of Contract Documents, and will provide services during construction consisting of: responding to questions of the OWNER and the ENGINEER about the Contract Documents; preparing change orders as needed; providing shop drawing review; and reviewing the CONTRACTOR progress pay requests. Strand Associates, Inc.<sup>®</sup> shall be provided with the same indemnification by the CONTRACTOR as is provided for the OWNER in the Contract Documents and shall be listed as an additional insured as is provided for the OWNER in the Contract Documents. Excepting those noted above, no other duties or responsibilities shall be construed from the Contract Documents as being the obligation of Strand Associates, Inc.<sup>®</sup>

### **B. INDEMNIFICATION AND HOLD HARMLESS PROVISION**

1. It is understood and agreed by the parties that the Contractor hereby assumes the entire responsibility and liability for any and all damages to persons or property caused by or resulting from or arising out of any act or omission on the part of the Contractor or its employees, agents, servants, owners, principals, licensees, assigns or subcontractors of any tier (hereinafter "CONTRACTOR") under or in connection with this agreement and/or the provision of goods or services and the performance or failure to perform any work required thereby.
2. The CONTRACTOR shall indemnify, save, hold harmless and defend the Lexington-Fayette Urban County Government and its elected and appointed officials, employees, agents, volunteers, and successors in interest (hereinafter "LFUCG") from and against all liability, damages, and losses, including but not limited to, demands, claims, obligations, causes of action, judgments, penalties,

finer, liens, costs, expenses, interest, defense costs and reasonable attorney's fees that are in any way incidental to or connected with, or that arise or are alleged to have arisen, directly or indirectly, from or by the CONTRACTOR's performance or breach of the agreement and/or the provision of goods or services provided that: (a) it is attributable to personal injury, bodily injury, sickness, or death, or to injury to or destruction of property (including the loss of use resulting therefrom), or to or from the negligent acts, errors or omissions or willful misconduct of the CONTRACTOR; and (b) not caused solely by the active negligence or willful misconduct of LFUCG.

3. In the event LFUCG is alleged to be liable based upon the above, the CONTRACTOR shall defend such allegations and shall bear all costs, fees and expenses of such defense, including but not limited to, all reasonable attorneys' fees and expenses, court costs, and expert witness fees and expenses, using attorneys approved in writing by LFUCG, which approval shall not be unreasonably withheld.
4. These provisions shall in no way be limited by any financial responsibility or insurance requirements, and shall survive the termination of this agreement.
5. LFUCG is a political subdivision of the Commonwealth of Kentucky. The CONTRACTOR acknowledges and agrees that LFUCG is unable to provide indemnity or otherwise save, hold harmless, or defend the CONTRACTOR in any manner.
6. The Work and services performed hereunder involve a Consent Decree as further explained in of Item 11, of the specifications. The provisions of that provision are incorporated herein by reference as if expressly stated.

**C. FINANCIAL RESPONSIBILITY**

The BIDDER/CONTRACTOR understands and agrees that it shall, prior to final acceptance of its bid and the commencement of any work, demonstrate the ability to assure compliance with the above Indemnity provisions and these other risk management provisions.

**D. INSURANCE REQUIREMENTS**

1. YOUR ATTENTION IS DIRECTED TO THE INSURANCE REQUIREMENTS BELOW, AND YOU MAY NEED TO CONFER WITH YOUR INSURANCE AGENTS, BROKERS, OR CARRIERS TO DETERMINE IN ADVANCE OF SUBMISSION OF A RESPONSE THE AVAILABILITY OF THE INSURANCE COVERAGES AND ENDORSEMENTS REQUIRED HEREIN. IF YOU FAIL TO COMPLY WITH THE INSURANCE REQUIREMENTS BELOW, YOU MAY BE DISQUALIFIED FROM AWARD OF THE CONTRACT.

2. Required Insurance Coverage

The BIDDER/CONTRACTOR shall procure and maintain for the duration of this contract the following or equivalent insurance policies at no less than the limits shown below and cause its subcontractors to maintain similar insurance with limits acceptable to LFUCG in order to protect LFUCG against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by the CONTRACTOR. The cost of such insurance shall be included in any bid:

<b><u>Coverage</u></b>	<b><u>Limits</u></b>
General Liability (Insurance Services Office Form CG 00 01)	\$1 million per occurrence, \$2 million aggregate, or \$2 million combined single limit
Commercial Automobile Liability (Insurance Services Office Form CA 0001)	combined single, \$2 million per occurrence
Worker's Compensation	Statutory
Employer's Liability	\$500,000

3. The policies above shall contain the following conditions:

- a. All Certificates of Insurance forms used by the insurance carrier shall be properly filed and approved by the Department of Insurance for the Commonwealth of Kentucky (DOI). LFUCG shall be named as an additional insured in the General Liability Policy and Commercial Automobile Liability Policy using the Kentucky DOI approved forms.
- b. The General Liability Policy shall be primary to any insurance or self-insurance retained by LFUCG.
- c. The General Liability Policy shall include Products and Completed Operations coverage and Premises and Operations coverage unless it is deemed not to apply by LFUCG.
- d. The General Liability Policy shall include an Explosion-Collapse Underground (XCU) endorsement unless it is deemed not to apply by LFUCG.
- e. The General Liability Policy shall include a Pollution liability and/or Environmental Casualty endorsement unless it is deemed not to apply by LFUCG.

- f. The Policy shall include Umbrella/Excess Liability coverage in the amount of \$5 million per occurrence, \$5 million aggregate, unless it is deemed not to apply by LFUCG.
- g. LFUCG shall be provided at least 30 days advance written notice via certified mail, return receipt requested, in the event any of the required policies are canceled or non-renewed.
- h. Said coverage shall be written by insurers acceptable to LFUCG and shall be in a form acceptable to LFUCG. Insurance placed with insurers with a rating classification of no less than Excellent (A or A-) and a financial size category of no less than VIII, as defined by the most current Best's Key Rating Guide shall be deemed automatically acceptable.

4. Renewals

After insurance has been approved by LFUCG, evidence of renewal of an expiring policy must be submitted to LFUCG and may be submitted on a manually signed renewal endorsement form. If the policy or carrier has changed, however, new evidence of coverage must be submitted in accordance with these Insurance Requirements.

5. Deductibles and Self-Insured Programs

**IF YOU INTEND TO SUBMIT A SELF-INSURANCE PLAN IT MUST BE FORWARDED TO LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT, DIVISION OF RISK MANAGEMENT, 200 EAST MAIN STREET, LEXINGTON, KENTUCKY 40507 NO LATER THAN A MINIMUM OF FIVE (5) WORKING DAYS PRIOR TO THE RESPONSE DATE.** Self-insurance programs, deductibles, and self-insured retentions in insurance policies are subject to separate approval by LFUCG's Division of Risk Management, upon review of evidence of the BIDDER/CONTRACTOR's financial capacity to respond to claims. Any such programs or retentions must provide LFUCG with at least the same protection from liability and defense of suits as would be afforded by first-dollar insurance coverage.

6. Safety and Loss Control

The CONTRACTOR shall comply with all applicable federal, state, and local safety standards related to the performance of its works or services under this Agreement and take necessary action to protect the life, health and safety and property of all of its personnel on the job site, the public, and LFUCG.

7. Verification of Coverage

The BIDDER/CONTRACTOR agrees to furnish LFUCG with all applicable Certificates of Insurance signed by a person authorized by the insurer to bind



coverage on its behalf prior to final award, and if requested, shall provide LFUCG copies of all insurance policies, including all endorsements.

8. Right to Review, Audit and Inspect

The CONTRACTOR understands and agrees that LFUCG may review, audit and inspect any and all of its records and operations to insure compliance with these Insurance Requirements.

9. Additional Insured Endorsement

- a. The CONTRACTOR shall purchase and maintain liability insurance, as described above, specifically naming as additional insureds the OWNER, ENGINEER, and the OWNER/ENGINEER's Consultant as well as other individuals or entities identified, using Additional Insurance Endorsement Form CG 20 26 07 04, CG 81 11 05 06, CG 20 10 07 04, or equivalent form. General liability policies shall also be endorsed with Form CG 20 37 07 04 to include the "products-completed operations hazard." Endorsements or General Liability policy shall not exclude supervisory or inspection services. The CONTRACTOR shall also provide an Additional Insured Endorsement for the automobile policy.
- b. The CONTRACTOR shall, prior to the start of any work on the project by an subcontractor receive: (1) a certificate of insurance from each subcontractor naming the OWNER, ENGINEER, and the OWNER/ENGINEER's Consultant as well as other individuals and entities so identified as an additional insured, under each subcontractor's general liability for policy; and (2) the Additional Insured Endorsement language as required by paragraph 1 for subcontractor's operations. Certificate shall be Acord 25-S or equivalent.
- c. That failure of the CONTRACTOR or subcontractor to comply with the above requirements with respect to the Additional Insured Endorsement and/or Certificate of Insurance, shall not be construed as waiver of those provisions by the OWNER, ENGINEER, and the OWNER/ENGINEER's Consultant as well as other individuals and entities so identified.

**E. DEFAULT**

The BIDDER/CONTRACTOR understands and agrees that the failure to comply with any of these insurance, safety, or loss control provisions shall constitute default and that LFUCG may elect at its option any single remedy or penalty or any combination of remedies and penalties, as available, including but not limited to purchasing insurance and charging the BIDDER/CONTRACTOR for any such insurance premiums purchased, or suspending or terminating the work.

## **2.0     CONSENT DECREE REQUIREMENTS**

The work to be provided through this Bid will assist the Lexington-Fayette Urban County Government (the “OWNER”) in successfully implementing the Agreement (Contract) and complying with any requirements which are related to the CONSENT DECREE entered in a case styled *United States & Commonwealth of Kentucky v. Lexington-Fayette Urban County Government*, United States District Court for the Eastern District of Kentucky, Civil Action No. 5:06-cv-386-KSF (the “CONSENT DECREE”). The services provided through this Bid are hereinafter referred to as the Agreement (Contract). The primary goal of the Agreement (Contract) is to provide the owner with the technical support and/or construction services necessary to successfully meet the obligations and deadlines of the CONSENT DECREE.

The BIDDER shall familiarize itself with and shall at all times comply with the CONSENT DECREE, and all federal, state and local laws, ordinances, and regulations that in any manner affect the Agreement (Contract). Time is of the essence in the performance of Agreement (Contract). Bidder is aware that the OWNER is subject to penalties for non-compliance with the CONSENT DECREE deadlines.

If delays result solely by reason of acts of the BIDDER, the BIDDER shall be held liable for any financial penalties incurred by the OWNER as a result of the delay, including but not limited to those assessed pursuant to the CONSENT DECREE. In the event the parties cannot mutually agree upon the cause(s) associated with the delays in completing project deliverables, the BIDDER must immediately notify the OWNER in the event of such delay, and provide the OWNER a written action plan within five (5) business days on how it will attempt to resolve the delay.

In the event that BIDDER’s delay or other nonperformance of its obligations hereunder results in the imposition of penalties against the OWNER pursuant to the CONSENT DECREE, or the OWNER otherwise suffers damage as a result of such delay or nonperformance, BIDDER shall be solely liable to OWNER for any and all such damages, including any costs and attorney’s fees.

An electronic version of the CONSENT DECREE is available on the LFUCG web page for review or to print a copy at no charge.

## **3.0     WAGE RATE DETERMINATIONS**

State and Federal Wage Determinations do not apply to this project.

**END OF SECTION**

**PART VI**  
**CONTRACT AGREEMENT**  
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**PART VI**  
**CONTRACT AGREEMENT**

THIS AGREEMENT, made on the 14<sup>TH</sup> day of NOVEMBER, 2024, by and between LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT, acting herein called "OWNER" and HERRICK COMPANY, INC., doing business as \*(an individual) (a partnership) (a corporation) located in the City of LEXINGTON, County of FAYETTE, and State of KENTUCKY, hereinafter called "CONTRACTOR."

WITNESSETH: That the CONTRACTOR and the OWNER in consideration of THIRTEEN MILLION, SEVEN HUNDRED THOUSAND Dollars and ZERO Cents (\$13,700,000.00) quoted in the proposal by the CONTRACTOR, dated OCTOBER 15, 2024, hereby agree to commence and complete the construction described as follows:

**1. SCOPE OF WORK**

The CONTRACTOR shall furnish all the materials, supplies, machinery, equipment, tools, oversight, labor, insurance, and other accessories and services necessary to complete the project in accordance with the conditions and prices stated in the Proposal, the General Conditions, and the Special Conditions of the Contract, the Specifications and Contract Documents therefore as prepared by Strand Associates, Inc.<sup>®</sup> for the ***TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION PROCESS REPLACEMENT PROJECT.***

**2. TIME OF COMPLETION**

For the duration of the contract, the time period authorized by the OWNER for the proper execution of the Work by the Contract, in full, is hereby fixed as five hundred forty-five (545) calendar days for Final Completion. The Work shall be Substantially Complete within four hundred eighty (480) calendar days. The time shall begin ten (10) days after the CONTRACTOR is given the Notice to Proceed with the Work.

In addition to the required completion date, there are milestones by which certain items of work must be completed. See General Requirements for milestone requirements. Milestone 1 Completion shall be three hundred ninety (390) calendar days.

**TIME IS OF THE ESSENCE IN THE PERFORMANCE OF THIS AGREEMENT AND CONTRACTOR SHALL BE LIABLE AND RESPONSIBLE FOR DAMAGES SUFFERED BY OWNER AS A RESULT OF THE DELAY CAUSED BY CONTRACTOR.**

Should the CONTRACTOR fail or refuse to complete the work within the time specified in his Proposal and/or Contract (or extension of time granted by the OWNER), the CONTRACTOR shall pay liquidated damages in an amount of \$1,500 per day. The amount of liquidated damages shall in no event be considered as a penalty, nor other than an amount agreed upon by the CONTRACTOR and the OWNER for damages, losses, additional engineering, additional resident representation and other cost that will be sustained by the owner, if the CONTRACTOR fails to complete the work

within the specified time. Liquidated damages will be applied on a rate per day for each and every calendar day (Sundays and holidays included) beyond the Contract expiration date stipulated in the Contract Documents, considering all time extension granted. **These Liquidated Damages are in addition to any other damages/fees/penalties that are incurred as a result of Consent Decree requirements.**

### **3. ISSUANCE OF WORK ORDERS**

Notice to begin Work will be given in whole or for part of the Work as determined by the OWNER pending the availability of funds.

### **4. THE CONTRACT SUM**

The OWNER agrees to pay the CONTRACTOR in current funds for the performance of the Contract, as quoted in the proposal, subject to any additions and deductions, as provided therein.

### **5. PROGRESS PAYMENTS**

The OWNER shall make payments on account of the Contract, as provided in accordance with the General Conditions, as estimated by the ENGINEER, less the aggregate of previous payments.

### **6. ACCEPTANCE AND FINAL PAYMENT**

Final payment shall be due within ninety (90) days after completion of the Work, provided the Work be then fully completed and the Contract fully accepted.

Before issuance of final certificate, the CONTRACTOR shall submit evidence satisfactory to the ENGINEER that all payrolls, material bills, and other indebtedness connected with the Work has been paid.

If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of the CONTRACTOR, and the ENGINEER so certifies, the OWNER shall upon certificate of the ENGINEER, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

### **7. THE CONTRACT DOCUMENTS**

The Advertisement for Bids, Information for Bidders, the General Conditions, Supplemental General Conditions, Contract Agreement, Special Conditions, Technical Specifications, any and all Addenda, and Proposal, and Plan Drawings form the Contract, and they are fully a part of the Contract as if hereto attached or herein repeated.

## **8. EXTRA WORK**

The OWNER, without invalidating the Contract, may order extra work or make changes by altering, adding to or deducting from the Work, the Contract Sum being adjusted accordingly. All such Work shall be executed and paid for in accordance with the General Conditions, which is a part of this Contract.

## **9. CONSENT DECREE REQUIREMENTS**

**9.1 OWNER**, the United States Environmental Protection Agency, and the Commonwealth of Kentucky have entered into a Consent Decree in a case styled *United States, et al. v. Lexington-Fayette Urban County Government*, United States District Court for the Eastern District of Kentucky, Case No. 5:06-CV-00386 (“CONSENT DECREE”), that requires the OWNER to complete numerous projects related to its sanitary sewer system and stormwater management program within specific periods of time.

**9.2 TIME IS OF THE ESSENCE IN THE PERFORMANCE OF THIS AGREEMENT.** CONTRACTOR is aware that the OWNER is subject to penalties for non-compliance with the CONSENT DECREE deadlines. The CONTRACTOR shall be specifically liable and responsible for payment of any and all penalties, fines, or fees assessed against or incurred by the OWNER as a result of any delay in, or non-performance of, any of the CONTRACTOR’s obligations or responsibilities under this Contract, or for any other damages suffered by the OWNER as a result of such delay or non-performance. This shall specifically include, but shall not be limited to, any penalty, fine, fee, or assessment against the OWNER by the U.S. Department of Justice, U.S. Environmental Protection Agency, and/or the Kentucky Energy and Environment Cabinet related to the Consent Decree.

**9.3** The provisions of this Section and the various rates of compensation for the CONTRACTOR’s services provided for elsewhere in this Agreement have been agreed to in anticipation of the orderly and continuous progress of the PROJECT through completion.

**9.4** If delays result by reason of acts of the OWNER or approving agencies, which are beyond the control of the CONTRACTOR, an extension of time for such delay will be considered. If delays occur, the CONTRACTOR shall immediately notify the OWNER, and within five (5) business days from the date of the delay apply in writing to the OWNER for an extension of time for such reasonable period as may be mutually agreed upon between the parties, and if approved, the PROJECT schedule shall be revised to reflect the extension. Such extension of time to the completion date shall in no way be construed to operate as a waiver on the part of the OWNER of any of its rights in the Agreement. Section 9.6 of this Agreement (Disputes) shall apply in the event the parties cannot agree upon an extension of time.

In the event that the overall delay resulting from the above-described causes is sufficient to prevent complete performance of the Agreement within six (6) months of the time specified herein, the fees to be paid to the CONTRACTOR shall be subject to adjustment

as agreed upon by the parties. Section 9.6 of this Agreement shall apply in the event the parties cannot agree upon an adjustment of fee.

**9.5** If delays result solely by reason of acts of the CONTRACTOR, the CONTRACTOR shall be held liable for any financial penalties incurred by the OWNER as a result of the delay, including but not limited to those assessed pursuant to the CONSENT DECREE as provided in Section 9.2, above. Section 9.6 of this Agreement (Disputes), shall apply in the event the parties cannot mutually agree upon the cause(s) associated with delays in completing project deliverables. The CONTRACTOR must immediately notify the OWNER in the event of such delay, and provide the OWNER a written action plan within five (5) business days on how it will attempt to resolve the delay.

## **9.6 DISPUTES**

Except as otherwise provided in this Agreement, any dispute hereunder may be resolved by agreement of the OWNER's Agent (Charles H. Martin, P.E., Director of Water Quality) and the CONTRACTOR. In the absence of such an agreement, the dispute shall be submitted to the OWNER's Commissioner, Department of Environmental Quality and Public Works, whose decision shall be final and conclusive unless determined by a court of competent jurisdiction to have been fraudulent, capricious, arbitrary, or so grossly erroneous as necessarily to imply bad faith. Pending a final decision of a dispute hereunder, the CONTRACTOR shall proceed diligently with the performance of the Agreement in accordance with the directions of the OWNER.

## **10. THE FOLLOWING IS AN ENUMERATION OF THE SPECIFICATIONS AND DRAWINGS (CONTRACT DOCUMENTS):**

### **SPECIFICATIONS**

<b>SECTION NO.</b>	<b>TITLE</b>	<b>PAGES</b>
I	Advertisement for Bids	AB-1 thru AB-11
II	Information for Bidders	IB-1 thru IB-10
III	Form of Proposal	P-1 thru P-22
IV	General Conditions	GC-1 thru GC-49
V	Special Conditions	SC-1 thru SC-7
VI	Contract Agreement	CA-1 thru CA-6
VII	Performance and Payment Bonds	PB-1 thru PB-7
VIII	Addenda	AD-1 thru AD-3
IX	Technical Specifications	DIV 01 thru DIV 46

IN WITNESSETH WHEREOF, the parties hereto have executed this Contract as of the date and year above written.

(Seal)

Lexington-Fayette Urban County Government.  
Lexington, Kentucky

(OWNER)

ATTEST:

BY:

Linda Gorton

MAYOR

Mayor  
(Title)

HERRICK COMPANY, INC  
(CONTRACTOR)

BY:

CFM  
Pres/CEO  
(Title)

78 ENTERPRISE DR., LEXINGTON, KY 40510  
(Address and Zip Code)

IMPORTANT: \*Strike out any non-applicable terms.

Secretary of the OWNER should attest. If the CONTRACTOR is corporation,  
Secretary should attest. Give proper title of each person-executing Contract.

END OF SECTION



**PART VII**

**PERFORMANCE AND PAYMENT BONDS**

1. PERFORMANCE BOND
2. PAYMENT BOND

PART VII

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that

Herrick Company, Inc.

(Name of Contractor)

Herrick Company, Inc., 780 Enterprise Dr, Lexington, KY 40510

(Address of Contractor)

a Corporation, hereinafter  
(Corporation, Partnership, or Individual)

called Principal, and

United Fire & Casualty Company

(Name of Surety)

118 Second Ave SE, Cedar Rapids, IA 52401

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
200 East Main Street, Third Floor  
Lexington, Kentucky 40507

hereinafter called "Owner" in the penal sum of Thirteen Million Seven Hundred Thousand and No/100 Dollars, (\$ 13,700,000.00 ), for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal by written agreement is entering into a Contract with Owner for **TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION PROCESS REPLACEMENT PROJECT** in accordance with drawings and specifications prepared by: **LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT DIVISION OF WATER QUALITY** which Contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Principal shall promptly and faithfully perform said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety hereby waives notice of any alteration or extension of time made by the Owner.

Whenever, Principal shall be, and declared by Owner to be in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

- (1) Complete the Contract in accordance with its terms and conditions or
- (2) Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, or if the Owner elects, upon determination by the Owner and Surety jointly of the lowest responsible bidder, arrange for a Contract between such bidder and Owner, and make available as Work progresses (even though there may be a default or a succession of defaults under the Contract or Contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract Price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the Contract Price", as used in this paragraph shall mean the total amount payable by Owner to Principal under the Contract and any amendments thereto, less the amount properly paid by Owner to Principal.

Any suit under this bond must be instituted before the expiration of two (2) years from the date on which final payment under the Contract falls due.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of Owner.

IN WITNESS WHEREOF, this instrument is executed in three (3) each one of which shall be

(number)  
deemed an original, this the 14th day of November, 2024.

ATTEST:

Karla Solis  
(Principal) Secretary

[Signature]  
Witness as to Principal

780 Enterprise Dr  
(Address)  
Lexington, KY 40510

ATTEST:

(Surety) Secretary

(SEAL)

Suzanna Knight  
Witness as to Surety Suzanna Knight

(Address)

2307 River Rd, Ste 200

Louisville, KY 40206

TITLE: Underwriting Assistant

Herrick Company, Inc.

Principal

BY: [Signature] (s)

780 Enterprise Dr

(Address)

Lexington, KY 40510

United Fire & Casualty Company

Surety

BY: [Signature]  
Attorney-in-Fact

118 Second Ave SE

(Address)

Cedar Rapids, IA 52401

TITLE: Attorney-in-Fact

Surety

BY: Leigh McCarthy

NOTE: The number of executed counterparts of the bond shall coincide with the number of executed counterparts of the Contract.

PART VII

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENT: that

Herrick Company, Inc.

(Name of Contractor)

Herrick Company, Inc., 780 Enterprise Dr, Lexington, KY 40510

(Address of Contractor)

a Corporation, hereinafter

(Corporation, Partnership or Individual)

called Principal, and

United Fire & Casualty Company

(Name of Surety)

118 Second Ave SE, Cedar Rapids, IA 52401

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto:

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT

200 East Main Street, Third Floor

Lexington, Kentucky 40507

Obligee, hereinafter called Owner, for the use and benefit of claimants as hereinafter defined, in the amount of Thirteen Million Seven Hundred Thousand and No/100-----Dollars

(\$ 13,700,000.00 ) the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal by written agreement is entering into a Contract with Owner for **TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION PROCESS REPLACEMENT PROJECT** in accordance with drawings and specifications prepared by: **LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT DIVISION OF WATER QUALITY** which Contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Principal shall promptly make payment to all claimants as hereinafter defined for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions.

1. A claimant is defined as one having a direct contract with the Principal or with a Subcontractor of the Principal for labor, material, or both, used or reasonably required for use in the performance of the Contract, labor and material being construed to include that

part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

2. The above named Principal and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses of any such suit.
3. No suit or action shall be commenced hereunder by any claimant:
  - (a) Unless claimant, other than one having a direct contract with the Principal, shall have given written notice to any two of the following: The Principal, the Owner, or the Surety above named, within ninety (90) days after such claimant did or performed the last of the Work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the Work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Owner, or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.
  - (b) After the expiration of one (1) year following the date on which Principal ceased Work on said Contract, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.
  - (c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.
4. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against aid improvement, whether or not claim for the amount of such lien be presented under and against this bond.

IN WITNESS WHEREOF, this instrument is executed in three (3) counterparts,  
each one of  
(number)

which shall be deemed an original, this the 14th day of November, 2024.

ATTEST:

Karla Lokite  
(Principal) Secretary

(SEAL)

Leigh McCarthy  
(Witness to Principal)

780 Enterprise Dr  
(Address)  
Lexington, KY 40510

Herrick Company, Inc.  
(Principal)

BY: [Signature] (s)  
780 Enterprise Dr  
(Address)  
Lexington, KY 40510

ATTEST:

(Surety) Secretary

(SEAL)

Suzanna Knight  
Witness as to Surety Suzanna Knight  
2307 River Rd, Ste 200  
(Address)  
Louisville, KY 40206



United Fire & Casualty Company  
(Surety)

BY: [Signature]  
Leigh McCarthy (Attorney-in-Fact)

(Address)  
118 Second Ave SE  
Cedar Rapids, IA 52401

NOTE: The number of executed counterparts of the bond shall coincide with the number of executed counterparts of the Contract.

END OF SECTION



UNITED FIRE & CASUALTY COMPANY, CEDAR RAPIDS, IA  
UNITED FIRE & INDEMNITY COMPANY, WEBSTER, TX  
FINANCIAL PACIFIC INSURANCE COMPANY, LOS ANGELES, CA  
CERTIFIED COPY OF POWER OF ATTORNEY  
(original on file at Home Office of Company – See Certification)

Inquiries: Surety Department  
118 Second Ave SE  
Cedar Rapids, IA 52401

KNOW ALL PERSONS BY THESE PRESENTS, That United Fire & Casualty Company, a corporation duly organized and existing under the laws of the State of Iowa; United Fire & Indemnity Company, a corporation duly organized and existing under the laws of the State of Texas; and Financial Pacific Insurance Company, a corporation duly organized and existing under the laws of the State of California (herein collectively called the Companies), and having their corporate headquarters in Cedar Rapids, State of Iowa, does make, constitute and appoint

JAMES T. SMITH, BROOK T. SMITH, RAYMOND M. HUNDLEY, DEBORAH NEICHTER, MICHELE LACROSSE, JASON CROMWELL, LEIGH MCCARTHY, RYAN BRITT, AMY SMITH, BARBARA DUNCAN, EACH INDIVIDUALLY

their true and lawful Attorney(s)-in-Fact with power and authority hereby conferred to sign, seal and execute in its behalf all lawful bonds, undertakings and other obligatory instruments of similar nature provided that no single obligation shall exceed \$75,000,000.00 and to bind the Companies thereby as fully and to the same extent as if such instruments were signed by the duly authorized officers of the Companies and all of the acts of said Attorney, pursuant to the authority hereby given and hereby ratified and confirmed.

The Authority hereby granted shall expire the 30th day of January, 2026 unless sooner revoked by United Fire & Casualty Company, United Fire & Indemnity Company, and Financial Pacific Insurance Company.

This Power of Attorney is made and executed pursuant to and by authority of the following bylaw duly adopted by the Boards of Directors of United Fire & Casualty Company, United Fire & Indemnity Company, and Financial Pacific Insurance Company.


**"Article VI – Surety Bonds and Undertakings"**

Section 2, Appointment of Attorney-in-Fact. "The President or any Vice President, or any other officer of the Companies may, from time to time, appoint by written certificates attorneys-in-fact to act in behalf of the Companies in the execution of policies of insurance, bonds, undertakings and other obligatory instruments of like nature. The signature of any officer authorized hereby, and the Corporate seal, may be affixed by facsimile to any power of attorney or special power of attorney or certification of either authorized hereby; such signature and seal, when so used, being adopted by the Companies as the original signature of such officer and the original seal of the Companies, to be valid and binding upon the Companies with the same force and effect as though manually affixed. Such attorneys-in-fact, subject to the limitations set forth in their respective certificates of authority shall have full power to bind the Companies by their signature and execution of any such instruments and to attach the seal the Companies thereto. The President or any Vice President, the Board of Directors or any other officer of the Companies may at any time revoke all power and authority previously given to any attorney-in-fact.

IN WITNESS WHEREOF, the COMPANIES have each caused these presents to be signed by its vice president and its corporate seal to be hereto affixed this 30th day of January, 2024

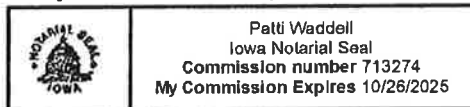
UNITED FIRE & CASUALTY COMPANY  
UNITED FIRE & INDEMNITY COMPANY  
FINANCIAL PACIFIC INSURANCE COMPANY



By:   
Vice President

State of Iowa, County of Linn, ss:

On 30th day of January, 2024, before me personally came Kyanna M. Saylor to me known, who being by me duly sworn, did depose and say; that she resides in Cedar Rapids, State of Iowa; that she is a Vice President of United Fire & Casualty Company, a Vice President of United Fire & Indemnity Company, and a Vice President of Financial Pacific Insurance Company the corporations described in and which executed the above instrument; that she knows the seal of said corporations; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said corporations and that she signed her name thereto pursuant to like authority, and acknowledges same to be the act and deed of said corporations.



  
Notary Public  
My commission expires: 10/26/2025

I, Mary A. Bertsch, Assistant Secretary of United Fire & Casualty Company and Assistant Secretary of United Fire & Indemnity Company, and Assistant Secretary of Financial Pacific Insurance Company, do hereby certify that I have compared the foregoing copy of the Power of Attorney and affidavit, and the copy of the Section of the bylaws and resolutions of said Corporations as set forth in said Power of Attorney, with the ORIGINALS ON FILE IN THE HOME OFFICE OF SAID CORPORATIONS, and that the same are correct transcripts thereof, and of the whole of the said originals, and that the said Power of Attorney has not been revoked and is now in full force and effect.

In testimony whereof I have hereunto subscribed my name and affixed the corporate seal of the said Corporations  
this 14th day of November, 2024.



By:   
Assistant Secretary,  
UF&C & UF&I & FPIC



**PART VIII**

**ADDENDA**

All addenda issued during the bidding of the Project will be reproduced in the signed Contract Documents, on the pages following this heading sheet.

<u>Addendum Number</u>	<u>Title</u>	<u>Date</u>
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____

ADDENDUM NO. 1

PROJECT MANUAL

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
LEXINGTON, KENTUCKY  
TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION  
PROCESS REPLACEMENT PROJECT  
CONTRACT 131-2024

Bids will be received until Tuesday, October 15, 2024, at 2:00 p.m., local time.

This Addendum to the Project Manual is issued to modify, explain, or correct the original Project Manual and is hereby made part of the Contract Documents. Insert the number of this Addendum in the blank space provided in the Form of Proposal, page P-3.

A. BIDDING AND CONTRACTING REQUIREMENTS

1. ADVERTISEMENT FOR BIDS

- a. AB-11, PART I-ADVERTISEMENT FOR BIDS, 14. AMERICAN RESCUE PLAN ACT REQUIREMENTS

ADD the following new paragraph after Paragraph 14.:

**“15. SALES TAX EXEMPTION**

CONTRACTOR agrees that the Contract Price for this Project shall not include sales tax on exempt building materials, fixtures, or supplies by signing the Certificate of Tax Exemption.

KRS 139.480(34) provides that “building materials, fixtures, or supplies purchased by a construction contractor if fulfilled by a construction contract for a sewer or water project with a governmental agency” if the building materials, fixtures, or supplies will be “permanently incorporated into a structure or improvement to real property, or will be completely consumed, in fulfilling a construction contract for the purpose of furnishing water or sewer services to the general public” and which would be tax free if purchased by the government, are exempt from sales/use taxes. Further “construction contract” means “a lump sum contract, cost plus contract, materials only contract, labor and materials contract, or any other type of contract.”

B. SPECIFICATIONS

1. DIVISION 01-GENERAL REQUIREMENTS

- a. Page 01 11 00-2, SECTION 01 11 00-SUMMARY OF WORK, PART 1-GENERAL, 1.04.A.1.

ADD “UV can be in service utilizing temporary electrical power from the plant distribution system. Permanent generator power is not included in this milestone.” to the end of Paragraph 1.04.A.1.

- b. Page 01 11 00-3, SECTION 01 11 00-SUMMARY OF WORK,  
PART 1-GENERAL, 1.04.C.3.

ADD "MCCs are not required to be on site prior to demolition, but a delivery date for them must be established before demolition occurs." to the end of Paragraph 1.04.C.3.

2. DIVISION 23-HEATING, VENTILATING, AND AIR CONDITIONING

- a. Page 23 74 17-4, SECTION 23 74 17-PACKAGED WALL MOUNTED AIR-CONDITIONING UNITS, PART 3-EXECUTION, 3.02.D.

DELETE "in accordance with Section 23 33 00-Air Duct Accessories."

C. DRAWINGS

1. SHEET NO. 44-UV DISINFECTION-OVERALL PLAN

REPLACE Key Note No. 2 with the following "SIDE MOUNTED GALVANIZED STEEL CHAIN LINK FENCE WITH TOE BOARD (TYP.) M/99-ASM5.01."

2. SHEET NO. 46-UV DISINFECTION-ENLARGED PLAN

REPLACE Key Note No. 2 with the following "SIDE MOUNTED GALVANIZED STEEL CHAIN LINK FENCE WITH TOE BOARD (TYP.) M/99-ASM5.01."

3. SHEET NO. 47-CHLORINE CONTACT TANK-SECTIONS-1

a. SECTION 2/90-ASM3.01

REPLACE "ALUMINUM RAILING WITH MESH FABRIC W/TOEBOARD" with "GALVANIZED STEEL CHAIN LINK FENCE WITH TOEBOARD "

b. SECTION 3/90-ASM3.01

REPLACE "ALUMINUM RAILING WITH TOEBOARD" with "GALVANIZED STEEL CHAIN LINK FENCE WITH TOEBOARD."

c. ENLARGED WALKWAY DETAIL B/90-ASM3.01

REPLACE "ALUMINUM RAILING WITH MESH FABRIC W/TOEBOARD" with "GALVANIZED STEEL CHAIN LINK FENCE WITH TOEBOARD."

4. SHEET NO. 48-CHLORINE CONTACT TANK-SECTIONS-2

REPLACE "ALUMINUM RAILING W/TOEBOARD" with "GALVANIZED STEEL CHAIN LINK FENCE WITH TOEBOARD."

5. SHEET NO. 65-ARCHITECTURAL/STRUCTURAL/MECHANICAL DETAILS-1

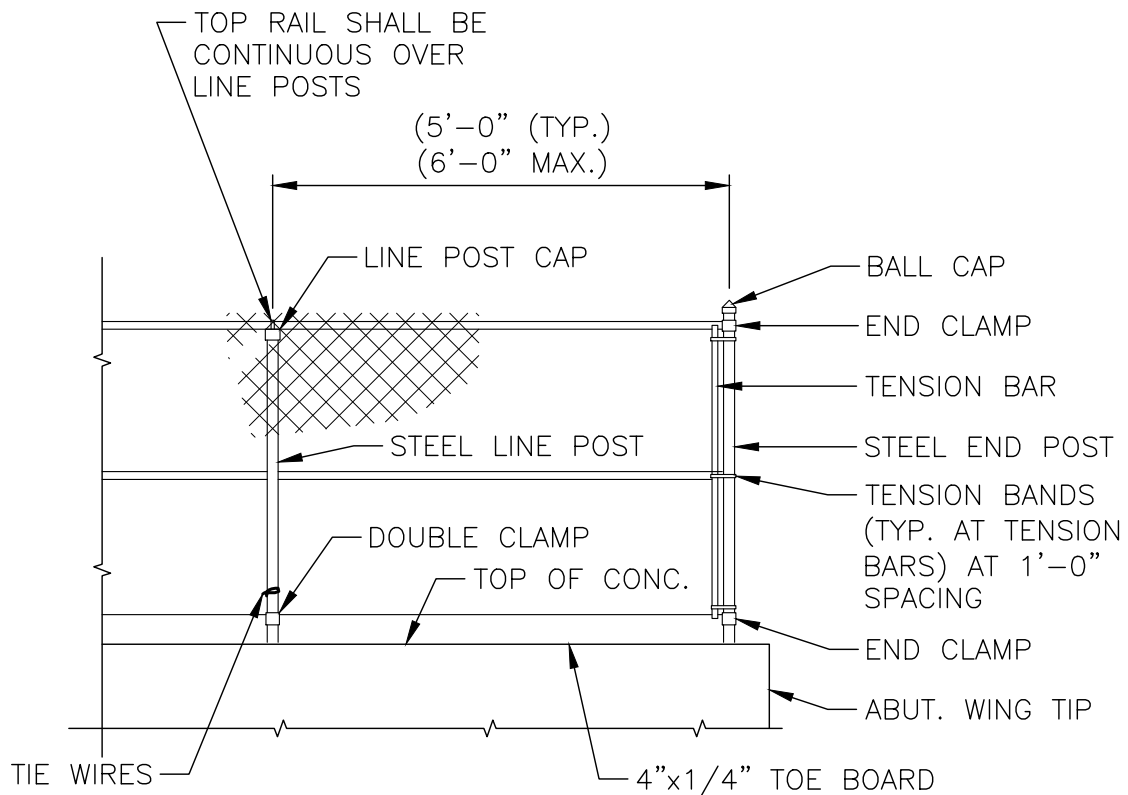
REPLACE Detail M/99-ASM5.01 with the attached new detail.

\*\*\*\*\*  
BIDDERS MUST ACKNOWLEDGE RECEIPT OF THIS ADDENDUM IN THE  
SPACE PROVIDED IN THE BID FORM  
\*\*\*\*\*

Dated at Lexington, Kentucky  
September 24, 2024

STRAND ASSOCIATES, INC.®  
651 Perimeter Drive, Suite 220  
Lexington, KY 40517





NOTE:  
FOR WALL MOUNTING,  
SEE

A  
99-ASM5.02

## GALVANIZED STEEL CHAIN LINK FENCE

M  
99-ASM5.01

NO SCALE

### ADDENDUM NO. 1

**TOWN BRANCH AND WEST HICKMAN WWTP  
UV DISINFECTION PROCESS REPLACEMENT PROJECT  
LEXINGTON - FAYETTE URBAN COUNTY GOVERNMENT  
LEXINGTON, KENTUCKY**



ADDENDUM NO. 1

2815.341

## ADDENDUM NO. 2

### PROJECT MANUAL

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
LEXINGTON, KENTUCKY  
TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION  
PROCESS REPLACEMENT PROJECT  
CONTRACT 131-2024

Bids will be received until Tuesday, October 15, 2024, at 2:00 p.m., local time.

This Addendum to the Project Manual is issued to modify, explain, or correct the original Project Manual and is hereby made part of the Contract Documents. Insert the number of this Addendum in the blank space provided in the Form of Proposal, page P-3.

#### A. GENERAL CONTRACTOR QUESTIONS

1. Question: It is noted the project is funded in part via federal ARPA funding and that Prevailing Wage Rates do not apply to this project. Please confirm American Iron and Steel requirements will not apply to this project.

Answer: American Iron and Steel requirements do not apply to this Contract.

2. Question: No Bid Bond/Bid Security Form appears to be provided within the documents. Please confirm a standard EJCDC Bid Bond Form is sufficient or provide the necessary alternate form.

Answer: The EJCDC form will be acceptable.

3. Question: Can record drawings be accessed?

Answer: Yes, they are being made available through Lynn Imaging.

4. Question: Is there any past geotechnical information for the West Hickman Meter Valve Vault? We are looking for soil information in order to support the 60-Inch FE pipes properly.

Answer: Yes, there is an older geotechnical report that shows borings for a nearby area, it is being made available through Lynn Imaging. For design purposes of the vault, conservative values per the building code were used for soil pressures. Owner will have the soils special inspector verify soils in the area during construction.

#### B. SECTION AB—ADVERTISEMENT FOR BIDS

- a. Page AB-4, PART I ADVERTISEMENT FOR BIDS, 10. NOTIFICATION TO THE LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT FOR AFFIRMATIVE ACTION PLAN AND CURRENT WORKFORCE

CHANGE the first sentence to read the following: "The successful bidder must submit with its bid the following items to the Lexington-Fayette Urban County Government:"

## C. PART III–FORM OF PROPOSAL

- a. Pages P-7 through P-22, PART III FORM OF PROPOSAL, 4. LUMP SUM BASE BID

REPLACE Proposal Pages P-7 through P-22 with the attached **Revised** Proposal Pages P-7 through P-23.

CLARIFICATION: Revisions were made to Proposal Pages P-7 through P-22, including the addition of a Cash Allowances table.

## D. SPECIFICATIONS

### 1. DIVISION 01–GENERAL REQUIREMENTS

- a. Page 01 11 00-3, SECTION 01 11 00–SUMMARY OF WORK, PART 1–GENERAL, 1.04.

CLARIFICATION: Section 01 11 00–Summary of Work references the use of temporary PAA feed systems during CCT modifications at each plant. This temporary feed system is separate from the mobile and permanent chemical feed systems that use Sodium Hypochlorite specified in Section 46 33 20–Liquid Chlorination Equipment.

- b. Page 01 29 00-1, SECTION 01 29 00–CONTRACT CONSIDERATIONS, PART 1–GENERAL, 1.01.A.

REPLACE Paragraph 1.01.A. in its entirety with the following:

- “ A. Work Included:
1. Cash Allowances.
  2. Measurement and Payment–Lump Sum.”

DELETE Paragraph 1.03 in its entirety.

CLARIFICATION: OWNER will hire a Special Inspector who will be responsible for items listed on Drawing 99-ASM6.01.

### 2. DIVISION 40–PROCESS INTERCONNECTIONS

- a. Page 40 05 00-4, SECTION 40 05 00–PIPING AND APPURTENANCES, PART 2–PRODUCTS, 2.02.E.

DELETE Paragraph 2.02.E. in its entirety.

## E. DRAWINGS

### 1. SHEET NO. 8–SITE WEST HICKMAN WWTP OVERALL SITE LOCATION PLAN

CLARIFICATION: Asphalt replacement noted shall be full depth replacement.

2. SHEET NO. 11-SITE TOWN BRANCH WWTP OVERALL SITE LOCATION PLAN

CLARIFICATION: Asphalt replacement noted shall be full depth replacement.

\*\*\*\*\*  
**BIDDERS MUST ACKNOWLEDGE RECEIPT OF THIS ADDENDUM IN THE  
SPACE PROVIDED IN THE BID FORM**  
\*\*\*\*\*

Dated at Lexington, Kentucky  
October 2, 2024

STRAND ASSOCIATES, INC.®  
651 Perimeter Drive, Suite 220  
Lexington, KY 40517





## CASH ALLOWANCES

The following Cash Allowances shall be included in the Lump Sum Base Bid. The Cash Allowances for non Lump Sum items shall be equal to the product of the quantity included in the Lump Sum Base Bid and the Unit Price. The Cash Allowances will be adjusted in the event that estimated quantities to be included in the Lump Sum Base Bid are different from final measured quantities. A single Unit Price shall be bid for each item. Failure to include one or more of the following Unit Price items may result in rejection of the entire Bid as nonconforming. For items with a quantity of 1, the Cash Allowance shall be adjusted based on actual final costs.

Item Number	Description	Estimated Quantity Included in the Lump Sum Base Bid	Unit	Bid Unit Price	Total Bid Price Included in the Lump Sum Base Bid
1.	Replace Unsuitable Foundation Material for Structures and Roads (Section 31 23 00–Excavation, Fill, Backfill, and Grading)	100	CY	\$	\$
2.	Replace Unsuitable Foundation Material for Utility Trenches (Section 31 23 00–Excavation, Fill, Backfill, and Grading)	100	CY	\$	\$

Submitted by:

\_\_\_\_\_  
*Firm*

\_\_\_\_\_  
*Address*

\_\_\_\_\_  
*City, State & Zip*

***Bid must be signed:  
(original signature)***

\_\_\_\_\_  
***Signature of Authorized Company Representative – Title***

\_\_\_\_\_  
*Representative/s Name (Typed or Printed)*

\_\_\_\_\_  
*Area Code – Phone – Extension*

\_\_\_\_\_  
*Fax #*

\_\_\_\_\_  
*E-Mail Address*

**OFFICIAL ADDRESS:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (Seal if Bid is by Corporation)

by signing this form you agree to ALL of the terms and associated forms.

## **5. STATEMENT OF BIDDER'S QUALIFICATIONS**

The following statement of the Bidder's qualifications is required to be filled in, executed, and submitted with the Proposal:

1. Name of Bidder: \_\_\_\_\_
2. Permanent Place of Business: \_\_\_\_\_
3. When Organized: \_\_\_\_\_
4. Where Incorporated: \_\_\_\_\_
5. Construction Plant and Equipment Available for this Project:

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(Attach Separate Sheet If Necessary)

6. Financial Condition:

If specifically requested by the OWNER, the apparent low Bidder is required to submit its latest three (3) years audited financial statements to the OWNER'S Division of Central Purchasing within seven (7) calendar days following the bid opening.

7. In the event the Contract is awarded to the undersigned, surety bonds will be furnished by:

\_\_\_\_\_(Surety)

Signed: \_\_\_\_\_(Representative of Surety)

8. The following is a list of similar projects performed by the Bidder: (Attach separate sheet if necessary).

<u>NAME</u>	<u>LOCATION</u>	<u>CONTRACT SUM</u>

9. The Bidder has now under contract and bonded the following projects:

<u>NAME</u>	<u>LOCATION</u>	<u>CONTRACT SUM</u>

10. List Key Bidder Personnel who will work on this Project.

<u>NAME</u>	<u>POSITION DESCRIPTION</u>	<u>NO. OF YEARS WITH BIDDER</u>

11. DBE Participation on current bonded projects under contract:

<b><u>SUBCONTRACTORS</u></b> <b><u>(LIST)</u></b>	<b><u>PROJECT</u></b> <b><u>(SPECIFIC TYPE)</u></b>	<b><u>DBE</u></b>	<b><u>MAJORITY</u></b>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

(USE ADDITIONAL SHEETS IF NECESSARY)

12. We acknowledge that, if we are the apparent low Bidder, we will submit to the OWNER within seven (7) calendar days following the Bid Opening, a sworn statement on the OWNER'S form regarding all current work on hand and under contract, and a statement on the OWNER'S form of the experience of our officers, office management and field management personnel. Additionally, if requested by the OWNER, we will within seven (7) days following the request submit audited financial statements and loss history for insurance claims for the three (3) most recent years (or a lesser period stipulated by the OWNER)—all in accordance with the Bid Documents.

## 6. LIST OF PROPOSED SUBCONTRACTORS

The following list of proposed subcontractors is required by the OWNER to be executed, completed and submitted with the BIDDER'S FORM OF PROPOSAL. All subcontractors are subject to approval of the Lexington-Fayette Urban County Government. Failure to submit this list completely filled out may be cause for rejection of bid.

<u>BRANCH OF WORK - LIST EACH</u> <u>MAJOR ITEM</u> Such as: Grading, bituminous paving, concrete, seeding and protection, construction staking, etc.	<u>SUBCONTRACTOR</u>	<u>DBE</u> <u>Yes/No</u>	<u>% of Work</u>
1. _____	Name: _____ Address: _____	_____	_____
2. _____	Name: _____ Address: _____	_____	_____
3. _____	Name: _____ Address: _____	_____	_____
4. _____	Name: _____ Address: _____	_____	_____
5. _____	Name: _____ Address: _____	_____	_____
6. _____	Name: _____ Address: _____	_____	_____
7. _____	Name: _____ Address: _____	_____	_____

(Attach additional sheet(s) if necessary.)

**7. AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND  
NON-CONFLICT OF INTEREST**

I hereby swear (or affirm) under the penalty for false swearing:

1. That I am the Bidder (if the Bidder is an individual), a partner of the Bidder (if the Bidder is a partnership), or an officer or employee of the bidding corporation having authority to sign on its behalf (if the Bidder is a corporation);
2. That the attached bid has been arrived at by the Bidder independently, and has been submitted without collusion with, and without any agreement, understanding or planned common course of action, with any other contractor, vendor of materials, supplies, equipment or services described in the Invitation to Bid, designed to limit independent bidding or competition;
3. That the contents of the bid or bids have not been communicated by the Bidder or its employees or agents to any person not an employee or agent of the Bidder or its surety on any bond furnished, with the bid or bids, and will not be communicated to any such person, prior to the official opening of the bid or bids;
4. That the Bidder is legally entitled to enter into the contracts with the Lexington-Fayette Urban County Government, and is not in violation of any prohibited conflict of interest;
5. (Applicable to corporation only) That as a foreign corporation, we are registered with the Secretary of State, Commonwealth of Kentucky, and authorized to do business in the State \_\_\_\_\_ or, that as a domestic corporation, we are in good standing with the Secretary of State, Commonwealth of Kentucky \_\_\_\_\_. Check the statement applicable.
6. This offer is for 60 calendar days from the date this bid is opened. In submitting the above, it is expressly agreed that, upon proper acceptance by the Lexington-Fayette Urban County Government of any or all items bid above, a contract shall thereby be created with respect to the items accepted.
7. That I have fully informed myself regarding the accuracy of the statements made in this statement.

READ CAREFULLY – SIGN IN SPACE BELOW – FAILURE TO SIGN INVALIDATES BID.

Signed by \_\_\_\_\_

Firm \_\_\_\_\_

Address \_\_\_\_\_

Telephone \_\_\_\_\_

Date \_\_\_\_\_

**8. STATEMENT OF EXPERIENCE**  
*(this section must be completed or your bid will be considered as non-responsive)*

NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

NAME OF INDIVIDUAL: \_\_\_\_\_

POSITION/TITLE: \_\_\_\_\_

STATEMENT OF EXPERIENCE: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

BY: \_\_\_\_\_

Name of Firm

DATE: \_\_\_\_\_

BY: \_\_\_\_\_

TITLE: \_\_\_\_\_

\* Include all officers, office management's, Affirmative Action officials, and field management personnel. (Attach separate sheets if necessary.)

## 9. EQUAL OPPORTUNITY AGREEMENT

### The Law

- \* Title VII of the Civil Rights Act of 1964 (amended 1972) states that it is unlawful for an employer to discriminate in employment because of race, color, religion, sex, age (40-70 years) or national origin.
- \* Executive Order No. 11246 on Nondiscrimination under Federal contract prohibits employment discrimination by contractor and subcontractor doing business with the Federal Government or recipients of Federal funds. This order was later amended by Executive Order No. 11375 to prohibit discrimination on the basis of sex.
- \* Section 503 of the Rehabilitation Act of 1973 States:  
*The Contractor will not discriminate against any employee or applicant for employment because of physical or mental handicap.*
- \* Section 2012 of the Vietnam Era Veterans Readjustment Act of 1973 requires Affirmative Action on behalf of disabled veterans and veterans of the Vietnam Era by contractors having Federal Contracts.
- \* Section 206 (A) of Executive Order 12086, Consolidation of Contract Compliance Functions for Equal Employment Opportunity, states:  
*The Secretary of Labor may investigate the employment practices of any Government contractor or sub-contractor to determine whether or not the contractual provisions specified in Section 202 of this order have been violated.*

The Lexington-Fayette Urban County Government practices Equal Opportunity in recruiting, hiring and promoting. It is the Government's intent to affirmatively provide employment opportunities for those individuals who have previously not been allowed to enter into the mainstream of society. Because of its importance to the local Government, this policy carries the full endorsement of the Mayor, Commissioners, Directors, and all supervisory personnel. In following this commitment to Equal Employment Opportunity and because the Government is the benefactor of the Federal funds, it is both against the Urban County Government policy and illegal for the Government to let contracts to companies which knowingly or unknowingly practice discrimination in their employment practices. Violation of the above mentioned ordinances may cause a contract to be canceled and the contractor may be declared ineligible for future consideration.

Please sign this statement in the appropriate space acknowledging that you have read and understand the provisions contained herein. Return this document as part of your application packet.

### Bidders

I/We agree to comply with the Civil Rights Laws listed above that govern employment rights of minorities, women, Vietnam veterans, handicapped, and aged persons.

---

Signature

---

Name of Business

The Entity (regardless of whether construction contractor, non-construction contractor or supplier) agrees to provide equal opportunity in employment for all qualified persons, to prohibit discrimination in employment because of race, color, creed, national origin, sex or age, and to promote equal employment through a positive, continuing program from itself and each of its sub-contracting agents. This program of equal employment opportunity shall apply to every aspect of its employment policies and practices.

The Kentucky equal Employment Opportunity Act of 1978 (KRS 45.560-45.640) requires that any count, city, town, school district, water district, hospital district, or other political subdivision of the state shall include in directly or indirectly publicly funded contracts for supplies, materials, services, or equipment hereinafter entered into the following provisions:

During the performance of this contract, the contractor agrees as follows:

- (1) *The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age or national origin;*
- (2) *The contractor will state in all solicitations or advertisements for employees placed by or on behalf of the contractors that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age or national origin;*
- (3) *The contract will post notices in conspicuous places, available to employees and applicants for employment, setting forth the provisions of the non-discrimination clauses required by this section; and*
- (4) *The contractor will send a notice to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding advising the labor union or workers' representative of the contractor's commitments under the nondiscrimination clauses.*

The Act further provides:

#### KRS 45.610. Hiring minorities – Information required

- a. *For the length of the contract, each contractor shall hire minorities from other sources within the drawing area, should the union with which he has collective bargaining agreements be unwilling to supply sufficient minorities to satisfy the agreed upon goals and timetable.*
- b. *Each contractor shall, for the length of the contract, furnish such information as required by KRS 45.560 to KRS 45.640 and by such rules, regulations and orders issued pursuant thereto and will permit access to all books and records pertaining to his employment practices and work sites by the contracting agency and the department for purposes of investigation to ascertain compliance with KRS 45.560 to 45.640 and such rules, regulations and orders issued pursuant thereto.*

KRS 45.620. Action against contractor – Hiring of minority contractor or subcontractor

- (1) *If any contractor is found by the department to have engaged in an unlawful practice under this chapter during the course of performing under a contract or subcontract covered under KRS 45.560 to 45.640, the department shall so certify to the contracting agency and such certification shall be binding upon the contracting agency unless it is reversed in the course of judicial review.*
- (2) *If the contractor is found to have committed an unlawful practice under KRS 45.560 to 45.640, the contracting agency may cancel or terminate the contract, conditioned upon a program for future compliance approved by the contracting agency and the department. The contracting agency may declare such a contractor ineligible to bid on further contracts with that agency until such time as the contractor complies in full with the requirements of KRS 45.560 – 45.640.*
- (3) *The equal employment provisions of KRS 45.560 to 45.640 may be met in part by a contractor by subcontracting to a minority contractor or subcontractor. For the provisions of KRS 45.560 to 45.640, a minority contractor or subcontractor shall mean a business that is owned and controlled by one or more persons disadvantaged by racial or ethnic circumstances.*

KRS 45.630 Termination of existing employee not required, when

*Any provision of KRS 45.560 to 45.640 notwithstanding, no contractor shall be required to terminate an existing employee upon proof that that employee was employed prior to the date of the contract.*

KRS 45.640 Minimum skills

*Nothing in KRS 45.560 to 45.640 shall require a contractor to hire anyone who fails to demonstrate the minimum skills required to perform a particular job.*

It is recommended that all of the provisions quoted above to be included as special conditions in each contract. In the case of a contract exceeding \$250,000, the contractor is required to furnish evidence that his work-force in Kentucky is representative of the available work-force in the area from which he draws employees, or to supply an Affirmative Action plan which will achieve such representation during the life of the contract.

**10. EQUAL EMPLOYMENT OPPORTUNITY AFFIRMATIVE ACTION POLICY**

It is the policy of \_\_\_\_\_  
to assure that all applicants for employment and all employees are treated on a fair and equitable basis without regard to their race, religion, sex, color, handicap, natural origin or age.

Such action shall include employment, promotion, demotion, recruitment or recruitment advertising, layoff or termination, rates of pay and other forms of compensation, and selection for training, whether apprenticeship and/or on-the-job-training.

Furthermore, this company agrees to make special recruitment efforts to hire the protected class whenever feasible. This company also agrees to adhere to all applicable federal, state, and local laws relating to Equal Employment Opportunity for all individuals.

Signature: \_\_\_\_\_  
(Bidding Contractor)

Title: \_\_\_\_\_

Date: \_\_\_\_\_

# 11. WORKFORCE ANALYSIS FORM

Name of Organization: \_\_\_\_\_

Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

Categories	Total	<u>White</u>		<u>Black</u>		<u>Other</u>		<u>Total</u>	
		M	F	M	F	M	F	M	F
Administrators									
Professionals									
Superintendents									
Supervisors									
Foremen									
Technicians									
Protective Service									
Para-Professionals									
Office/Clerical									
Skilled Craft									
Service/Maintenance									
Total:									

Prepared By: \_\_\_\_\_

## 12. EVIDENCE OF INSURABILITY

### LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT CONSTRUCTION PROJECT

(Use separate form for each Agency or Brokerage agreeing to provide coverage)

Names Insured: \_\_\_\_\_

Employee ID: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Project to be insured: \_\_\_\_\_

In lieu of obtaining certificates of insurance at this time, the undersigned agrees to provide the above Named Insured with the minimum coverage listed below. These are outlined in the Insurance and Risk Management of Part V (Special Conditions), including all requirements, and conditions:

Section Items	Coverage	Minimum Limits and Policy Requirements	Limits Provided To Insured	Name of Insurer	A.M. Best's	
					Code	Rating
SC 1.3.D.1 – see provisions	CGL	\$1,000,000 per occ. And \$2,000,000 aggregate	\$			
SC 1.3.D.1 – see provisions	AUTO	\$2,000,000/per occ.	\$			
SC 1.3.D.1 – see provisions	WC	Statutory w /endorsement as noted	\$			

Section 2 includes required provisions, statements regarding insurance requirements, and the undersigned agrees to abide by all provisions for the coverage's checked above unless stated otherwise when submitting.

\_\_\_\_\_  
Agency or Brokerage

\_\_\_\_\_  
Name of Authorized Representative

\_\_\_\_\_  
Street Address

\_\_\_\_\_  
Title

\_\_\_\_\_  
City State Zip

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Telephone Number

\_\_\_\_\_  
Date

NOTE: Authorized signatures may be the agent's if agent has placed insurance through an agency agreement with the insurer. If insurance is brokered, authorized signature must be that of authorized representative of insurer.

### 13. DEBARRED FIRMS

**PROJECT NAME:** Town Branch and West Hickman WWTP UV Disinfection Process Replacement Project

**BID NUMBER:** 131-2024

**LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
LEXINGTON, KY**

All prime Contractors shall certify that Subcontractors have not and will not be awarded to any firms that has been debarred for noncompliance with the Federal Labor Standards, Title VI of the Civil Rights Act of 1964 As Amended, Executive Order 11246 As Amended or any other Federal Law.

All bidders shall complete the attached certification in duplicate and submit both copies to the Owner with the bid proposal. The Owner (grantee) shall transmit one copy to the Lexington-Fayette Urban County Government, Division of Community Development, within fourteen (14) days after bid opening.

The undersigned hereby certifies that the firm of \_\_\_\_\_ has not and will not award a subcontract, in connection with any contract award to it as the result of this bid, to any firm that has been debarred for noncompliance with the Federal labor Standards, Title VI of the civil Rights Act of 1964, Executive Order 11246 as amended or any Federal Law.

\_\_\_\_\_  
Name of Firm Submitting Bid

\_\_\_\_\_  
Signature of Authorized Official

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date



#### 14. DEBARMENT CERTIFICATION

All contractors/subcontractors shall complete the following certification and submit it with the bid proposal.

The contractor/subcontractor certifies in accordance with Executive Order 12549 (Debarment and Suspension 2/18/86) that to the best of its knowledge and belief, that it and its principals:

- 1) Are not presently debarred, suspended, proposed for debarment, declared negligible, or voluntarily excluded from covered transactions or contract by any Federal department or agency for noncompliance with the Federal Labor Standards, Title VI of the Civil Rights Act of 1964 as amended, Executive Order 11246 as amended or any other Federal law;
  - a) Have not within a three year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
  - b) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(a) of this certification; and
  - c) Have not within a three year period preceding this bid has one or more public (Federal, State or local) transactions or contracts terminated for cause or default.
- 2) Where the contractor is unable to certify to any of the statements in this certification, such prospective contractors shall attach an explanation to this certification form.

Firm Name: \_\_\_\_\_

Project: \_\_\_\_\_

Printed Name and Title of Authorized Representative: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

END OF SECTION

ADDENDUM NO. 3  
PROJECT MANUAL  
LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
LEXINGTON, KENTUCKY  
TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION  
PROCESS REPLACEMENT PROJECT  
CONTRACT 131-2024

Bids will be received until Tuesday, October 15, 2024, at 2:00 p.m., local time.

This Addendum to the Project Manual is issued to modify, explain, or correct the original Project Manual and is hereby made part of the Contract Documents. Insert the number of this Addendum in the blank space provided in the Form of Proposal, page P-3.

A. GENERAL CONTRACTOR QUESTIONS

1. Question: Will the Contractor be required to replace all grating located over the concrete Y-channel at the West Hickman site with new grating or can the existing be used once the new stainless steel air piping is installed?

Answer: The existing grating can be reused. Corroded or damaged clamps and anchors should be replaced as needed.

2. Question: West Hickman Site: Please confirm if a 3rd gate exists in the influent chamber of Tank Nos. 3 and 4 and if so, please define its purpose. Also, please confirm the different deck arrangement on the influent chamber to Tank Nos. 1 and 2 compared to the Tank Nos. 3 and 4 allows for the planned upgrade to gates slg Nos. 1 and 2.

Answer: There is a third gate in the splitter structure for Tank Nos. 1 and 2. We believe the gate was for a tank bypass and is no longer in use.

3. Question: Please provide a piping schedule to include piping coating, lining, and type for the drain lines, scum lines, npw lines, etc.

Answer: Piping is scheduled in Section 33 00 10–Buried Piping and Appurtenances and Section 40 05 00–Piping and Appurtenances. Painting is scheduled in Section 09 91 00–Painting.

4. Question: Sheet No. 9 (05-m1.01) appears to show a valve or other fitting arrangement at the 8-inch drain line exiting the cct to the new 4-foot dia manhole. Please provide additional details as to whether this is a buried valve or other arrangement.

Answer: There is no valve between the CCT and new manhole. There are two 90-degree fittings to make up for the change in elevation.

5. Question: Is the pipe encasement shown around the 36-inch nrsl line, under the two 60-inch fe lines shown on Sheet No. 15, existing or will the Contractor be required to install this casing pipe?

Answer: The encasement will need to be installed by the Contractor based on detail B/99-ASM5.04.

6. Question: Where are the existing TDW Pumps No. 1 and No. 2 located which will be relocated in the chlorine contact tank at the Town Branch WWTP? Can drawings be provided?

Answer: Refer to demo note U, Sheet No. 41.

7. Question: Can a plan sheet showing the installation of all piping, secondary containment and portable eyewash system in the dechlorination building as called out in the West Hickman Construction Sequence be provided?

Answer: See attached Figure 1.

8. Question: What material and size is the PW line which the Contractor will be tapping into at the West Hickman WWTP to install the Yard Hydrant shown on Sheet No. 9?

Answer: PW line size is 1 1/2-inch shown on the Drawings already. Assume the existing pipe is copper. Contractor shall verify during construction.

9. Question: Will chemical feed equipment (that gets demolished) be flushed before shutting down?

Answer: Yes, water shall be used to purge the lines before chemical feed equipment is removed.

10. Question: Will abandoned piping that gets removed be marked?

Answer: No. Refer to Section 02 41 00–Demolition.

11. Question: Town Branch Site: Please confirm the isolation gates on the influent end of each existing chlorine contact basin is functioning properly and seal.

Answer: The existing gates function properly and seal.

12. Question: Is any of the wiring for equipment that is being demolished contain asbestos? If so, who is responsible for testing?

Answer: It is unknown if any wiring contains asbestos, it is not expected that it would.

13. Question: Can a geotechnical report be provided for the Town Branch site?

Answer: The last geotechnical report for Town Branch WWTP is from 1989 and is not expected to be of much help to bidders.

14. Question: West Hickman Site: Please clarify the intent of routing of electrical raceways from the power and control sources to the new equipment installed in Tank Nos. 1 and 2 considering the suggested sequencing of work to upgrade Tank Nos. 1 and 2 first while Tank Nos. 3 and 4 remain in service. Tank Nos. 3 and 4 are closest in proximity to the new MCCs, however the demolition

and upgrades to this set of tanks occurs last which restricts raceway access to Tank Nos. 1 and 2. Please advise.

Answer: We would not expect you to install anything that would be disturbed during demolition therefore routing should be carefully considered.

15. Question: Can historic flow data be provided?

Answer: Rainfall totals and daily influent flow at West Hickman and PTE flow at Town Branch for the past year have been included as an appendix to this addendum to understand historic data on flows. These are daily flows, but peak hourly flow may exceed the capacity of half the UV system installed.

16. Question: SLG -9, SLG-10, and SLG-11 seem to be shown as being motor operated, this doesn't line up with anything else in the plans/schedule, can you confirm that they should be handwheel operated?

Answer: These are manual and do not need to be motor operated; these are small gates that will only be used to drain the tanks.

17. Question: SLG-1 and SLG-2 have note 4 attached, which indicates a new sluice gate actuator. Per the schedule these two should be re-using the motor actuator already in place. Can you confirm that only SLG-3 and SLG-4 will require new actuators?

Answer: SLG-1 and SLG-2 are reusing the existing actuators.

18. Question: Can we confirm whether the motorized actuators we're replacing (SLG-3, SLG-4, SG-28) will be modulating or open/close? It's not super clear in the specs.

Answer: These will all be open/close.

## B. SPECIFICATIONS

### 1. DIVISION 01--GENERAL REQUIREMENTS

a. Page 01 11 00-3, SECTION 01 11 00--SUMMARY OF WORK, PART 1--GENERAL, 1.04.C.

ADD "The Southern tank shall be temporarily drained enough to remove the screen and install a plug in the existing 12-inch NPW line. Remove plug and reinstall screen as soon as practical once the relocation of the 12-inch NPW drawoff line and additional supports are installed in the Northern tank. LFUCG will be without the NPW Pump Station during the time when the plug is installed. Limit NPW Pump Station outage to 2 weeks." to the end of Paragraph 1.04.C.4.a.(3):

CLARIFICATION: Regarding Paragraph 1.04.C.4.a.(3), the Post Aeration Cascade at Town Branch will be fully out of service during the installation of the Cofferdam. After the Cofferdam installation, the Post Aeration Cascade will remain in service.

CLARIFICATION: Regarding Paragraph 1.04.C.4.a.(6) and Paragraph 1.04.C.5.a.(5), PAA feed skids are readily available from various suppliers. Feed pumps shall meet the range of flow specified. No additional specifications will be provided.

ADD the following paragraph after Paragraph 1.04.C.5.b.(4):

- “6. CONTRACTOR shall drain caustic chemical from the scrubbers at each plant once the scrubbers are no longer needed. When caustic soda (sodium hydroxide) solution is drained, dilution water from a nearby tank shall be added to mitigate the pH in the drain. Reaction with water may be exothermic. Follow all precautions listed in the safety data sheet for handling and disposal.”

ADD “Air to the diffusers may be shut down for up to 8 hours with advance approval from LFUCG.” to the end of Paragraph 1.04.C.5.a.(3).

ADD “Air to the diffusers shall be shut down for up to 8 hours with advance approval from LFUCG.” to the end of Paragraph 1.04.C.5.a.(8).

ADD “Sodium Bisulfite use will vary, but CONTRACTOR shall anticipate up to 700 gallons of Sodium Bisulfite may be used per week. Two totes shall be plumbed up to temporary feed pump skid at all times.” to the end of Paragraph 1.04.C.5.a.(4).

ADD the following paragraph after Paragraph 1.04.C.5.b.(4):

- “c. Meter Valve Vault: CONTRACTOR is advised that the following general sequence of construction was used by the ENGINEER during design.
- (1) CONTRACTOR to relocate 1 1/2-inch city water line before construction of the Structure 20.
  - (2) CONTRACTOR to modify 60-inch FE lines during the modification of the related UV system.”

## 2. DIVISION 02—EXISTING CONDITIONS

- a. Page 02 41 00-4, SECTION 02 41 00—DEMOLITION, PART 3—EXECUTION, 3.04.D.

CLARIFICATION: Information of removal of equipment bases is located here.

## 3. DIVISION 05—METALS

- a. Page 05 12 00-2, SECTION 05 12 00—STRUCTURAL STEEL, PART 1—GENERAL, 1.04.B.

CLARIFICATION: Information on AWS welding qualification is located here.

## 4. DIVISION 07—THERMAL AND MOISTURE PROTECTION

- a. Page 07 61 00-1, SECTION 07 61 00—SHEET METAL ROOFING, PART 1—GENERAL, 1.03.D.

CLARIFICATION: Warranty information located here is confirmed.

5. DIVISION 26–ELECTRICAL

- a. Page 26 09 00-6, SECTION 26 09 00–CONTROLS AND INSTRUMENTATION  
PART 1–GENERAL, 1.09.I.

REPLACE Paragraph 1.09.I. with the following:

- “I. All components shall be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The Base Bid System Supplier shall be Rawden Myers, Inc., Milford, Ohio; LoVo Systems, Inc., Lexington, Kentucky; or AEES, Frankfort, Kentucky.”
- b. Page 26 09 00-17, SECTION 26 09 00–CONTROLS AND INSTRUMENTATION  
PART 1–GENERAL, 2.02.H.

REPLACE Paragraph 2.02.H. with the following:

“H. PLC shall be as manufactured by Rockwell Automation, Contrologix 5580, or equal.”

- c. Page 26 32 13.1-4, SECTION 26 32 13.1–STANDBY POWER SYSTEM WEST HICKMAN  
WWTP, PART 2–PRODUCTS, 2.04.B.10.

REPLACE third sentence in Paragraph 2.04.B.10. with the following:

“Heater shall be rated single phase, 240vac and 6kw at 25 amps.”

- d. Page 26 32 13.1-4, SECTION 26 32 13.1–STANDBY POWER SYSTEM WEST HICKMAN  
WWTP, PART 2–PRODUCTS, 2.04.B.15.

ADD the following paragraph after Paragraph 2.04.B.15.:

- “16. A duplex remote pumping unit shall be provided to transfer diesel fuel from the existing above-ground fuel tank and the new generator sub-base tank. The pumping unit shall be furnished on a mounting frame with drip pan. The supply pumps shall have a 2 gpm pumping capacity. The return pumps shall have a 4 gpm pumping capacity. The unit shall be provided with a NEMA 3R enclosure for mounted adjacent to the generator. The electrical service shall be 120 volt, single phase, 60 Hz. Remote pumping unit shall be as manufactured by Pryco, Inc., or equal. Piping shall be steel, provided with isolation and check valves for each pump.”

- e. Page 26 32 13.1-6, SECTION 26 32 13.1–STANDBY POWER SYSTEM WEST HICKMAN  
WWTP, PART 2–PRODUCTS, 2.08.G.

REPLACE: Paragraph 2.08.G. with the following:

- “G. All components shall Provide a 1200-amp mainline circuit breaker with the engine-generator set. Circuit breaker shall meet the requirements specified in Section 26 28 00–Overcurrent Protective Devices.”

## 6. DIVISION 40–PROCESS INTERCONNECTIONS

- a. Page 40 70 00-4, SECTION 40 70 00–CONTROLS AND INSTRUMENTATION EQUIPMENT, PART 2–PRODUCTS, 2.02.H.

REPLACE the first sentence in Paragraph 2.02.H. with the following:

“Control panels that include programmable or electronic controllers (e.g. Programmable Logic Controllers (PLCs) shall be provide with a 24-volt DC on-line UPS backup that will provide continuous operation for at least 30 minutes following a power failure.”

- b. Page 40 70 00-4, SECTION 40 70 00–CONTROLS AND INSTRUMENTATION EQUIPMENT, PART 2–PRODUCTS, 2.02.H.2.

DELETE the first sentence on Paragraph 2.02.H.2.

- c. Page 40 70 00-5, SECTION 40 70 00–CONTROLS AND INSTRUMENTATION EQUIPMENT, PART 2–PRODUCTS, 2.02.H.5.

REPLACE Paragraph 2.02.H.5 with the following:

“5. PLCs shall be Rockwell Automation CompactLogix 5069, or equal with 24 VDC I/O.”

- d. Page 40 70 00-8, SECTION 40 70 00–CONTROLS AND INSTRUMENTATION EQUIPMENT, PART 3–EXECUTION, 3.03.B.2.

REPLACE Paragraph 3.03.B.2. with the following:

“2. 8 AWG and Smaller: Provide conductors with black insulation for all phase conductors, green insulation for ground, yellow for foreign voltage within the panel.”

- e. Page 40 70 00-11, SECTION 40 70 00–CONTROLS AND INSTRUMENTATION EQUIPMENT, PART 3–EXECUTION, 3.04.C.3.

DELETE Paragraph 3.04.C.3. in its entirety.

## 7. DIVISION 46–WATER AND WASTEWATER EQUIPMENT

- a. Page 46 33 20-5, SECTION 46 33 20–LIQUID CHLORINATION EQUIPMENT, PART 2–PRODUCTS, 2.03.A.4.

Add the following paragraph after Paragraph 2.03.A.4.:

“5. The skids shall be contained within the Promguard Enclosure. Each enclosure shall have a space heater and thermostat.”

- b. Page 46 33 20-5, SECTION 46 33 20–LIQUID CHLORINATION EQUIPMENT, PART 2–PRODUCTS, 2.03.B.4.b.

Add the following paragraph after Paragraph 2.03.B.4.b.:

“5. 120-volt outlet.”

- c. Page 46 33 20-6, SECTION 46 33 20–LIQUID CHLORINATION EQUIPMENT, PART 2–PRODUCTS, 2.04.C.5.

Add the following paragraph after Paragraph 2.04.C.5.:

- “D. Provide Double IBC 4000i 750-gallon Prefabricated Containment Sumps for the Town Branch and West Hickman Permanent Skids. OWNER will furnish totes of sodium hypochlorite.
- E. Provide Single IBC 2000i 385-gallon Prefabricated Containment Sumps for the Town Branch and West Hickman pump skids.”
- d. Page 46 66 57-11, SECTION 46 66 57–ULTRAVIOLET DISINFECTION SYSTEM, PART 2–PRODUCTS, 2.07.A.

REPLACE Paragraph 2.07.A.2. with the following:

- “2. Provide a NEMA 4X freestanding enclosure including, but not limited to the following:
- a. Main circuit breaker: 20-amp. Power to the SCC shall be 120-volts, single phase.
  - b. Programmable logic control (PLC). PLC shall be manufacturer standard by Rockwell Automation, CompactLogix 5069, or equal.
  - c. Operator interface panel with project-specific HMI screens.
  - d. Relays and control devices as required for controlling the UV disinfection system.
  - e. Managed ethernet switch.
  - f. Fiber optic patch panel.
  - g. 24-volt uninterruptible power supply (UPS).”

REPLACE Paragraph 2.07.A.3.b. with the following:

- “b. Hand-Off-Auto (H-O-A) control for equipment where applicable.”

DELETE Paragraph 2.07.A.3.h. in its entirety.

- e. Page 46 66 57-12, SECTION 46 66 57–ULTRAVIOLET DISINFECTION SYSTEM, PART 2–PRODUCTS, 2.07.A.5.

REPLACE the last sentence of Paragraph 2.07.A.5. with the following:

“The dose pacing system shall receive a 4-20 mAdc flow signal from the effluent flow meter and shall automatically adjust the received UV dose to maintain the required levels under all operation conditions.”

- f. Page 46 66 57-13, SECTION 46 66 57–ULTRAVIOLET DISINFECTION SYSTEM, PART 2–PRODUCTS, 2.07.D.8.

REPLACE first sentence in Paragraph 2.07.D.8. with the following:

“A common lamp fault alarm shall be provided for each bank, with the alarm displayed on HMI and communicated to the plant SCADA system.”



- g. Page 46 66 57-14, SECTION 46 66 57–ULTRAVIOLET DISINFECTION SYSTEM, PART 2–PRODUCTS, 2.07.G.3.

REPLACE first sentence in Paragraph 2.07.G.3. with the following:

“3. Upon loss of UV influent flow signal, an alarm shall be generated to the plant SCADA system and the system flow will be set to the “Flow Default Value” parameter. This default value shall be operator adjustable.”

- h. Page 46 66 57-15, SECTION 46 66 57–ULTRAVIOLET DISINFECTION SYSTEM, PART 2–PRODUCTS, 2.10.A.

REPLACE Paragraph 2.10.A. with the following:

“A. CONTRACTOR shall supply all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.”

## C. DRAWINGS

### 1. SHEET NO. 9–WEST HICKMAN WWTP ENLARGED YARD PIPING PLAN

CLARIFICATION: For the seven existing lines ranging from 1 1/4-inch to 6-inch near Meter Valve Vault (Structure 20):

- The 1 1/4-inch City Water line shall be relocated north of Structure 20 by CONTRACTOR prior to Structure 20 construction.
- The 1 1/4-inch NPW pipe shall be relocated to the east of Structure 20 by CONTRACTOR prior to Structure 20 construction.
- The four 3-inch CLS pipes can be demolished and removed once the chlorine feed system is removed from service.
- The 4-inch EFW line running through Structure 20 is currently out of service.
- The 4-inch EFW and 6-inch CLDW lines to the northwest of Structure 20 must remain in service.

### 2. SHEET NO. 12–TOWN BRANCH WWTP ENLARGED YARD PIPING PLAN

CLARIFICATION: The three valves called out by Key Note No. 4 adjacent to Structure 95 are 12-inch gate valves and the pipe material is Ductile Iron. The three valves called out by Key Note No. 4 shown east of Structure 90 are 10-inch gate valves and the pipe material is Ductile Iron.

### 3. SHEET NO. 16–CHLORINATION INFLUENT FLOW SPLITTER BOX DEMOLITION PLAN, PLAN AND SECTIONS

ADD the following General Note:

“STOP PLANKS ARE AVAILABLE FOR CONTRACTOR TEMPORARY INSERTION IN THE STOP PLANK GROOVES LOCATED UPSTREAM OF NEW GATE INSTALLATIONS.”

### 4. SHEET NO. 21–WEST HICKMAN WWTP UV DISINFECTION PROCESS REPLACEMENT CHLORINE CONTACT TANK–DEMOLITION PLAN

REPLACE Key Note E with the following, “REMOVE EXISTING SCUM BAFFLE WALL.”

REPLACE Key Note F with the following, "REMOVE EXISTING EFFLUENT WEIR AND FIRST STEP IN CASCADE DOWN TO EL. 881.51."

CLARIFICATION: The scrubber ductwork is to be demolished. Repair of the opening can be made following Specification 02 41 00–Demolition, Paragraph 3.05.C.

5. SHEET NO. 22–WEST HICKMAN WWTP UV DISINFECTION PROCESS REPLACEMENT CHLORINE CONTACT TANK–DEMOLITION SECTIONS

REPLACE Key Note E with the following, "REMOVE EFFLUENT WEIR AND FIRST STEP IN CASCADE DOWN TO EL. 881.51."

6. SHEET NO. 32–WEST HICKMAN WWTP DECHLORINATION BUILDING DEMOLITION PLAN AND SECTIONS

CLARIFICATION: Any ducting connected to the scrubber shall be removed.

7. SHEET NO. 41–UV DISINFECTION PROCESS REPLACEMENT CHLORINE CONTACT TANK DEMOLITION PLAN–1

ADD the following to the end of Key Note N, "PRESERVE TRASH SCREENS ON END OF LINE."

8. SHEET NO. 44–TOWN BRANCH WWTP UV DISINFECTION PROCESS REPLACEMENT UV DISINFECTION–OVERALL PLAN

CLARIFICATION: The existing 12-inch NPW Drawoff line in the Northern Contact Tank is supported from the existing wall at approximately 4 feet on center. When portions of the existing wall are demolished, the existing 12-inch NPW pipe will need additional support per Section 40 05 00–Piping and Appurtenances, Paragraph 3.02.A.1. pipe supports.

9. SHEET NO. 47–TOWN BRANCH WWTP UV DISINFECTION PROCESS REPLACEMENT CHLORINE CONTACT TANK–SECTIONS–1

ADD "TOE BOARD SHALL BE ADDED TO EAST AND WEST ENDS OF ALUMINUM PLANK AT ELEVATION 894.00. TOE BOARD SHALL BE SCREWED DOWN TO TOP OF PLANK."

10. SHEET NO. 54–TOWN BRANCH WWTP NONPOTABLE WATER PUMP STATION OVERALL PLAN

REPLACE Key Note No. 7: "FREESTANDING TRIPLEX PUMP SKID WITH ENCLOSURE, MOUNTED ON SHALLOW PREFABRICATED CHEMICAL CONTAINMENT SUMP."

11. SHEET NO. 55–TOWN BRANCH WWTP NONPOTABLE WATER PUMP STATION SECTIONS

CLARIFICATION: The 8-inch piping reduces down to match the pump discharge diameter of the provided pump.

12. SHEET NO. 61–TOWN BRANCH WWTP CHLORINE BUILDING DEMOLITION PLAN

CLARIFICATION: Any ducting connected to the scrubber shall be removed.

CLARIFICATION: Any piping connected to the existing pump in the Scrubber Room shall be removed. Install blind flanges on piping that cannot be removed.

13. SHEET NO. 77-SCHEDULES AND DETAILS WEST HICKMAN WWTP ONE-LINE DIAGRAM

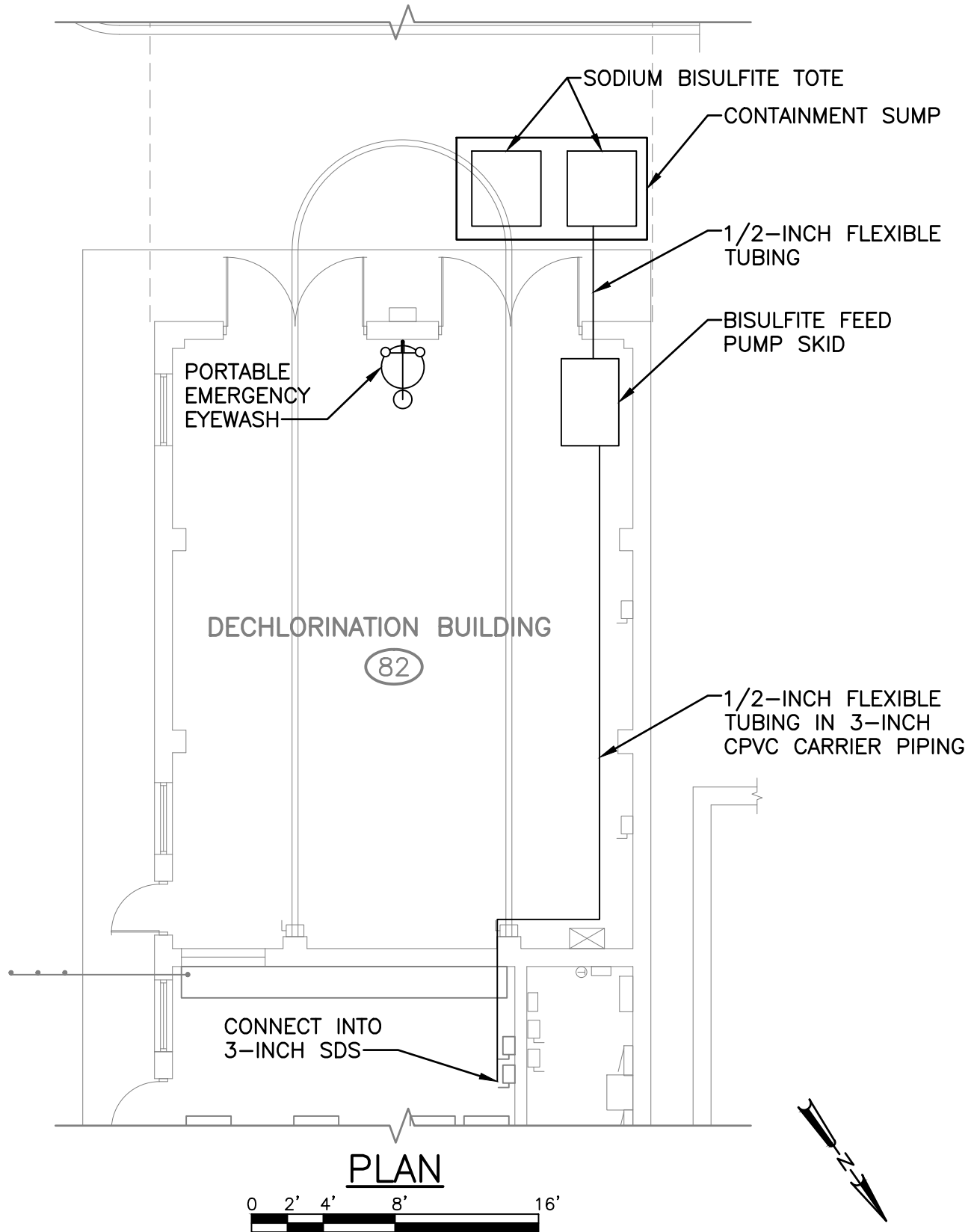
CLARIFICATION: For the South substation 480-volt distribution board the 3000 amp ATS is existing and will be reused in place. Conduit and conductors from the new generator to the existing ATS are shown on Sheet No. 31.

\*\*\*\*\*  
**BIDDERS MUST ACKNOWLEDGE RECEIPT OF THIS ADDENDUM IN THE  
SPACE PROVIDED IN THE BID FORM**  
\*\*\*\*\*

Dated at Lexington, Kentucky  
October 8, 2024

STRAND ASSOCIATES, INC.®  
651 Perimeter Drive, Suite 220  
Lexington, KY 40517





**ADDENDUM NO. 3**

**TOWN BRANCH AND WEST HICKMAN WWTP  
UV DISINFECTION PROCESS REPLACEMENT PROJECT  
LEXINGTON - FAYETTE URBAN COUNTY GOVERNMENT  
LEXINGTON, KENTUCKY**



**FIGURE 1**

2815.341

Date	West Hickman		Town Branch	
	16182	1001	604	5002
	Rainfall	Combined	Rainfall	Effluent
		Influent Flow		Metered Flow
	inches	MGD	Inches	MGD
9/1/2023	-	14.16	-	13.96
9/2/2023	-	12.81	-	13.92
9/3/2023	-	13.15	-	13.71
9/4/2023	-	13.05	-	13.82
9/5/2023	-	13.06	-	14.65
9/6/2023	-	11.91	-	15.20
9/7/2023	-	11.63	-	14.41
9/8/2023	-	10.25	-	14.51
9/9/2023	-	12.44	-	13.73
9/10/2023	-	14.05	-	13.76
9/11/2023	-	11.39	-	14.24
9/12/2023	0.10	11.88	0.44	15.58
9/13/2023	-	11.94	-	15.27
9/14/2023	-	12.94	-	14.48
9/15/2023	-	11.16	-	14.21
9/16/2023	-	13.19	-	13.42
9/17/2023	-	12.17	-	12.96
9/18/2023	-	14.26	-	14.65
9/19/2023	-	16.34	-	14.60
9/20/2023	-	15.52	-	13.97
9/21/2023	-	14.52	-	13.98
9/22/2023	-	13.60	-	13.96
9/23/2023	-	11.75	-	12.17
9/24/2023	-	12.23	-	12.38
9/25/2023	0.01	11.53	-	13.05
9/26/2023	-	11.75	-	13.15
9/27/2023	0.30	12.61	0.04	13.50
9/28/2023	0.45	15.24	0.43	16.85
9/29/2023	0.01	13.74	-	15.53
9/30/2023	-	13.11	-	13.73
10/1/2023	-	13.17	-	13.51
10/2/2023	-	12.46	-	13.81
10/3/2023	-	12.12	-	13.75
10/4/2023	-	12.05	-	13.55
10/5/2023	-	12.01	0.01	14.42
10/6/2023	-	12.43	0.08	14.45
10/7/2023	-	12.33	-	12.69
10/8/2023	-	12.73	-	13.06

10/9/2023	-	12.26	-	13.54
10/10/2023	-	12.14	-	13.75
10/11/2023	-	11.87	-	12.73
10/12/2023	-	11.86	-	13.55
10/13/2023	-	11.95	-	14.01
10/14/2023	0.35	13.60	0.27	13.95
10/15/2023	-	13.37	-	13.10
10/16/2023	0.10	13.07	0.15	13.67
10/17/2023	-	12.44	-	13.68
10/18/2023	-	12.34	-	13.04
10/19/2023	0.30	13.44	0.45	13.48
10/20/2023	0.25	17.53	0.43	19.70
10/21/2023	-	15.21	-	15.59
10/22/2023	-	14.50	-	14.20
10/23/2023	-	13.40	-	13.82
10/24/2023	-	13.11	-	14.07
10/25/2023	-	12.75	-	14.52
10/26/2023	-	12.65	-	14.16
10/27/2023	0.04	12.60	0.05	14.51
10/28/2023	0.01	13.19	0.12	14.11
10/29/2023	0.50	14.63	0.10	15.39
10/30/2023	0.35	21.56	0.92	23.15
10/31/2023	-	18.84	-	17.86
11/1/2023	-	21.29	-	15.80
11/2/2023	-	20.54	-	14.76
11/3/2023	-	19.75	-	14.19
11/4/2023	-	18.85	-	13.38
11/5/2023	-	19.15	-	13.97
11/6/2023	-	18.55	-	14.29
11/7/2023	-	18.32	-	14.31
11/8/2023	-	18.08	-	14.39
11/9/2023	-	14.70	-	14.05
11/10/2023	0.15	18.41	0.15	13.85
11/11/2023	-	18.75	-	13.26
11/12/2023	-	18.92	-	13.29
11/13/2023	-	17.60	-	13.54
11/14/2023	-	16.82	-	13.29
11/15/2023	-	16.13	-	13.52
11/16/2023	-	15.77	-	13.46
11/17/2023	-	16.19	-	13.17
11/18/2023	-	16.25	-	12.60
11/19/2023	-	16.39	-	12.57
11/20/2023	0.14	13.44	-	13.00
11/21/2023	1.22	25.66	1.32	28.00

11/22/2023	-	19.80	1.32	22.00
11/23/2023	-	14.45	-	16.10
11/24/2023	-	13.95	-	15.20
11/25/2023	-	13.54	-	14.80
11/26/2023	0.10	13.71	-	14.00
11/27/2023	0.10	13.78	-	13.98
11/28/2023	-	12.79	-	13.40
11/29/2023	-	12.77	-	15.00
11/30/2023	-	11.98	-	14.30
12/1/2023	0.38	15.40	0.37	17.90
12/2/2023	0.25	15.46	0.55	15.83
12/3/2023	-	19.93	0.11	20.01
12/4/2023	0.11	16.96	0.10	18.00
12/5/2023	0.30	15.85	0.10	18.01
12/6/2023	0.04	15.72	0.03	17.26
12/7/2023	-	14.90	-	16.42
12/8/2023	-	14.24	-	14.25
12/9/2023	0.77	14.46	0.66	16.22
12/10/2023	-	24.62	0.03	22.20
12/11/2023	-	18.57	-	18.85
12/12/2023	-	15.41	-	17.01
12/13/2023	-	14.57	-	15.57
12/14/2023	-	14.06	-	14.90
12/15/2023	-	14.41	-	14.44
12/16/2023	-	13.52	0.02	13.34
12/17/2023	0.38	17.95	0.54	17.15
12/18/2023	-	16.91	-	16.49
12/19/2023	-	15.12	-	17.21
12/20/2023	-	14.63	-	14.36
12/21/2023	-	14.63	-	14.77
12/22/2023	-	14.03	-	12.56
12/23/2023	-	14.11	0.10	12.33
12/24/2023	-	13.29	-	12.02
12/25/2023	0.41	14.85	1.02	13.23
12/26/2023	0.42	20.06	0.09	19.22
12/27/2023	-	17.65	-	15.84
12/28/2023	-	15.95	-	16.29
12/29/2023	-	15.44	-	14.65
12/30/2023	0.05	14.55	0.18	13.60
12/31/2023	-	14.34	-	13.67
1/1/2024	-	13.96	-	12.68
1/2/2024	-	13.71	-	13.31
1/3/2024	-	13.42	-	13.78
1/4/2024	-	13.09	-	13.48

1/5/2024	-	13.12	-	12.85
1/6/2024	0.98	27.78	0.97	23.49
1/7/2024	0.08	25.77	-	23.56
1/8/2024	0.07	19.82	-	20.67
1/9/2024	1.02	31.72	-	28.95
1/10/2024	0.02	36.01	0.05	36.90
1/11/2024	-	28.73	-	41.23
1/12/2024	0.69	32.62	1.07	30.84
1/13/2024	-	37.32	-	35.71
1/14/2024	-	26.57	-	32.59
1/15/2024	-	21.60	-	30.04
1/16/2024	-	19.16	-	21.73
1/17/2024	-	20.65	-	20.23
1/18/2024	-	16.88	-	18.93
1/19/2024	-	17.04	-	17.70
1/20/2024	0.01	15.27	-	16.90
1/21/2024	-	16.33	-	16.67
1/22/2024	0.03	15.14	-	16.95
1/23/2024	-	34.95	0.06	18.04
1/24/2024	1.10	26.10	1.40	28.01
1/25/2024	0.25	43.48	0.89	46.69
1/26/2024	-	44.84	0.01	49.26
1/27/2024	0.14	32.60	0.48	38.83
1/28/2024	0.33	34.93	0.26	34.91
1/29/2024	0.06	36.71	0.03	42.74
1/30/2024	0.02	35.40	-	38.13
1/31/2024	-	32.76	-	26.53
2/1/2024	-	33.49	-	23.30
2/2/2024	-	26.05	-	21.13
2/3/2024	-	18.71	-	19.49
2/4/2024	-	17.26	-	21.14
2/5/2024	-	16.28	-	18.54
2/6/2024	-	15.29	-	17.15
2/7/2024	-	14.80	-	16.77
2/8/2024	-	9.78	-	16.06
2/9/2024	-	18.76	0.02	15.59
2/10/2024	0.71	20.32	0.62	20.83
2/11/2024	0.10	24.30	0.13	22.67
2/12/2024	1.25	23.06	0.85	24.05
2/13/2024	-	40.33	0.02	45.05
2/14/2024	-	34.34	-	31.51
2/15/2024	-	33.47	-	25.27
2/16/2024	0.19	33.65	0.32	23.48
2/17/2024	-	25.40	-	24.95



2/18/2024	-	21.13	-	22.53
2/19/2024	-	19.79	-	21.59
2/20/2024	-	18.24	-	19.85
2/21/2024	-	17.42	-	18.90
2/22/2024	-	19.22	0.70	21.20
2/23/2024	-	28.80	-	28.57
2/24/2024	-	21.63	-	23.82
2/25/2024	-	20.70	-	21.64
2/26/2024	0.03	18.53	0.02	20.75
2/27/2024	0.23	24.34	0.40	24.07
2/28/2024	0.67	13.97	1.91	44.11
2/29/2024	-	37.39	-	55.44
3/1/2024	0.27	32.90	0.35	44.81
3/2/2024	0.04	31.60	0.10	39.31
3/3/2024	0.01	25.74	-	32.73
3/4/2024	-	22.98	-	29.43
3/5/2024	0.69	27.90	0.38	28.82
3/6/2024	0.62	43.43	0.55	45.05
3/7/2024	-	40.82	0.05	38.74
3/8/2024	0.02	33.66	0.15	31.36
3/9/2024	0.49	37.66	0.57	41.54
3/10/2024	-	36.57	-	33.33
3/11/2024	-	32.53	-	28.55
3/12/2024	-	28.92	-	24.86
3/13/2024	-	23.19	-	22.63
3/14/2024	-	19.42	-	20.60
3/15/2024	0.07	27.42	0.66	28.81
3/16/2024	-	22.75	-	24.50
3/17/2024	-	21.45	-	22.14
3/18/2024	-	19.27	-	20.78
3/19/2024	-	17.81	-	20.16
3/20/2024	-	16.90	-	18.58
3/21/2024	-	16.24	-	17.77
3/22/2024	0.01	17.05	0.05	17.04
3/23/2024	-	14.45	-	15.92
3/24/2024	-	15.78	-	15.70
3/25/2024	-	14.56	-	15.86
3/26/2024	0.48	18.68	0.63	20.22
3/27/2024	-	18.81		20.76
3/28/2024	-	16.29	-	17.75
3/29/2024	-	16.61	-	16.37
3/30/2024	-	14.13	-	15.18
3/31/2024	0.11	15.70	0.11	15.69
4/1/2024	-	15.11	-	16.04

4/2/2024	2.20	20.19	1.13	22.05
4/3/2024	0.07	33.55	0.05	37.68
4/4/2024	0.13	37.80	0.01	33.11
4/5/2024	0.05	36.66	0.06	31.20
4/6/2024	-	24.49	0.01	21.33
4/7/2024	-	24.83	-	19.47
4/8/2024	-	26.23	-	18.81
4/9/2024	0.30	24.64	0.15	18.78
4/10/2024	0.67	32.52	0.51	26.03
4/11/2024	0.86	37.88	1.63	35.97
4/12/2024	0.17	36.66	0.15	53.86
4/13/2024	-	44.40	-	41.74
4/14/2024	-	37.57	-	35.46
4/15/2024	-	33.97	0.01	35.53
4/16/2024	-	31.44	-	32.71
4/17/2024	0.06	24.76	-	22.71
4/18/2024	-	25.15	-	20.76
4/19/2024	0.14	18.75	0.20	19.60
4/20/2024	-	17.58	-	17.86
4/21/2024	-	17.40	-	16.82
4/22/2024	-	15.93	-	16.88
4/23/2024	0.04	15.70	0.05	16.22
4/24/2024	0.04	15.51	-	16.37
4/25/2024	-	14.78	-	15.73
4/26/2024	-	14.56	-	15.46
4/27/2024	-	14.58	-	14.89
4/28/2024	-	14.63	-	14.85
4/29/2024	-	14.14	-	15.45
4/30/2024	62.00	19.64	0.65	21.27
5/1/2024	-	17.28	-	18.89
5/2/2024	-	15.71	-	17.42
5/3/2024	0.13	16.09	0.22	16.74
5/4/2024	-	16.89	0.02	16.01
5/5/2024	-	15.72	-	15.32
5/6/2024	0.34	16.38	0.83	18.21
5/7/2024	0.09	19.10	0.25	22.93
5/8/2024	0.71	19.72	1.06	30.14
5/9/2024	0.07	26.46	0.13	32.58
5/10/2024	-	21.60	-	23.95
5/11/2024	-	17.49	-	19.80
5/12/2024	-	16.60	-	17.58
5/13/2024	-	15.33	-	17.98
5/14/2024	0.24	14.57	0.21	17.08
5/15/2024	1.11	29.55	2.17	36.16

5/16/2024	-	24.51	-	31.41
5/17/2024	0.37	20.79	0.26	25.46
5/18/2024	0.02	21.29	-	22.79
5/19/2024	-	18.89	-	20.19
5/20/2024	-	16.47	-	18.69
5/21/2024	-	15.35	-	17.38
5/22/2024	0.21	15.20	0.02	17.63
5/23/2024	0.20	15.98	0.43	17.51
5/24/2024	0.01	19.24	0.02	20.06
5/25/2024	-	14.45	-	16.85
5/26/2024	0.66	18.21	0.62	19.39
5/27/2024	0.53	32.78	0.51	32.14
5/28/2024	-	21.73	-	25.12
5/29/2024	-	17.98	-	20.97
5/30/2024	-	16.18	-	18.50
5/31/2024	-	16.04	-	16.74
6/1/2024	0.03	15.18	0.08	15.62
6/2/2024	0.55	17.41	0.22	17.97
6/3/2024	0.01	19.29	-	20.40
6/4/2024	0.03	17.53	0.27	22.79
6/5/2024	0.09	21.05	0.55	29.09
6/6/2024	0.22	26.46	0.26	40.59
6/7/2024	-	21.16	-	27.37
6/8/2024	-	15.91	-	21.56
6/9/2024	-	15.95	-	19.30
6/10/2024	-	14.82	-	18.09
6/11/2024	-	14.02	-	17.62
6/12/2024	-	13.49	-	16.36
6/13/2024	-	13.14	-	15.81
6/14/2024	0.21	13.02	0.15	15.52
6/15/2024	-	12.40	-	14.47
6/16/2024	-	12.96	-	13.94
6/17/2024	-	14.09	-	15.69
6/18/2024	-	14.03	-	15.05
6/19/2024	-	12.95	-	15.53
6/20/2024	-	12.80	-	14.71
6/21/2024	-	12.69	-	14.13
6/22/2024	-	12.51	-	13.39
6/23/2024	0.02	13.03	0.02	13.54
6/24/2024	-	12.22	-	13.20
6/25/2024	0.02	12.34	0.12	15.33
6/26/2024	0.01	13.10	0.34	16.07
6/27/2024	-	14.64	-	17.02
6/28/2024	-	13.46	-	15.22

6/29/2024	-	12.08	-	14.34
6/30/2024	-	12.61	-	14.21
7/1/2024	-	12.35	-	13.97
7/2/2024	-	12.37	-	13.70
7/3/2024	-	12.25	0.03	13.45
7/4/2024	-	12.14	0.03	12.75
7/5/2024	0.60	14.28	0.25	15.78
7/6/2024	-	13.75	-	14.45
7/7/2024	-	12.99	-	13.57
7/8/2024	-	12.46	-	14.04
7/9/2024	-	12.54	0.02	14.18
7/10/2024	0.08	12.61	-	13.91
7/11/2024	0.04	12.49	-	13.60
7/12/2024	0.05	16.13	-	14.04
7/13/2024	-	12.79	-	13.18
7/14/2024	-	12.52	-	13.07
7/15/2024	-	12.33	-	13.83
7/16/2024	-	13.63	0.03	13.71
7/17/2024	0.69	17.96	0.58	16.34
7/18/2024	-	16.85	-	14.36
7/19/2024	-	12.88	-	14.07
7/20/2024	-	12.54	0.01	13.24
7/21/2024	0.06	12.43	-	13.45
7/22/2024	0.43	15.01	-	15.95
7/23/2024	-	13.97	0.52	16.36
7/24/2024	-	13.14	-	16.26
7/25/2024	-	12.62	-	14.96
7/26/2024	-	12.53	-	14.13
7/27/2024	-	12.43	-	13.31
7/28/2024	0.52	14.46	0.96	16.02
7/29/2024	0.04	15.06	0.13	18.05
7/30/2024	0.59	18.08	0.33	21.06
7/31/2024	0.70	17.83	0.72	20.28
8/1/2024	0.30	19.91	0.32	18.61
8/2/2024	0.66	22.13	1.07	25.23
8/3/2024	0.02	22.00	0.28	27.07
8/4/2024	0.01	18.56	-	24.15
8/5/2024	-	15.81	-	23.14
8/6/2024	-	14.63	-	17.41
8/7/2024	-	14.85	-	16.79
8/8/2024	-	14.65	-	16.19
8/9/2024	-	13.70	-	15.05
8/10/2024	-	12.89	-	13.61
8/11/2024	-	12.90	-	13.41

8/12/2024	-	12.49	-	13.72
8/13/2024	-	12.52	-	14.22
8/14/2024	-	12.42	-	13.86
8/15/2024	-	12.29	-	13.91
8/16/2024	0.17	12.53	0.37	14.90
8/17/2024	0.84	16.48	0.51	16.15
8/18/2024	0.06	21.42	0.09	19.62
8/19/2024	-	21.62	-	17.14
8/20/2024	-	20.13	-	15.41
8/21/2024	-	13.49	-	14.43
8/22/2024	-	13.27	-	13.78
8/23/2024	-	12.86	-	13.86
8/24/2024	-	13.19	-	13.15
8/25/2024	-	13.42	-	13.64
8/26/2024	-	12.67	-	15.69
8/27/2024	-	12.44	-	17.54
8/28/2024	-	12.38	-	17.14
8/29/2024	-	12.49	-	15.57
8/30/2024	-	12.54	0.06	14.32
8/31/2024	0.46	14.57	1.03	16.28

## **IX**

### **TECHNICAL SPECIFICATIONS**

## SECTION 01 11 00

### SUMMARY OF WORK

#### PART 1—GENERAL

##### 1.01 DIVISION ONE

- A. The requirements of Division 01 apply to all sections of the Contract.

##### 1.02 PROJECT SCOPE

- A. CONTRACTOR shall provide all items, articles, materials, operations or methods mentioned or scheduled on the Drawings or herein specified: including all labor, supervision, equipment, incidentals, taxes, and permits necessary to complete the Work as described within the Contract Documents. CONTRACTOR shall install all items provided by OWNER as mentioned or scheduled on the Drawings or herein specified.

##### 1.03 CONTRACT DOCUMENTS—INTENT AND USE

###### A. Intent of Documents:

1. Singular notations and specifications shall be considered plural where application is reasonably inferred.
2. Mention or indication of extent of work under any division or Specification section is done only for convenience of CONTRACTOR and shall not be construed as describing all work required under that division or section.
3. Some individual sections may contain a list of related sections. The list of related sections in individual sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. CONTRACTOR may not rely upon this listing for determination of scope of work. Other sections of the Specifications not referenced in individual sections shall apply as required for proper performance of the Work.
4. Command type sentences may be used in the Contract Documents. These sentences refer to and are directed to CONTRACTOR.
5. Symbols for various elements and systems are shown on the Drawings. Should there be any doubt regarding the meaning or intent of the symbols used, a written interpretation shall be obtained from ENGINEER.

###### B. Use of Documents:

1. CONTRACTOR shall examine all Specifications and Drawings for the Work, including those that may pertain to Work CONTRACTOR does not normally perform with its own forces.
2. CONTRACTOR shall use all of the Project Drawings and Specifications:
  - a. For a complete understanding of the Project.
  - b. To determine the type of construction and systems required.
  - c. For coordination with other contractors.
  - d. To determine what other work may be involved in various parts or phases.
  - e. To anticipate and notify others when work by others will be required.
  - f. And all other relevant matters related to the project.
3. CONTRACTOR is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its Work as may be shown or inferred by the entire set of Project Drawings and Specifications.

## 1.04 CONSTRUCTION REQUIREMENTS

- A. In general, the following contract completion Milestones shall be followed. See Agreement for specific dates:
1. Milestone 1 Completion: CONTRACTOR shall by that date, have completed and placed in service half of the UV capacity at both Town Branch and West Hickman WWTPs.
  2. Substantial Completion: CONTRACTOR shall by that date, have the entire project substantially completed.
- B. General Information and Requirements:
1. Currently, wastewater treatment at the LFUCG Town Branch WWTP consists of screening, grit removal, primary clarification, activated sludge aeration followed by final clarification, chlorine disinfection, sulfur dioxide dechlorination, and post aeration of the final effluent. Primary and waste activated sludge are cothickened in the primary clarifiers, stabilized in anaerobic digesters, dewatered utilizing centrifuges and landfilled. Sludge is thickened utilizing gravity sludge thickeners.
  2. Currently, wastewater treatment at the LFUCG West Hickman WWTP consists of screening, grit removal, biological nutrient removal, activated sludge aeration, final clarification, chlorine disinfection, sulfur dioxide dechlorination, and post aeration of final effluent. Waste activated sludge is thickened in gravity thickeners, stabilized in aerated sludge holding tanks, dewatered utilizing centrifuges and landfilled.
  3. Wastewater treatment during construction must be continuous and the treatment efficiency must be equal to that achieved prior to the start of construction.
  4. It shall be the responsibility of CONTRACTOR to not in any way impair the normal treatment or operating efficiency of the facilities, regardless of the work underway. No bypassing of raw or partially treated wastewater to receiving stream shall occur at any time as a result of construction. In general, this requires that new facilities be complete and ready for service or that temporary facilities be provided prior to removing existing units from service for modification or repair. CONTRACTOR shall provide all temporary piping, bypass pumping, and temporary construction required to complete the Work.
  5. Operation of existing treatment facilities will be the responsibility of OWNER. CONTRACTOR shall cooperate with OWNER's staff at all times. A minimum of 48 hours prior to making any process or electrical connections to existing facilities or modification or demolition of existing facilities, CONTRACTOR shall notify OWNER in writing. At the time of notification, CONTRACTOR shall submit a schedule for completion of the Work, including a description of measures that will be taken to minimize the impact to existing facilities.
  6. Except as specified, OWNER will drain existing tanks to the level of the lowest existing drain line or will remove tank contents using existing piping and pumping equipment. Subsequent cleaning or further draining and/or pumping shall be provided by CONTRACTOR. If there exists sludge, grit, or other residue that cannot be drained or pumped in its present state, it shall be the responsibility of CONTRACTOR to remove and dispose of this material.
  7. Access: CONTRACTOR shall maintain roadways open at all times to meet OWNER's requirements, including access for vehicles and deliveries. CONTRACTOR shall be responsible for maintaining roadways in drivable condition, including placement of temporary stone and gravel and providing drainage as necessary. OWNER's roadways around the treatment facility shall be cleaned of construction site materials, soil, and debris as necessary.



C. Construction Sequence:

1. The following construction sequence is provided as a general guideline for the information and for the benefit of CONTRACTOR. This construction sequence is not intended to dictate means, method of construction, or direct construction activities. This construction sequence is a conceptual general construction sequence with minimum recommended outage, shutdowns, and operating units to be maintained in service. The general construction sequence is projected to allow the Work to be completed while maintaining treatment of the wastewater treatment plant. It is not intended to be all inclusive and does not list all work elements or details that are required to complete the Work, complete treatment processes, or place unit processes in service. CONTRACTOR shall be responsible for implementing any additional details required, including temporary piping, bypass pumping, or temporary construction at no additional cost to OWNER.
2. CONTRACTOR may propose alternate sequence or modifications to this sequence. OWNER will review the proposed modification and determine if such modification of the sequence interferes with the proper operation of the treatment activities. Any modifications to this general construction sequence shall be proposed in writing and shall be approved by OWNER prior to their implementations.
3. Demolition shall not begin until all equipment required for an operable installation has been delivered to the site.
4. Town Branch Construction Sequence:
  - a. UV System: CONTRACTOR is advised that the following general sequence of construction was developed by ENGINEER during design.
    - (1) Take northern contact tank (Tank No. 1) out of service. CONTRACTOR shall produce a schedule for work on the tank that demonstrates the tank will not be out of service longer than needed for the scheduled work and sequence with the expected equipment deliveries in order to minimize the time LFUCG will be without the tank. One thickener dilution water (TDW) pump shall be maintained in service at all times unless a shutdown is scheduled with plant operations.
    - (2) LFUCG will increase the dosage of chlorine for southern contact tank (Tank No 2).
    - (3) Within a 4 hour shutdown of flow, during dry weather and with advance approval from LFUCG, CONTRACTOR shall install a temporary coffer dam in the channel between Tank No. 1 and No. 2 discharge to the cascade aeration.
    - (4) CONTRACTOR will modify Tank No. 1 to include new UV system, weir troughs, decant pipe, drainage pipe, relocated TDW pump NPW draw off valve, walls, slabs, and sluice gate.
    - (5) CONTRACTOR will modify the Chlorination Building for the UV power Supply equipment.
    - (6) CONTRACTOR to provide a supplementary PAA feed system for Tank No. 1. CONTRACTOR must supply a redundant chemical feed pump skid for PAA service; each pump shall be capable of pumping minimum 0.1 gpm and maximum 8.5 gpm. CONTRACTOR shall install temporary feed system including all piping, secondary containment and portable eyewash system and provide totes of PAA for OWNER's use before CONTRACTOR begins work in Tank No. 2. CONTRACTOR shall maintain a 1 week minimum supply of PAA on site at all times. PAA is anticipated to be fed only during times when the forward flow exceeds 30 mgd. PAA use will vary, but CONTRACTOR shall anticipate up to 600 gallons of PAA may be used per week.
    - (7) Place Tank No. 1 in Service using UV (all flows) and PAA (during high flows).
    - (8) Take Tank No. 2 out of service.

- (9) CONTRACTOR will modify Tank No. 2 to include new UV system, weir troughs, decant pipe, drainage pipe, NPW draw off valve, walls, slabs, and sluice gate.
- (10) CONTRACTOR will relocate TDW Pump No. 2 to foam spray channel.
- (11) Place Tank No. 2 in Service.
- (12) CONTRACTOR shall modify the Tanks to include the new hoist structure and shelters for the UV control equipment.
- b. NPW System: CONTRACTOR shall produce a schedule for work on the NPW System that demonstrates the NPW system will not be out of service longer than needed for the scheduled work and sequence with the expected equipment deliveries in order to minimize the time LFUCG will be without the NPW System. LFUCG will employ backflow-prevented potable water while the NPW system is out of service. CONTRACTOR is advised that the following general sequence of construction was used by ENGINEER during design.
  - (1) Drain NPW wet well.
  - (2) CONTRACTOR to modify NPW building to include new NPW pumps, valves, piping, appurtenances, chemical feed skid and totes, eyewash/shower station, equipment pad, and piping for chemical feed.
  - (3) Place NPW Wet well into service.
  - (4) CONTRACTOR shall modify temporary chlorination points to include new eyewash/shower stations, piping and fittings, and equipment pad.
5. West Hickman Construction Sequence:
  - a. UV System: CONTRACTOR is advised that the following general sequence of construction was developed by ENGINEER during design.
    - (1) Take Tank No. 1 and No. 2 out of service. In order to take Tank No. 2 out of service, the isolation gate will need to be replaced. CONTRACTOR shall produce a schedule for work on the tank that demonstrates the tank will not be out of service longer than needed for the scheduled work and sequence with the expected equipment deliveries in order to minimize the time LFUCG will be without the tanks. Any shutdown in forward flow shall be limited to 8 hours during dry weather and with advance approval from LFUCG. CONTRACTOR shall anticipate that a flood of West Hickman Creek may cause effluent to fill Tank No. 1 and No. 2 by over-topping the effluent weir at the cascade.
    - (2) OWNER will increase the dosage of chlorine for Tank No. 3 and No. 4.
    - (3) CONTRACTOR will modify Tank No. 1 and No. 2 to include new UV system, weirs, decant pipe, drainage pipe, air piping, scum collection piping, and diffusers.
    - (4) CONTRACTOR to modify Dechlorination Building to include a new temporary liquid 38% sodium bisulfite solution (SBS) feed system as well as UV electrical equipment. CONTRACTOR may employ temporary feed skid No. 4 (Section 46 33 20–Liquid Chlorination Equipment) for SBS service. CONTRACTOR shall install temporary feed system including all piping, secondary containment and portable eyewash system and provide totes of SBS for OWNER's use while CONTRACTOR is working in Tank No. 1 and No. 2. CONTRACTOR shall maintain a 1-week minimum supply of SBS on site at all times.
    - (5) CONTRACTOR to provide a supplementary PAA feed system for Tank No. 1 and No. 2. Each PAA pump shall be capable of pumping minimum 0.1 gpm and maximum 8.5 gpm. CONTRACTOR shall install temporary feed system including all piping, secondary containment and portable eyewash system and provide totes of PAA for OWNER's use before CONTRACTOR begins work in

Tank No. 3 and No. 4. CONTRACTOR shall maintain a 1-week minimum supply of PAA on site at all times. PAA is anticipated to be fed only during times when the forward flow exceeds 30 mgd. PAA use will vary, but CONTRACTOR shall anticipate up to 600 gallons of PAA may be used per week.

- (6) Put Tank No. 1 and No. 2 into service. CONTRACTOR shall clean temporary feed skid no. 4 and turn over to OWNER.
  - (7) Take Tank No. 3 and No. 4 out of service. CONTRACTOR shall anticipate that a flood of West Hickman Creek may cause effluent to fill Tank No. 3 and No. 4 by over-topping the effluent weir at the cascade.
  - (8) CONTRACTOR will modify Tank No. 3 and No. 4 to include new UV system, weirs, decant pipe, drainage pipe, air piping, and diffusers.
  - (9) Put Tank No. 3 and No. 4 into service.
  - (10) CONTRACTOR will modify tanks to include a new Trolley Hoist system.
- b. Chemical Feed System: CONTRACTOR is advised that the following general sequence of constriction was used by ENGINEER during design.
- (1) CONTRACTOR to modify Chlorination building to include new chemical feed skid, day-tank, totes, and piping after the full UV system is installed and commissioned.
  - (2) CONTRACTOR to install new 1/2-inch PVC tubing in existing 6-inch CLDW line.
  - (3) CONTRACTOR to modify NPW Pump Room with new chemical tubing, safety shields, and piping and fittings.
  - (4) CONTRACTOR to modify Temporary chlorination points to include new eyewash/shower stations, piping and fittings, and equipment pad.

## 1.05 CONTRACTOR USE OF SITE

### A. General:

1. The "area of the site" referred to in these Specifications shall be as shown on the Drawings. If the "area of the site" is not shown, OWNER's property lines, the Project right-of-way and/or any easements obtained for the Project shall be considered the "area of the site."
2. Construction activities shall be confined within the "area of the site" limits.
3. From the start of work to completion CONTRACTOR is responsible for the care of the site and the premises which are affected by operations of Work of this Contract.
4. Except for permanent site improvements provided under the Contract, CONTRACTOR shall restore property disturbed during the Work, to the conditions which previously existed.
5. Work in occupied spaces shall be restricted to specified Work and essential activities, such as making necessary connections and extending services or constructing temporary access ways. Such work shall be scheduled in advance with OWNER.

### B. Parking and Deliveries:

1. CONTRACTOR is responsible for control of traffic by vehicles and persons within the limits of its operations.
2. Parking for employees, subcontractors, and agents of CONTRACTOR shall be in areas subject to approval of OWNER.
3. Access to the site for delivery of construction material or equipment shall be subject to approval of OWNER.

1.06 EXISTING SERVICES, OVERHEAD UTILITIES, AND UNDERGROUND FACILITIES INCLUDING STRUCTURES

- A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security systems, and similar work shall be kept to an absolute minimum and shall be limited to times approved by OWNER.
- B. If deemed necessary by OWNER, such work shall be accomplished after OWNER's normal office hours.
- C. Work shall not commence until all labor, materials, and equipment are available so Work can continue without interruption or delay.
- D. Should uncharted or incorrectly charted services or Underground Facilities be encountered during installation, notify OWNER and consult with utility owner immediately.
- E. Cooperate with OWNER and utility companies in keeping respective services and Underground Facilities in operation and repair any damage.
- F. CONTRACTOR shall not interrupt existing services and Underground Facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.
- G. Any accidental interruption of services and Underground Facilities shall be repaired immediately, including provision of temporary facilities until permanent repairs can be made.
- H. Prior to any excavation, demolition, or drilling on site, CONTRACTOR shall contact owners of the Underground Facilities in and near the construction area of the intent to excavate, demolish, or drill. As part of this notification requirement, CONTRACTOR shall contact the utility notification service Kentucky 811 (811 or 1-800-752-6007) at least two but not more than 10 business days in advance of any work. CONTRACTOR shall be aware that not all owners participate in Kentucky 811. A call to this agency shall not absolve CONTRACTOR of the requirements for contacting all owners of Underground Facilities in and near the construction area. CONTRACTOR shall give reasonable advance notice to Kentucky 811 and other owners—such notification shall not be less than the minimum advance notification required.
- I. Locations and elevations of services and Underground Facilities as shown on the Drawings are approximate. It shall be CONTRACTOR's responsibility to determine their exact location when in their vicinity. To this end, CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of services and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such services and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.
- J. Where potential grade conflicts might occur with existing services and Underground Facilities, CONTRACTOR shall uncover such services and Underground Facilities sufficiently in advance of construction so that elevations may be determined to allow any necessary adjustments to be made.
- K. CONTRACTOR shall coordinate with overhead utility companies prior to the Work. CONTRACTOR shall provide all necessary temporary and permanent support relocation or temporary and permanent restraint to maintain overhead utilities in service.

- L. CONTRACTOR shall keep an accurate and complete record of all such services and Underground Facilities encountered and shall provide OWNER a copy of this record. The record shall include a description of the item encountered, opinion as to conditions, and adequate measurements and depths so that the item can be located in the future.
- M. CONTRACTOR shall inspect all services and Underground Facilities for condition and soundness. Unsound conditions shall be reported to OWNER immediately after exposing. CONTRACTOR shall not proceed with the Work until the service or facility owner has been notified. Service or facility owner shall then be given time to inspect and correct, if required, the service or Underground Facility. CONTRACTOR may make claim under the provisions of Articles 11 and 12 of the General Conditions should CONTRACTOR feel a price or time adjustment is justified.
- N. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing services and Underground Facility encountered shall be paid for by CONTRACTOR.
- O. Whenever ENGINEER feels it is necessary to explore and excavate to determine the location of existing services and Underground Facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is required to perform additional Work in making the explorations and excavations, extra compensation will be allowed as provided for in the General Conditions.

#### 1.07 PROTECTION OF WORK AND IMPROVEMENTS

- A. CONTRACTOR shall protect the property of OWNER, existing improvements, and the Work installed by CONTRACTOR and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.
- B. CONTRACTOR shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.
- C. CONTRACTOR shall keep property, existing improvements, and the Work including structures, mains, fittings, and accessories free from dirt and foreign matter at all times.
- D. CONTRACTOR shall provide temporary plugging of openings, holes, and pipe ends that are existing or that CONTRACTOR has installed.
- E. Property, improvements, and Work damaged by CONTRACTOR shall be repaired or replaced by CONTRACTOR to the satisfaction of OWNER.
- F. CONTRACTOR is cautioned that existing public and private streets, alleyways, and roads may not hold up to typical construction traffic or activities. CONTRACTOR shall repair or replace streets, alleyways, roads, and shoulders damaged by its construction activities to their original condition at CONTRACTOR's expense.

#### 1.08 AVAILABILITY OF LANDS

- A. Easements were not obtained for this Project. CONTRACTOR shall confine its operations, equipment and storage areas to the easements, lands and rights-of-way in which the Project is to be located. CONTRACTOR may enter into written agreements with property owners for

use of other lands during construction. Copies of such agreements shall be provided to OWNER.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 29 00

### CONTRACT CONSIDERATIONS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Cash Allowances.
  - 2. Inspection and Testing Allowances.
  - 3. Measurement and Payment—Lump Sum.

##### 1.02 CASH 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 person 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, 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 for any of the foregoing will be valid.
- C. Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR for Work covered by allowances, and the Contract Price will be correspondingly adjusted.
- D. Refer to sections of the specifications identified in the Bid Form for specific information on use of cash allowances.
- E. The Bid shall include the amount equal to the specified quantity times the unit price.

##### 1.03 INSPECTION AND TESTING ALLOWANCES

- A. Costs Included in Inspection and Testing Allowances: Cost of engaging an inspection or testing firm; execution of inspection and tests; and reporting results.
- B. Costs not to be included in Inspection and Testing Allowances but to be included in the Contract Price:
  - 1. Costs of incidental labor and facilities required to assist inspection or testing firm.
  - 2. Costs of testing laboratory services used by CONTRACTOR separate from Contract Document requirements.
  - 3. Costs of retesting upon failure of previous tests.
  - 4. Costs of tests specified to be provided by CONTRACTOR.

- C. Payment Procedures: Submit one copy of the inspection or testing firm's invoice with next application for payment.
- D. Refer to technical sections of specifications for required testing and any associated allowances.

#### 1.04 MEASUREMENT AND PAYMENT–LUMP SUM

- A. Payment for Lump Sum projects will be based on the accepted schedule of values for the project.
- B. An acceptable schedule of values will include the following features:
  - 1. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction. Schedule shall be subdivided as necessary by specification section and work area.
  - 2. Identify each line item with the number and title of the respective Specification Section.
  - 3. For each major line item list sub-values of major products or operations under the item.
  - 4. For the various portions of the work:
    - a. Each item shall include a directly proportional amount of CONTRACTOR's overhead and profit.
    - b. For items on which progress payments will be requested for stored materials, break down the value into:
      - (1) The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by ENGINEER.
      - (2) The total installed value.
  - 5. The sum of all values listed in the schedule shall equal the total Contract Sum.
  - 6. Schedule shall include a separate listing of general items such as bonds, insurance, mobilization, demobilization, field supervision, and record documents.
- C. Once a schedule of values is accepted, it shall not be revised, except for changes associated with subsequently executed change orders.
- D. No separate measurement for payment will be performed for Lump Sum Work.
- E. CONTRACTOR shall estimate percentage of Work completed. ENGINEER will review CONTRACTOR's estimate of quantity of Work completed.
- F. Payment will be made based on the percentage of the Contract completed less retainage and/or liquidated damages.
- G. Unless noted otherwise, all Work described in the Specifications and/or shown on the Drawings shall be included in the Lump Sum Bid.
- H. Some technical specification sections may include payment provisions. These provisions are in addition to the provisions of this section which apply to all of the Work.

#### PART 2–PRODUCTS

NOT APPLICABLE



PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 31 00

### COORDINATION, FIELD ENGINEERING, AND MEETINGS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Coordination.
  - 2. Field Engineering.
  - 3. Progress Meetings.
  - 4. Preinstallation Meeting.
  - 5. Preinstallation Videoconference.

##### 1.02 COORDINATION

- A. CONTRACTOR shall coordinate scheduling, submittals, and work of the various sections of the work to provide an efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later. See Section 01 11 00—Summary of Work for specific construction sequence.
- B. CONTRACTOR shall verify utility requirements and characteristics of operating equipment are compatible with building utilities and coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.
- C. CONTRACTOR shall coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings and shall follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, except as otherwise indicated, CONTRACTOR shall conceal pipes, ducts, and wiring within the construction and coordinate locations of fixtures and outlets with finish elements.
- E. CONTRACTOR shall coordinate completion and cleanup of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNER's occupancy.
- F. After OWNER occupancy of premises, CONTRACTOR shall coordinate access to Site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of OWNER's activities.

##### 1.03 FIELD ENGINEERING

- A. CONTRACTOR shall locate and protect property stakes, legal survey monuments, benchmarks, and survey control and reference points. CONTRACTOR shall pay for replacement of disturbed property stakes and legal survey monuments by a Registered Land Surveyor acceptable to OWNER and for replacement of benchmarks and survey control and reference points provided by ENGINEER.

- B. CONTRACTOR shall provide field engineering services as required to establish elevations, lines, and levels utilizing recognized engineering survey practices.
- C. CONTRACTOR shall furnish all required plummets and graduated poles to check all Work.
- D. If stakes and boards have to be reset because of negligence of CONTRACTOR, CONTRACTOR shall bear the cost of such work.
- E. If laser beam is used, CONTRACTOR shall check its Work against intermediate grade stakes provided between manholes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- F. CONTRACTOR shall be responsible for all lines, elevations, and measurements of buildings, structures, piping, utilities, and other work executed by CONTRACTOR under the Contract. CONTRACTOR must exercise proper precaution to verify figures before laying out the Work and will be held responsible for any error resulting from its failure to exercise such precaution.

#### 1.04 PROGRESS MEETINGS

- A. Progress meetings will be held throughout progress of the Work at intervals agreed to by OWNER, ENGINEER, and CONTRACTOR. Interval will generally be monthly.
- B. CONTRACTOR's project manager, job superintendent, major subcontractors, and suppliers shall attend as appropriate to address agenda topics for each meeting. CONTRACTOR's representatives shall have authority to bind CONTRACTOR to decisions at the meetings.
- C. The project schedule shall be updated monthly and shall be reviewed at each progress meeting.
- D. CONTRACTOR shall also provide the following information in written form at each meeting.
  - 1. Construction progress, including:
    - a. Activities completed this reporting period.
    - b. Activities in progress this reporting period.
    - c. Activities scheduled to commence this reporting period.
  - 2. Description of problem areas.
  - 3. Current and anticipated delays.
    - a. Cause of the delay.
    - b. Corrective action and schedule adjustments to correct the delay.
    - c. Impact of the delay on other activities, on milestones, and on completion dates.
  - 4. Changes in construction sequence.
- E. ENGINEER will prepare and distribute minutes to all attending parties.

#### 1.05 PREINSTALLATION MEETING

- A. When required in individual specification sections, CONTRACTOR shall convene a preinstallation meeting at Work Site prior to commencing Work of the section.
- B. CONTRACTOR shall require attendance of parties directly affecting or affected by work of the specific section.

- C. CONTRACTOR shall notify ENGINEER seven days in advance of meeting date.
- D. CONTRACTOR shall prepare agenda and preside at meeting:
  - 1. Review conditions of installation, preparation, and installation procedures.
  - 2. Review coordination with related work.
- E. CONTRACTOR shall record minutes and distribute copies to participants and those affected by decisions made within one week after meeting.

#### 1.06 PREINSTALLATION VIDEOCONFERENCE

- A. When required in Section 26 09 00—Controls and Instrumentation, CONTRACTOR shall convene a preinstallation videoconference prior to the on-site functional acceptance testing.
- B. CONTRACTOR shall require attendance of CONTRACTOR, System Supplier, Division 26 contractor, OWNER, ENGINEER, and all other parties responsible for the equipment and controls schedules for on-site functional acceptance testing.
- C. CONTRACTOR shall arrange videoconference two months prior to the anticipated on-site functional acceptance testing. CONTRACTOR shall arrange an additional videoconference one month prior to the date for on-site functional acceptance testing of each group of equipment.
- D. Additional requirements for the videoconference can be found in Section 26 09 00—Controls and Instrumentation.

#### PART 2—PRODUCTS

NOT APPLICABLE

#### PART 3—EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 33 00

### SUBMITTALS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number or by reference to recognized industry standards.
  - 2. To facilitate CONTRACTOR's understanding of the design intent, procedures have been established for advance submittal of design data and for its review or rejection by ENGINEER.
  - 3. The type of submittal requirements specified in this section include construction progress schedule, submittal schedule, shop drawings, product data, samples, maintenance manuals, and other miscellaneous work-related submittals.
- B. Related work described elsewhere: More detailed requirements for submittals are described in other sections of these specifications for some materials and equipment. They are to be considered additional requirements to supplement the requirements specified in this section. Submittals shall conform to Article 7 of the General Conditions.
- C. Definitions: "Electronic Submittal" is defined as any submittal transmitted electronically to ENGINEER for review.

##### 1.02 IDENTIFICATION OF SUBMITTALS

- A. CONTRACTOR shall completely identify each submittal and resubmittal by showing at least the following information:
  - 1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
  - 2. Name and location of project and identification number.
  - 3. Drawing number and specifications section number to which the submittal applies.
  - 4. Include the date of each submittal or resubmittal.

##### 1.03 GROUPING OF SUBMITTALS

- A. Unless otherwise specifically permitted by ENGINEER, CONTRACTOR shall make all submittals in groups containing all associated items so that information is available for checking each item when it is received.
- B. Partial submittals may be rejected as not complying with the provisions of the Contract Documents.

##### 1.04 TIMING OF SUBMITTALS

- A. CONTRACTOR shall make all submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary approval, for possible revision and resubmittal, and for placing orders and securing delivery.

- B. The review period for submittals that are received after 3 P.M. shall commence on the following business day.

#### 1.05 CONSTRUCTION PROGRESS AND SUBMITTAL SCHEDULES

- A. Submit preliminary schedules within 10 days of the Effective Date of the Contract.
- B. Revise schedules incorporating any comments provided at the schedule review conference required in GC-2.05 and resubmit.
- C. As a minimum, the construction progress schedule shall consist of a horizontal bar chart with a separate line for each major portion of Work or operation, identifying first workday of each week.
- D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration for each activity. Identify activities that are on the critical path.
- E. Include line items for milestones (if any), Substantial, and Final Completion.
- F. Submit updated schedules with each Application for Payment, identifying changes since previous version.
- G. Indicate estimated percentage of completion for each item of Work at each submission.
- H. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

#### 1.06 SHOP DRAWINGS

- A. Shop drawings shall include specially prepared technical data for this project including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements, and similar information not in standard printed form for general application to a range of similar projects. Shop drawings shall be submitted for all manufactured or fabricated items. See individual technical sections for special requirements.
- B. CONTRACTOR shall make all shop drawings accurately to scale and sufficiently large to show all pertinent aspects of the item and its method of connection to the work.
- C. Shop drawings shall be checked, approved, and stamped by CONTRACTOR in accordance with the General Conditions before transmittal to ENGINEER for review and approval.
- D. Complete shop drawings and descriptive data shall be submitted on all manufactured or fabricated items prior to 50% completion of the Work. Applications for payment beyond 50% of the Contract amount will not be recommended for payment until all shop drawings are submitted, including color hard copies if requested by OWNER, or a revised schedule for any remaining submittals is agreed to by OWNER and ENGINEER.
- E. CONTRACTOR shall submit shop drawings following the electronic submittal procedure described below.

- F. Shop drawings submitted to ENGINEER will be reviewed and stamped “Approved,” “Approved as Noted,” “Approved as Noted-Resubmit,” or “Not Approved.” CONTRACTOR shall resubmit shop drawings stamped “Approved as Noted-Resubmit” and “Not Approved,” and will continue this process until shop drawings are stamped “Approved” or “Approved as Noted.” If drawings are stamped “Approved as Noted-Resubmit,” fabrication may proceed in accordance with the marked-up shop drawings. Installation shall not proceed until shop drawings have been resubmitted and stamped “Approved” or “Approved as Noted.”
- G. If shop drawings are stamped “Approved as Noted” or “Approved as Noted-Resubmit” and CONTRACTOR does not agree with revisions or cannot conform with revisions, fabrication shall not proceed and shop drawings shall be resubmitted with explanation of CONTRACTOR’s position.
- H. All shop drawings used for construction site activities shall bear the “Approved” or “Approved as Noted” stamp of ENGINEER.
- I. Electronic Submittal Procedures:
  - 1. Summary:
    - a. Shop drawing and product data submittals shall be transmitted to ENGINEER in electronic (PDF) format using Submittal Exchange, or equal, a website service designed specifically for transmitting submittals between construction team members, or equal.
    - b. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
    - c. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
  - 2. Procedures:
    - a. CONTRACTOR shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer/product, dimensions and coordination of information with other parts of the work.
    - b. CONTRACTOR shall transmit each submittal to ENGINEER using the Submittal Exchange website, [www.submittalexchange.com](http://www.submittalexchange.com), or equal.
    - c. ENGINEER review comments will be made available on the Submittal Exchange website for downloading. CONTRACTOR will receive email notice of completed review.
    - d. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of CONTRACTOR.
    - e. Electronically submitted shop drawings shall follow the following format:
      - (1) Filenames for the shop drawing submittals shall follow a XX XX XX.YYY-Z. Description convention where XX XX XX is the specification section number, YYY is the submittal number, .Z is the resubmittal number, and description is a short description of what the submittal includes. Submittals shall be consecutively numbered in direct sequence of submittal. Resubmittals shall be consecutively numbered with the first submittal numbered with a -0 and the first resubmittal numbered with a -1. Example file name: 03 20 00.016-1. Structure 10 Concrete Reinforcement. This would be the first revision of the sixteenth submittal and contain information on concrete reinforcement.
      - (2) All files shall be delivered in PDF format with a minimum resolution of 300 dpi unless otherwise requested by ENGINEER. Scanned in material shall be scanned in color and any markings by CONTRACTOR shall be made in red.

Pages shall be rotated to the appropriate position for easy reading on a computer monitor such that the majority of text is vertical.

- (3) Files shall be delivered without security features activated.
- (4) Shop Drawings shall be uploaded as individual files. Files combined into a zip drive are not acceptable. All pages of one submittal should be contained in one file.
- (5) The file shall open to a cover page containing, at a minimum, the following information:
  - (a) CONTRACTOR's stamp.
  - (b) Name, e-mail, and telephone number of the individual who may be contacted for further information.
  - (c) Project number.
  - (d) Submittal number.
  - (e) Submission date, if resubmittal, all previous submission dates.
  - (f) Index detailing contents and the total number of pages in the submittal.

f. Once a shop drawing has been "Approved" or "Approved as Noted," CONTRACTOR shall provide one hard color copy of the "Approved" or "Approved as Noted" shop drawings to ENGINEER. CONTRACTOR is responsible for the hard copy color replication of ENGINEER's "Approved" or "Approved as Noted" shop drawings for use by CONTRACTOR. Hard copy shop drawings shall be submitted in 3-ring binders or 3-tab report covers.

3. Costs:

- a. CONTRACTOR shall include the full cost of Submittal Exchange, or equal, project subscription in their proposal. This cost shall be included in the Contract amount. Contact Submittal Exchange at 1-800-714-0024 to verify cost prior to Bid.
- b. At CONTRACTOR's option, training is available from Submittal Exchange regarding use of website and PDF submittals. Contact Submittal Exchange at 1-800-714-0024.
- c. Internet Service and Equipment Requirements:
  - (1) Email address and Internet access at CONTRACTOR's main office.
  - (2) Adobe Acrobat ([www.adobe.com](http://www.adobe.com)), Bluebeam PDF Revu ([www.bluebeam.com](http://www.bluebeam.com)), or other similar PDF review software for applying electronic stamps and comments.

J. CONTRACTOR is fully responsible for obtaining any and all copyright permission associated with conversion of shop drawing information to electronic format.

K. Shop drawings shall include verification that the item meets applicable codes and standards.

## 1.07 COLORS AND PATTERNS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, whenever a choice of color or pattern is available in a specified product, CONTRACTOR shall submit accurate color charts and pattern charts to ENGINEER for OWNER's review and selection.
- B. Unless all available colors and patterns have identical wearing capabilities and are identically suited for the installation, CONTRACTOR shall completely describe the relative capabilities of each.



## 1.08 PRODUCT DATA

- A. CONTRACTOR shall provide product data as required to supplement shop drawings.
- B. Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by CONTRACTOR to illustrate a material, product, or system for some portion of the work.
- C. CONTRACTOR shall collect required product data into one submittal for each unit of work or system.
- D. CONTRACTOR shall include manufacturer's standard printed recommendations for application and use, compliance with standards, performance characteristics, wiring and piping diagrams and controls, component parts, finishes, dimensions, required clearances, and other special coordination requirements.
- E. CONTRACTOR shall mark each copy of standard printed data to identify pertinent products, models, options, and other data.
- F. CONTRACTOR shall supplement manufacturer's standard data to provide information unique to the work.

## 1.09 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by ENGINEER.
- B. Shop Drawings and Product Data:
  - 1. Revise initial drawings or data and resubmit as specified for initial submittal.
  - 2. Itemize in a cover letter any changes which have been made other than those requested by ENGINEER.
- C. CONTRACTOR shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than three submittals. ENGINEER will record ENGINEER's time for review subsequent submittals of shop drawings, samples, or other items required for approval and CONTRACTOR shall reimburse OWNER and ENGINEER's charges for such time.
- D. In the event that CONTRACTOR requests a substitution for previously approved item, CONTRACTOR shall reimburse OWNER for ENGINEER's charges for its review time unless the need for such change is beyond control of CONTRACTOR.

## 1.10 MANUFACTURER'S DIRECTIONS

- A. Manufactured articles, materials, and equipment shall be stored, commissioned, operated, applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer, unless specified to the contrary.
- B. Wherever specifications call for work to be performed or materials to be installed in accordance with the manufacturer's printed instructions or directions, CONTRACTOR shall furnish copies as required for shop drawings of those instructions or directions to ENGINEER before installing the material or performing the work.

## 1.11 MAINTENANCE MANUAL

- A. Prior to 75% completion of the Contract or at a minimum of 45 days prior to the scheduled start-up date of any individual item of equipment, whichever is earlier, CONTRACTOR shall furnish to ENGINEER two complete color hard copies of a maintenance manual for all equipment furnished. Applications for payment beyond 75% of the contract amount will not be recommended for payment until all maintenance manuals are submitted or a revised schedule for remaining maintenance manuals is agreed to by OWNER and ENGINEER.
- B. The manuals shall include manufacturer's instructions for maintenance and operation for each item of mechanical and electrical equipment. Manuals shall be specific for the equipment as installed; provide project specific inserts as required. Manuals shall contain: operation instructions, lubrication schedules, types and quantities, preventative maintenance program, spare parts list, parts lists, I.D. No. and exploded views, assembly instructions, parts supplier location, trouble shooting and startup procedures and, where applicable, test data and curves.
- C. All sheets shall have reduced dimensions as described for shop drawings, and shall be furnished in 3-ring binders or 3-tab report covers.
- D. CONTRACTOR is responsible for producing an electronic version of the Equipment Operations and Maintenance (O&M) Manuals Manual. The Electronic Equipment O&M Manual shall be delivered in Portable Document Format (PDF). The entire manual may be converted to PDF via scanning or other method of conversion. Drawings or other graphics must be converted to PDF format and made part of the PDF document. CONTRACTOR shall provide all Equipment O&M Manuals in the electronic format as defined below.
- E. The filename for the Equipment O&M Manual submittal will be provided with the request for final Equipment O&M Manuals. Filenames use the "eight dot three" convention (XX XX XX\_YY.PDF) where XX XX XX is the specification section number and YY is an ID number. No one file shall be larger than 10 MB. If technical problems require that the submittal be divided into more than one file, a letter extension shall be added to the end of each filename.
- F. The number of files shall be kept to a minimum. Equipment O&M Manuals that span more than one file shall have the final Bookmark "Return to Table of Contents" which shall take the User to the first file on the Equipment O&M Manual.
- G. All text (word processed), spreadsheets, and electronic graphics shall be delivered in portable document format (\*.PDF). The resolution of all scanned images shall be a minimum of 300 dpi unless otherwise requested by ENGINEER. Scanned images shall be processed with the "original image with hidden text" option (Adobe Acrobat 6 or higher). This results in a clear image and provides for optical character recognition (OCR) and word search functionality. Graphical files shall be fully searchable. All submittals must be indexed with the Adobe Catalog feature. Placement and structure of index files shall be in accordance with Adobe's recommendations to minimize problems when transferring files. Successful searches for words or strings in the PDF document shall demonstrate proof of OCR.
- H. Rotate pages viewed in landscape to the appropriate position for easy reading on a computer monitor.
- I. Bookmarks shall be created in the navigation frame for each entry in the Table of Contents. Three levels deep is usually enough (i.e., "Chapter," "Section," "Subsection"); however,

complex submittals like instrumentation and electrical may be required at the discretion of ENGINEER. When setting bookmarks for Chapter level heading, the page shall be displayed at Full Page. Section and Subsection level heading pages shall be displayed as a magnified view. Bookmarks shall be displayed as subordinate to other bookmarks in their hierarchy set so that only the Chapter level headings are displayed.

- J. Thumbnails shall be generated and embedded in each PDF file.
- K. Files shall be delivered without Security features activated. Password protected files will be unacceptable.
- L. The opening view for PDF files shall be set as follows:
  - 1. Initial View: Bookmarks and Page
  - 2. Magnification: Fit In Window
  - 3. Page Layout: Single Page
- M. The file shall open to the cover page of the Equipment O&M Manual with bookmarks to the left. The first bookmark shall be the name of Equipment O&M Manual.
- N. O&M Manual PDFs shall be delivered electronically.
- O. CONTRACTOR shall reprocess any portion of the document that does not view or print to OWNER's satisfaction.
- P. CONTRACTOR is fully responsible for obtaining any and all copyright permissions associated with conversion of this information to electronic format.

## PART 2-PRODUCTS

NOT APPLICABLE

## PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 41 00

### REGULATORY REQUIREMENTS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. OSHA Requirements.
  - 2. Roadway Limits.
  - 3. Permits.
  - 4. Wage Rates.
  - 5. Recording and Preserving Historical and Archaeological Finds.

##### 1.02 OSHA REQUIREMENTS

- A. All work including site safety, equipment, materials, and fabricated items provided under the Contract shall comply with the provisions of the "Occupational Safety and Health Act" (OSHA), the Kentucky Occupational Safety and Health Act (KYOSH), and all other applicable federal, state, county and local laws, ordinances, codes, the requirements set forth herein, and any regulations that may be specified in other parts of these Contract Documents. Where any of these are in conflict, the more stringent requirements shall be followed.
- B. CONTRACTOR's failure to thoroughly familiarize itself with the aforementioned safety provisions shall not relieve CONTRACTOR from compliance with the obligations and penalties set forth therein.

##### 1.03 ROADWAY LIMITS

- A. CONTRACTOR shall comply with roadway weight restrictions including seasonal weight restrictions.

##### 1.04 PERMITS

- A. The following permits were obtained by OWNER:
  - 1. Facility Construction Permit for Town Branch, issued by Kentucky Division of Water, dated July 3, 2024.
  - 2. Facility Construction Permit for West Hickman, issued by Kentucky Division of Water, dated July 15, 2024.
- B. They are included as attachments to this division. CONTRACTOR shall comply with all provisions of these permits and shall be responsible for notifications as required by these permits. CONTRACTOR shall obtain all other permits required for the Work. Where the requirements of any permit is more restrictive than the Drawings or the Specifications, the permit requirements shall govern.
- C. Any permits required for dewatering operations shall be obtained and paid for by CONTRACTOR.

#### 1.05 WAGE RATES

- A. A state wage rate determination is not a requirement of this project.

#### 1.06 RECORDING AND PRESERVING HISTORICAL AND ARCHAEOLOGICAL FINDS

- A. In the event archaeological materials (arrowheads, stone tools, stone axes, prehistoric and historic pottery, bottles, foundations, Civil War artifacts, and other types of artifacts) are uncovered during the construction of the Project, Work is to immediately cease at the location and the Kentucky Heritage Council shall be contacted. The telephone number is (502) 564-7005. Construction shall not commence at this location until a written release is received from the Kentucky Heritage Council. Failure to report a find could result in legal action.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 42 00

### REFERENCE STANDARDS AND DEFINITIONS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Reference Standards:
    - a. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
    - b. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is CONTRACTOR's responsibility to provide materials and workmanship which meet or exceed that specifically named code or standard.
    - c. It is also CONTRACTOR's responsibility, when so required by the Contract Documents, to deliver to ENGINEER all required proof that the material or workmanship, or both, meet or exceed the requirements of the specifically named code or standard.
  - 2. Definitions:
    - a. A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon.
    - b. Certain terms used in the Contract Documents are defined generally in this section to supplement definitions of the Agreement, General Conditions, Supplementary Conditions, and other general contract documents.
    - c. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the Work.
- B. Related Work Described Elsewhere: The specific naming of codes or standards occurs on the Drawings and in other sections of these Specifications.

##### 1.02 QUALITY ASSURANCE

- A. Familiarity with Pertinent Codes and Standards:
  - 1. It is CONTRACTOR's responsibility to verify the requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.
  - 2. When required by individual sections of these specifications, CONTRACTOR shall obtain a copy of each pertinent code or standard and maintain the copies at the job site during submittals, planning, and progress of the Work until Substantial Completion of the Work is attained.
- B. Overlapping or Conflicting Requirements:
  - 1. Where compliance with two or more industry standards or sets of requirements are specified, and the overlapping of those standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement (which is

generally recognized to be also most costly) is intended and will be enforced, unless more detailed language written directly into Contract Documents clearly indicates that a less stringent requirement is acceptable.

2. Refer all uncertainties to ENGINEER for decision before proceeding.

### 1.03 REFERENCE STANDARDS

- A. Applicable standards of the construction industry are made a part of the Contract Documents by reference as if copied directly into the Contract Documents, or as if published copies were bound herewith. See Article 3.02 of the General Conditions for additional provisions regarding references.
- B. Standards referenced directly in the Contract Documents or by governing regulation, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
- C. Nonreference standards are hereby defined to have no particular applicability to the Work except as a general measurement of whether the Work complies with standards recognized in the construction industry.
- D. Reference standards and codes listed in these specifications may include, but are not necessarily limited to, standards or codes published by the following agencies and organizations:

1. AA                      Aluminum Association  
1525 Wilson Boulevard, Arlington, VA 22209
2. AAMA                  American Architectural Manufacturer's Association  
1827 Walden Office Square Suite 550, Schaumburg, IL 60173-4268
3. AASHTO              American Association of State Highway & Transportation Officials  
444 North Capitol Street NW Suite 249, Washington, DC 20001
4. ACI                     American Concrete Institute  
38800 Country Club Drive, Farmington Hills, MI 48331-3439
5. AI                        Asphalt Institute  
2696 Research Park Drive, Lexington, KY 40511-8480
6. AISC                   American Institute of Steel Construction  
One East Wacker Drive Suite 700, Chicago, IL 60601-1802
7. AISI                    American Iron and Steel Institute  
25 Massachusetts Avenue NW Suite 800, Washington, DC 20001
8. ANSI                   American National Standards Institute  
25 West 43rd Street, New York, NY 10036
9. APA                    American Plywood Association  
7011 South 19th, Tacoma, WA 98466-5333

10. API American Petroleum Institute  
1220 L Street NW, Washington, DC 20005-4070
11. ARI Air-Conditioning & Refrigeration Institute  
4100 North Fairfax Drive Suite 200, Arlington, VA 22203
12. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers  
1791 Tullie Circle NE, Atlanta, GA 30329
13. ASME American Society of Mechanical Engineers  
Two Park Avenue, New York, NY 10016-5990
14. ASSE American Society of Sanitary Engineering  
901 Canterbury Suite A, Westlake, OH 44145
15. ASTM ASTM International  
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
16. AWI Architectural Woodwork Institute  
46179 Westlake Drive Suite 120, Potomac Falls, VA 20165-5874
17. AWPA American Wood Protection Association  
P.O. Box 361784, Birmingham, AL 35236-1784
18. AWS American Welding Society  
8669 Doral Boulevard Suite 130, Doral, FL 33166
19. AWWA American Water Works Association  
6666 West Quincy Avenue, Denver, CO 80235
20. BHMA Builder's Hardware Manufacturers Association  
355 Lexington Avenue 15th floor, New York, NY 10017
21. BIA Brick Industry Association  
1850 Centennial Park Drive Suite 301, Reston, VA 20191
22. CRSI Concrete Reinforcing Steel Institute  
9333 North Plum Grove Road, Schaumburg, IL 60173
23. DOT U.S. Department of Transportation  
1200 New Jersey Avenue, SE, Washington, DC 20590
24. EJMA Expansion Joint Manufacturers Association  
25 North Broadway, Tarrytown, NY 10591
25. FM FM Global  
FM Global Corporate Offices, 270 Central Avenue, Johnston, RI 02919



26. FTI           Facing Tile Institute  
Box 8880, Canton, OH 44711
27. GA           Gypsum Association  
6525 Belcrest Road Suite 480, Hyattsville, MD 20782
28. GANA       Glass Association of North America  
800 SW Jackson Street Suite 1500, Topeka, KS 66612-1200
29. ICC         International Code Council  
500 New Jersey Avenue NW 6th Floor, Washington, DC 20001
30. IES         Illuminating Engineering Society  
120 Wall Street, Floor 17, New York, NY 10005-4001
31. MIL         Military Specifications  
Naval Publications and Forms Center  
5801 Tabor Avenue, Philadelphia, PA 19120
32. NAAMM      National Association of Architectural Metal Manufacturers  
800 Roosevelt Road Building C Suite 312, Glen Ellyn, IL 60137
33. NCMA       National Concrete Masonry Association  
13750 Sunrise Valley Drive, Herndon, VA 20171-4662
34. NECA       NECA  
National Electrical Contractors Association  
3 Bethesda Metro Center Suite 1100, Bethesda, MD 20814
35. NEMA       National Electrical Manufacturers Association  
1300 North 17th Street Suite 1752, Rosslyn, VA 22209
36. NFPA       National Fire Protection Association  
1 Batterymarch Park, Quincy, MA 02169-7471
37. NIST        National Institute of Standards and Technology  
(U.S. Department of Commerce), 100 Bureau Drive, Stop 1070  
Gaithersburg, MD 20899-1070
38. NRCA       National Roofing Contractors Association  
10255 West Higgins Road Suite 600, Rosemont, IL 60018-5607
39. NSF         National Sanitation Foundation International  
P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, MI 48113-0140
40. OSHA       Occupational Safety & Health Administration  
200 Constitution Avenue NW, Washington, DC 20210
41. PCA         Portland Cement Association  
5420 Old Orchard Road, Skokie, IL 60077

- |            |  |
|------------|--|
| 42. PCI    | Prestressed Concrete Institute<br>200 West Adams Street Suite 2100, Chicago, IL 60606  |
| 43. SAE    | Society of Automotive Engineers<br>SAE World Headquarters<br>400 Commonwealth Drive, Warrendale, PA 15096-0001                 |
| 44. SDI    | Steel Deck Institute<br>P.O. Box 25, Fox River Grove, IL 60021   |
| 45. SDI    | Steel Door Institute<br>30200 Detroit Road, Westlake, OH 44145-1987  |
| 46. SIGMA  | Sealed Insulating Glass Manufacturers Assoc.<br>401 North Michigan Avenue Suite 2400, Chicago, IL 60611                        |
| 47. SJI    | Steel Joist Institute<br>234 Cheves Street, Florence, SC 29501   |
| 48. SMACNA | Sheet Metal and Air Conditioning<br>Contractor's National Association<br>4201 Lafayette Center Drive, Chantilly, VA 20151-1219 |
| 49. SSPC   | Society for Protective Coatings<br>40 24th Street 6th Floor, Pittsburgh, PA 15222-4656   |
| 50. TCA    | Tile Council of America<br>100 Clemson Research Boulevard, Anderson, SC 29625  |
| 51. UL     | Underwriters Laboratories<br>333 Pfingston Road; Northbrook, IL 60062  |

#### 1.04 SUBMITTALS

- A. For OWNER's records, CONTRACTOR shall submit copies of permits, licenses, certifications, inspection reports, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

#### 1.05 DEFINITIONS

- A. Indicated:
  - 1. The term "indicated" is a cross-reference to details, notes, or schedules on the drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in the Contract Documents.
  - 2. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping the reader locate cross-reference, and no limitation is intended except as specifically noted.

- B. Approve (or Words of Similar Nature):
1. Where used in conjunction with ENGINEER's response to submittals, requests, applications, inquiries, reports, and claims by CONTRACTOR, the meaning of the term "approve" will be held to the limitation of ENGINEER's responsibilities and duties as specified in the General Conditions.
  2. In no case will "approval" by ENGINEER be interpreted as a release of CONTRACTOR from responsibility to fulfill requirements of the Contract Documents.
- C. Minimum Requirements:
1. Indicated requirements are for a specific minimum acceptable level of quality or quantity, as recognized in the industry.
  2. Actual work must comply with (or within specified tolerances) or exceed minimums.
  3. CONTRACTOR shall refer uncertainties to ENGINEER before proceeding.
- D. Abbreviations: Abbreviations, where not defined in the Contract Documents, will be interpreted to mean the normal construction industry terminology.

## PART 2-PRODUCTS

NOT APPLICABLE

## PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 45 00

### QUALITY CONTROL

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Includes:
  - 1. Quality Assurance—Control of Installation.
  - 2. Tolerances.
  - 3. Manufacturers' Field Services and Reports.

##### 1.02 QUALITY ASSURANCE—CONTROL OF INSTALLATION

- A. CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
- B. CONTRACTOR shall comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.
- D. CONTRACTOR shall comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Work shall be performed by persons qualified to produce workmanship of specified quality.
- F. CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

##### 1.03 TOLERANCES

- A. CONTRACTOR shall monitor tolerance control of installed products to produce acceptable work and shall not permit tolerances to accumulate.
- B. CONTRACTOR shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.
- C. CONTRACTOR shall adjust products to appropriate dimensions; position before securing products in place.

##### 1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification sections or when requested by ENGINEER, CONTRACTOR shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship.

- B. CONTRACTOR shall submit qualifications of observer to ENGINEER 30 days in advance of required observations.
- C. CONTRACTOR shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. CONTRACTOR shall submit report in duplicate within 30 days of observation to ENGINEER for information.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 50 00

### TEMPORARY FACILITIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Temporary Utilities.
  - 2. Temporary Stairs and Access.
  - 3. Temporary Support Facilities.
  - 4. Removal of Temporary Facilities.
  - 5. Temporary Chemical Feed Systems.
- B. CONTRACTOR shall arrange for and provide temporary facilities as required for proper and expeditious prosecution of the Work.
- C. CONTRACTOR shall pay all costs, except as otherwise specified, until final acceptance of the Work unless OWNER makes arrangements for use of completed portions of the Work after substantial completion in accordance with the provisions of the General Conditions.
- D. CONTRACTOR shall make all temporary connections to utilities and services in locations acceptable to OWNER and local authorities having appropriate jurisdiction.
  - 1. Furnish all necessary labor and materials.
  - 2. Make all installations in a manner subject to the acceptance of such authorities and OWNER.
  - 3. Maintain such connections.
  - 4. Remove temporary installation and connection when no longer required.
  - 5. Restore services and sources of supply to proper operating conditions.

##### 1.02 TEMPORARY UTILITIES

- A. Temporary Toilets: CONTRACTOR shall provide and maintain sanitary temporary chemical toilets located where approved by OWNER and in sufficient number required for the work force employed by CONTRACTOR.
- B. Weather Protection and Temporary Heat:
  - 1. CONTRACTOR shall provide weather protection to protect the Work from damage because of freezing, rain, snow, and other inclement weather.
  - 2. CONTRACTOR shall provide temporary heat within buildings, without cost to OWNER, from the time the buildings or portions thereof are enclosed until the Project is accepted or occupied by OWNER, whichever occurs first. The building work is to be heated during construction so a minimum temperature of 50°F is maintained at all times. Temporary heating equipment shall be properly vented.
  - 3. Tanks that are constructed and existing tanks taken out of service as part of the Work shall be protected by CONTRACTOR from damage because of frost by insulating, enclosure, heating, or a combination of methods as required.
  - 4. No permanent heating equipment shall be used on a temporary basis without express written permission by OWNER. Such approval, if given, shall not affect the guarantee period. If OWNER authorizes use of permanent heating equipment, CONTRACTOR

shall pay all related energy costs until acceptance or occupancy (whichever occurs first) of the building by OWNER.

- C. CONTRACTOR's and Subcontractor(s)' personnel shall refrain from smoking during excavation, laying pipe, backfilling, and other work at the Site which may involve potential contact with explosive vapors or gasoline products.

#### 1.03 TEMPORARY STAIRS AND ACCESS

- A. CONTRACTOR shall provide and maintain all equipment such as temporary stairs, ladders, ramps, runways, chutes, and so on as required for proper execution of the Work. CONTRACTOR shall be responsible for providing its own scaffolds, hoists, etc.
- B. All such apparatus, equipment, and construction shall meet all requirements of OSHA, the labor laws, and other applicable State and local laws. Provide stairs with handrails. As soon as possible and where applicable, permanent stairs shall be installed.
- C. As soon as permanent stairs are created, provide temporary protective treads, handrails, and shaft protection.
- D. Provide barricades at hazardous locations, complete with signs, temporary general lighting, warning lights, and similar devices as required.

#### 1.04 TEMPORARY SUPPORT FACILITIES

- A. CONTRACTOR shall provide whatever facilities and services which may be needed to properly support primary construction process and meet compliance requirements and governing regulations.
- B. CONTRACTOR shall not use permanent facilities except as otherwise indicated, unless authorized by OWNER.

#### 1.05 REMOVAL OF TEMPORARY FACILITIES

- A. Remove temporary materials, equipment, services, and construction as soon as practicable but no later than just prior to substantial completion inspection.
- B. Clean and repair damage caused by installation or use of temporary facilities and restore existing facilities used during construction to specified, or to original, condition.
- C. Minor temporary facilities which interfere with OWNER's operations shall be removed at the end of each Work period.

#### 1.06 TEMPORARY CHEMICAL FEED SYSTEMS

- A. Refer to Section 01 11 00–Summary of Work for a discussion on CONTRACTOR-provided temporary chemical feed systems and CONTRACTOR's responsibilities to provide chemicals during construction.

### PART 2–PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION



SECTION 01 52 13  
FIELD OFFICES AND SHEDS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Materials, Equipment, and Furnishings.
  - 2. Construction.
  - 3. Environmental Control.
  - 4. CONTRACTOR Office and Facilities.
  - 5. Storage Areas and Sheds.
  - 6. Preparation.
  - 7. Installation.
  - 8. Maintenance and Cleaning.
  - 9. Removal.

PART 2–PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FURNISHINGS

- A. Materials, equipment, and furnishings shall be serviceable, new or used, and adequate for required purpose.

2.02 CONSTRUCTION

- A. Portable or mobile buildings or buildings shall be constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. CONTRACTOR shall provide structurally sound, secure, weathertight enclosures for office and storage spaces.
- C. Temperature transmission resistance of floors, walls, and ceilings shall be compatible with occupancy and storage requirements.
- D. Exterior materials shall be weather resistant.
- E. Interior materials in offices shall consist of sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
- F. Lighting for offices shall be 50 footcandles minimum at desk top height, with exterior lighting at entrance doors.
- G. Provide appropriate type fire extinguisher at each office and each storage area.
- H. Interior materials in storage sheds shall be as required to provide specified conditions for storage of products.

## 2.03 ENVIRONMENTAL CONTROL

- A. Heating, cooling, and ventilating for offices shall consist of automatic equipment to maintain comfort conditions; 70°F heating and 78°F cooling.
- B. Heating and ventilation for storage spaces shall be as needed to maintain products in accordance with Contract Documents and to provide adequate lighting for maintenance and observation of products.

## 2.04 CONTRACTOR OFFICE AND FACILITIES

- A. CONTRACTOR shall provide facilities to meet CONTRACTOR's needs and to provide space for Project meetings.
- B. Provide telephone as required for CONTRACTOR's needs.
- C. Provide furnishings in meeting area. As a minimum, provide conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents.

## 2.05 STORAGE AREAS AND SHEDS

- A. Provide storage areas and sheds of size to meet storage requirements for products of individual sections, allowing for access and orderly provision for maintenance and for observation of products to meet requirements of Section 01 60 00—Materials and Equipment.

# PART 3—EXECUTION

## 3.01 PREPARATION

- A. CONTRACTOR shall fill and grade sites for temporary structures to provide drainage away from buildings.

## 3.02 INSTALLATION

- A. CONTRACTOR shall install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed or as agreed upon by ENGINEER.
- B. Provide two hard surfaced parking spaces for use by ENGINEER, connected to office by hard surfaced walk.

## 3.03 MAINTENANCE AND CLEANING

- A. CONTRACTOR shall maintain approach walks free of mud, water, and snow.

## 3.04 REMOVAL

- A. Upon final acceptance and completion of the Work, CONTRACTOR shall remove field offices, foundations, utility services, and debris and shall restore areas.

END OF SECTION

Section 01 52 13-2

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## SECTION 01 57 00

### TEMPORARY CONTROLS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Dust Control.
  - 2. Water, Erosion, and Sediment Control.
  - 3. Site Security.
  - 4. Daily Cleanup.

#### PART 2–PRODUCTS

NOT APPLICABLE

#### PART 3–EXECUTION

##### 3.01 DUST CONTROL

- A. CONTRACTOR shall execute the Work by methods to minimize raising dust from construction operations.
- B. CONTRACTOR shall provide positive means to prevent airborne dust from dispersing into atmosphere.
- C. CONTRACTOR shall provide partitions, enclosures, etc., within buildings as necessary to confine dust and protect adjacent areas.

##### 3.02 WATER, EROSION, AND SEDIMENT CONTROL

- A. CONTRACTOR shall grade site to drain and shall maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. CONTRACTOR shall protect Site from puddling or running water.
- C. CONTRACTOR shall provide erosion control measures as necessary to control discharge of sediment laden water to surface waters and wetlands.
- D. Except as provided for in the document, overland discharge of water from dewatering operations shall not be allowed. Depending on water quality, such water shall either be piped directly to the surface water or shall be directed to sedimentation basins or other such structures or features prior to discharge to surface waters so as not to cause damage to existing ground and improvements, erosion, or deposition in the discharge area.
- E. CONTRACTOR shall use jute or synthetic netting, silt fences, straw bales, dikes, channels, and other applicable measures to prevent erosion of soils disturbed by its construction operation.

- F. Restoration of the Site shall proceed concurrently with the construction operation. See Drawings and Specifications for erosion control measures in addition to that which may be required above.
- G. Erosion control measures shall comply with the following document: Kentucky's Best Management Practices for Construction Activities.

### 3.03 SITE SECURITY

- A. CONTRACTOR shall have the sole responsibility of safeguarding the Site perimeter to prevent unauthorized entry to the Site throughout the duration of the Project. CONTRACTOR shall at all times provide such permanent and temporary fencing or barricades or other measures as may be necessary to restrict unauthorized entry to its construction area including construction in public rights-of-way or easements. Site security measures shall include safeguards against attractive nuisance hazards as a result of construction activity.
- B. CONTRACTOR shall at all times be responsible for the security of the Work including materials and equipment. OWNER will not take any responsibility for missing or damaged equipment, tools, or personal belongings. CONTRACTOR shall have the sole responsibility of safeguarding the Work and the Site throughout the duration of the Project.

### 3.04 DAILY CLEANUP

- A. CONTRACTOR shall clean up the Site and remove all rubbish on a daily basis.
- B. CONTRACTOR shall clean up public streets and highways and remove any dirt, mud, or other materials due to project traffic on daily basis and shall comply with all local and state ordinances and permit requirements.

END OF SECTION

## SECTION 01 60 00

### MATERIALS AND EQUIPMENT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for the delivery, handling, storage and protection of all material and equipment required to complete the Work as specified herein.
- B. Related Sections and Divisions: Specific requirements for the handling and storage of material and equipment are described in other sections of these Specifications.

##### 1.02 PRODUCTS

- A. Components required to be supplied in quantity within a Specification section shall be the same and shall be interchangeable.
- B. CONTRACTOR shall not use materials and equipment removed from existing construction, except as specifically required, or allowed, by the Contract Documents.
- C. When any construction deviations from the Drawings and/or Specifications necessary to accommodate equipment supplied by CONTRACTOR, result in additional costs to CONTRACTOR or other contractors, such additional costs shall be borne by CONTRACTOR. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.
- D. Each major component of equipment shall bear a nameplate giving the name and address of the manufacturer and the catalogue number or designation.

##### 1.03 TRANSPORTATION AND HANDLING

- A. Materials, products and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.
- B. CONTRACTOR shall not overload any portion of the structure in the transporting or storage of materials.
- C. CONTRACTOR shall not damage other construction by careless transportation, handling, spillage, staining or impact of materials.
- D. CONTRACTOR shall provide equipment and personnel to handle products, including those provided by OWNER, by methods to prevent soiling and damage.
- E. CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.
- F. CONTRACTOR shall handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

#### 1.04 DELIVERY AND RECEIVING

- A. CONTRACTOR shall arrange deliveries of products in accordance with the Progress Schedule, allowing time for observation prior to installation.
- B. CONTRACTOR shall coordinate deliveries to avoid conflict with the Work and conditions at the Site; work activities of other contractors or OWNER; limitations on storage space; availability of personnel and handling equipment and OWNER's use of premises.
- C. CONTRACTOR shall deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. CONTRACTOR shall clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.
- E. Immediately on delivery, CONTRACTOR shall inspect shipment to review that:
  - 1. Product complies with requirements of Contract Documents and reviewed submittals.
  - 2. Quantities are correct.
  - 3. Accessories and installation hardware are correct.
  - 4. Containers and packages are intact and labels legible.
  - 5. Products are protected and undamaged.

#### 1.05 STORAGE AND PROTECTION

- A. General:
  - 1. CONTRACTOR shall store products, immediately on delivery, in accordance with manufacturer's instructions, with all seals and labels intact and legible.
  - 2. Any additional off-site space required shall be arranged by CONTRACTOR.
  - 3. CONTRACTOR shall allocate the available storage areas and coordinate their use by the trades on the job.
  - 4. CONTRACTOR shall arrange storage in a manner to provide access for maintenance of stored items and for observation.
- B. In enclosed storage, CONTRACTOR shall:
  - 1. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.
  - 2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
  - 3. Provide ventilation for sensitive products as required by manufacturer's instructions.
  - 4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.
  - 5. Store solid materials such as insulation, tile, mechanical and electrical equipment, fittings, and fixtures under shelter, in original packages, away from dampness and other hazards.
  - 6. Store liquid materials away from fire or intense heat and protect from freezing.
- C. At exterior storage, CONTRACTOR shall:
  - 1. Store unit materials such as concrete block, brick, steel, pipe, conduit, door frames, and lumber off ground, out of reach of dirt, water, mud and splashing.
  - 2. Store tools or equipment that carry dirt outside.
  - 3. Store large equipment so as not to damage the Work or present a fire hazard.
  - 4. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet material and provide ventilation to avoid condensation.

5. Completely cover and protect any equipment or material which is prime coated or finish painted with secured plastic or cloth tarps. Store out of reach of dirt, water, mud and splashing.
6. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
7. Provide surface drainage to prevent erosion and ponding of water.
8. Prevent mixing of refuse or chemically injurious materials or liquids.
9. Cover aggregates such as sand and gravel in cold wet weather.
10. Remove all traces of piled bulk materials at completion of work and return site to original or indicated condition.

#### 1.06 MAINTENANCE OF STORAGE

- A. CONTRACTOR shall periodically inspect stored products on a scheduled basis.
- B. CONTRACTOR shall verify that storage facilities comply with manufacturer's product storage requirements and verify that manufacturer required environmental conditions are maintained continually.
- C. CONTRACTOR shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.
- D. CONTRACTOR shall perform scheduled maintenance of equipment in storage as recommended by the manufacturer. A record of the maintenance shall be kept and turned over to ENGINEER when the equipment is installed.

#### 1.07 INSTALLATION REQUIREMENTS

- A. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respective manufacturers, unless otherwise specified.
- B. After installation, CONTRACTOR shall protect all materials and equipment against weather, dust, moisture, and mechanical damage.
- C. CONTRACTOR shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until completion and final acceptance of the Work by OWNER. Damaged material and equipment shall be immediately removed from the Site.

#### 1.08 EQUIPMENT WARRANTIES

- A. Warranties shall be nonprorated, include all parts and labor, and be in written form. Warranties shall specifically exclude buyer's indemnification language. Warranty language shall not eliminate manufacturer's responsibility for sizing of the equipment. During warranty period, manufacturer shall be responsible for any travel expenses, outside contractor fees, and rental equipment fees associated with providing warranty service. Manufacturer shall pay expenses incurred for repairs and parts replacement not made by manufacturer if manufacturer's response is not within 72 hours of notification by OWNER. Warranty language shall be provided with the shop drawings.

## 1.09 CONCRETE EQUIPMENT BASE

- A. Cast-in-place concrete equipment bases shall be provided for all new and relocated equipment including electrical control panels, motor control centers, switchgear, etc. Concrete equipment bases shall be provided by CONTRACTOR except where specifically noted to be provided by others. Bases shall be 3 1/2-inch minimum height and shall be a minimum of 3 inches larger than equipment being supported. Grouting of equipment bases shall be as recommended by equipment manufacturer.
- B. Concrete and grout shall meet applicable sections of the specifications.
- C. Provide all anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete for support of equipment.

### PART 2-PRODUCTS

NOT APPLICABLE

### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION



## SECTION 01 73 29

### CUTTING, PATCHING, AND ALTERATIONS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for all cutting, fitting, patching, and other alterations required to complete the Work as specified herein or to:
  - 1. Make its several parts fit together properly.
  - 2. Uncover portions of the Work to install improperly sequenced Work.
  - 3. Remove and replace defective Work.
  - 4. Remove and replace Work not conforming to requirements of the Contract Documents.
  - 5. Remove samples of installed Work as specified for testing.
  - 6. Provide penetrations of surfaces for installation of piping and electrical conduit.
  - 7. Rehabilitate or renovate existing spaces.

##### 1.02 REFERENCES

- A. ANSI A10 Safety Requirements for Construction and Demolition.

##### 1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform all cutting, patching, and alterations in strict accordance with pertinent requirements of these Specifications.
- B. Except as modified by governing codes, CONTRACTOR shall comply with the applicable provision and recommendations of ANSI A10.

##### 1.04 SUBMITTALS

- A. CONTRACTOR shall submit a written request to OWNER well in advance of executing any cutting or alteration which affects the following:
  - 1. Work of OWNER or any separate contractor.
  - 2. Structural value or integrity of any element of the Project.
  - 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
  - 4. Efficiency, operational life, maintenance, or safety of operational elements.
  - 5. Visual qualities of sight-exposed elements.
- B. The request shall include:
  - 1. Description of affected work.
  - 2. The necessity for cutting, patching, or alteration.
  - 3. Effect on work of OWNER, any separate contractor, or on the structural or weather-proof integrity of the Project.
  - 4. Description of proposed work to include:
    - a. Scope of cutting, patching, or alteration.
    - b. Trades who will execute the Work.
    - c. Products proposed to be used.
    - d. Extent of refinishing to be done.

- 5. Alternatives to cutting and patching.
  - 6. Written permission of any separate contractor whose work will be affected.
- C. Submit written notice to OWNER designating the date and the time the Work will be uncovered or executed.

#### 1.05 SCHEDULING AND COORDINATION

- A. All work under this section shall be coordinated with OWNER's work forces and those of other contractors and shall be accomplished at times acceptable to OWNER.
- B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service to the existing building, notify ENGINEER and OWNER 72 hours in advance and obtain OWNER's approval before proceeding with this phase of the Work. Temporary facilities, if required, shall be in place prior to disruption of service.

### PART 2-PRODUCTS

#### 2.01 NEW MATERIALS

- A. For replacement of work removed, CONTRACTOR shall use materials which comply with the pertinent sections of these Specifications.
- B. All new materials for patching and extending work shall match existing products and work.
- C. CONTRACTOR shall determine type and quality of existing products by inspection and any necessary testing and workmanship by use of existing as the standard.

#### 2.02 SALVAGEABLE MATERIAL

- A. Materials or items designated to be reinstalled or to become the property of OWNER shall be as specified or as shown on the Drawings.
- B. CONTRACTOR shall remove such items with care under the supervision of the trade responsible for reinstallation.
- C. CONTRACTOR shall store these materials (off-site if necessary) and protect from damage until they are incorporated into the new work.
- D. Items which are not to be reinstalled but are to become the property of OWNER shall be removed by CONTRACTOR with care, cleaned, and stored in a location at the Site to be approved by OWNER.
- E. Materials or items damaged in its removal shall be replaced by CONTRACTOR with similar new material at no additional cost to OWNER.
- F. Where existing equipment or fixtures are indicated to be reused, CONTRACTOR shall repair such equipment and refinish as specified elsewhere.

## 2.03 UNSALVAGEABLE MATERIALS

- A. Materials or items demolished and not designated to become the property of OWNER or not designated to be reinstalled shall become the property of CONTRACTOR and shall be removed from the site and legally and properly disposed of by CONTRACTOR.
- B. Materials shall be removed by CONTRACTOR in a manner that will avoid damage to materials or equipment to remain.

## PART 3-EXECUTION

### 3.01 INSPECTION

- A. CONTRACTOR shall inspect existing conditions including elements subject to movement or damage during cutting, patching, and other alterations.
- B. After uncovering the Work, CONTRACTOR shall inspect conditions affecting installation of new products or performance of new Work.
- C. CONTRACTOR shall report unsatisfactory or questionable conditions to ENGINEER in writing.
- D. CONTRACTOR shall not proceed with work until unsatisfactory or questionable conditions are resolved.
- E. Beginning of cutting, patching, and alterations work means acceptance of existing conditions by CONTRACTOR.

### 3.02 PREPARATION AND PROTECTION

- A. CONTRACTOR shall provide temporary bracing, shoring, needling, and support of the structure during alterations work as necessary to prevent collapse, settling, or deflection and to protect persons and property from injury or damage.
- B. Temporary supports must adequately carry all existing and imposed load.
- C. CONTRACTOR shall provide and maintain temporary protection of surface finishes, equipment, and adjacent work designated to remain where demolition, removal, and new work is being done, connections are being made, materials are being handled, or equipment is being removed.
- D. CONTRACTOR shall provide temporary partitions or barriers to contain all dust, dirt, and debris from entering into finished areas or areas where OWNER is operating, storing, or manufacturing products.
- E. CONTRACTOR shall provide adequate fire protection in accordance with local Fire Department requirements.
- F. CONTRACTOR shall provide waterproofing, weather protection, heat, and other facilities for that portion of the Work which may be exposed by cutting and patching, demolition, or other alterations.

- G. CONTRACTOR shall cut, move, or remove items as necessary for access to alterations and renovations work and replace and restore at completion of the Work.
- H. CONTRACTOR shall prepare surfaces and remove surface finishes to provide for proper installation of new work and new finishes.
- I. CONTRACTOR shall be responsible for any damage to the existing structure or its contents directly or indirectly by its crews or those of its subcontractors.

### 3.03 PERFORMANCE

- A. CONTRACTOR shall accomplish all Work of cutting, removal, demolition, patching, or other alterations using only persons skilled in the appropriate trade.
- B. CONTRACTOR shall execute the Work in a careful and orderly manner.
- C. CONTRACTOR shall execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- D. CONTRACTOR shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
- E. CONTRACTOR shall fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- F. CONTRACTOR shall thoroughly clean and prepare all surfaces to receive new finish or covering to completely remove all dirt, dust, grease, oil, paint, loose materials, and soil.
- G. CONTRACTOR shall refinish entire surface as necessary to provide an even finish to match adjacent finishes:
  - 1. For continuous surfaces, refinish to nearest intersection.
  - 2. For an assembly, refinish entire unit.

### 3.04 DEMOLITION, CUTTING, AND REMOVAL

- A. Cutting and removal of construction shall be performed by CONTRACTOR so as not to cut or remove more than is necessary and so as not to damage adjacent work.
- B. CONTRACTOR shall cut out embedded anchorages and attachment items as required to properly provide for patching and repair of the respective finishes.
- C. CONTRACTOR shall not cut structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.
- D. CONTRACTOR shall not cut operational elements and safety components in a manner resulting in decreased performance, shortened useful life, or increased maintenance.
- E. CONTRACTOR shall not cut work exposed to view (exterior or interior) in a manner resulting in noticeable reduction of visual qualities as determined by OWNER.
- F. Construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of careless cutting or demolition and is unsuitable for use intended shall be removed and replaced at no additional cost to OWNER.

- G. CONTRACTOR shall clean demolished areas and remove debris, waste, and rubbish from the building at the conclusion of each day's work.
- H. CONTRACTOR shall not let piled waste material endanger the structure.

### 3.05 PATCHING, EXTENDING, AND MATCHING

- A. Patching work shall conform to the standards of the Specifications where applicable, and where not specified, work shall conform to the highest standards of the applicable trade.
- B. CONTRACTOR shall patch construction to match adjacent work unless noted otherwise.
- C. Patching or restoration shall be carried to natural breaks (e.g., corners) wherever possible.
- D. CONTRACTOR shall provide adequate support to substrate for patching finishes.
- E. At locations in existing areas where partitions are removed, CONTRACTOR shall patch floors, walls, and ceiling with finish material to match adjacent surfaces.
- F. Transitions:
  - 1. Where new work abuts or finishes flush with existing work, CONTRACTOR shall make the transition as smooth as possible.
  - 2. Patched work shall match adjacent work in texture and appearance so as to make the patch or transition invisible to the eye at a distance of 3 feet.
  - 3. Where masonry, tile, plaster, metal, or other finished surface is cut in such a way that a smooth transition is not possible, CONTRACTOR shall terminate the existing surface in a neat fashion along a straight line at a natural line of division and provide trim appropriate to the finished surface.
  - 4. Where two or more spaces are indicated to become one space, CONTRACTOR shall rework floors and ceilings so that horizontal planes are without breaks, steps, or bulkheads, unless shown otherwise.
  - 5. In case of extreme level changes (3 inches or more), review condition with ENGINEER prior to making transition.
  - 6. CONTRACTOR shall restore existing work that is damaged during patching operations to a condition equal to its construction at the time of the start of the Work.

### 3.06 UNANTICIPATED MECHANICAL AND ELECTRICAL WORK EXPOSED

- A. Where unanticipated mechanical piping or electrical conduit is exposed during removal of partitions or walls, removal or rerouting shall be accomplished by CONTRACTOR as applicable.
  - 1. Rerouted piping shall be located and shall be connected to maintain all functions in proper operations.
  - 2. Abandoned piping may be left in place where it is buried in floors or walls, providing that it is completely disconnected from its source.
  - 3. There shall be no "dead end" gas, water, sewer, or vent piping existing in the completed work.
  - 4. Unless otherwise shown, abandoned piping, ductwork, conduit, or other mechanical or electrical items in chases, vertical enclosures, or concealed above ceilings shall be completely removed.
- B. Removals, capping, or otherwise terminating services which are abandoned shall be accomplished without additional cost to OWNER.

- C. Relocation of services resulting from unanticipated conflicts of new and existing work in concealed spaces shall be paid for in accordance with the General Conditions.

END OF SECTION

## SECTION 01 77 00

### CONTRACT CLOSEOUT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Closeout Procedures.
  - 2. Final Cleaning.
  - 3. Adjusting.
  - 4. Project Record Documents.
  - 5. Warranties.

##### 1.02 CLOSEOUT PROCEDURES

- A. CONTRACTOR shall provide submittals to ENGINEER that are required by governing or other authorities.
- B. CONTRACTOR shall comply with General Conditions and Supplementary Conditions and complete the following before requesting ENGINEER's observation of the Work or designated portion thereof for substantial completion.
  - 1. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, and similar required documentation for specific units of Work, enabling OWNER's unrestricted occupancy and use.
  - 2. Submit record documentation, maintenance manuals, tools, spare parts, keys, and similar operational items.
  - 3. Submit consent of surety (if surety required in Contract).
  - 4. Complete final cleaning, touch-up work of marred surfaces, and remove temporary facilities and tools.

##### 1.03 FINAL CLEANING

- A. It is CONTRACTOR's responsibility to completely clean up the inside and outside of all buildings and the construction site at the completion of the Work.
- B. CONTRACTOR shall clean areas of the building in which painting and finishing work is to be performed just prior to the start of this work and maintain these areas in satisfactory condition for painting and finishing. This cleaning includes:
  - 1. Removal of trash and rubbish from these areas.
  - 2. Broom cleaning of floors.
  - 3. Removal of any plaster, mortar, dust, and other extraneous materials from finish surfaces, including but not limited to exposed structural steel, miscellaneous metal, masonry, concrete, mechanical equipment, piping, and electrical equipment.
- C. In addition to the cleaning specified above and the more specific cleaning that may be required in various technical sections of the Specifications, CONTRACTOR shall prepare the Project for occupancy by a thorough cleaning throughout, which shall include the following:

1. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
3. Replace filters of operating equipment.
4. Clean debris from roofs, gutters, downspouts, and drainage systems.
5. Clean site; sweep paved areas, rake clean landscaped surfaces.
6. Remove waste and surplus materials, rubbish, and construction facilities from the Site.

#### 1.04 ADJUSTING

- A. CONTRACTOR shall adjust operating products and equipment to provide smooth and unhindered operation.

#### 1.05 PROJECT RECORD DOCUMENTS

- A. CONTRACTOR shall maintain on Site one set of the following record documents to record actual revisions to the Work:
  1. Drawings.
  2. Specifications.
  3. Addenda.
  4. Change orders and other modifications to the Contract.
  5. Reviewed shop drawings, product data, and samples.
  6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. CONTRACTOR shall make entries that are complete and accurate, enabling future reference by OWNER.
- C. CONTRACTOR shall store record documents separate from documents used for construction.
- D. CONTRACTOR shall record information concurrent with construction progress.
- E. Specifications: CONTRACTOR shall legibly mark and record at each Product section description of actual products installed, including the following:
  1. Manufacturer's name and product model and number.
  2. Product substitutions or alternates utilized.
  3. Changes made by addenda and modifications.
- F. Record Drawings: CONTRACTOR shall legibly mark each item to record actual construction including:
  1. Measured depths of foundations in relation to finish floor datum.
  2. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
  3. Measured locations of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of the Work.
  4. Field changes of dimension and detail.
  5. Details not on original Contract drawings.



## 1.06 WARRANTIES

- A. CONTRACTOR shall provide warranties beyond project one-year warranty as required by technical sections.
- B. Submit warranty information as follows:
  - 1. Provide original copies bearing authorized signatures.
  - 2. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers, and provide Table of Contents and assemble in three-ring binder with durable cover.
  - 3. Submit with request for certificate of Substantial Completion.
  - 4. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance listing date of acceptance as start of warranty period.

### PART 2-PRODUCTS

NOT APPLICABLE

### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 91 00  
STARTING OF SYSTEMS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. General.
  - 2. Equipment and System Installation.
  - 3. Starting Equipment and Systems.
  - 4. Demonstration, Instructions, and Operator Training.
  - 5. Start-Up and Testing.
  - 6. Equipment Systems Requiring Certification of Proper Installation.
  - 7. Equipment Systems Requiring Additional Documentation.
- B. CONTRACTOR shall perform the Work described in the following subsections.

1.02 GENERAL

- A. The number of days for manufacturer's services stated in the Specifications shall be considered as the minimum number of days. Should additional time be required for services because of equipment malfunction or other problem, such time shall be at the expense of CONTRACTOR, with no change in Contract Price.
- B. "Days" specified shall consist of 8-hour days on-site, excluding travel time.
- C. CONTRACTOR shall designate and provide one person to be responsible for scheduling, coordinating, and expediting the specified services. Scheduling the services shall be done in cooperation with, and with the prior approval of ENGINEER and OWNER. Such schedule shall be arranged with the appropriate subcontractors, manufacturers, and suppliers with sufficient time to allow their compliance with the service requirements.
- D. CONTRACTOR shall manage equipment checkout such that checkout has been completed and deficiencies addressed prior to demonstration and training. Scheduling training prior to checkout may result in cancellation when checkout cannot be completed prior to training.

1.03 EQUIPMENT AND SYSTEM INSTALLATION

- A. Competent and experienced technical personnel shall represent the manufacturers of all equipment and systems for as many days as may be necessary to provide proper installation and to resolve assembly or installation problems at the site that are attributable to, or associated with, the equipment furnished. This requirement applies to manufacturers for all equipment furnished, whether or not specifically set forth in the Specifications.
- B. Where a Certificate of Proper Installation is called for in this Specification Section, the manufacturer's representative shall provide the attached Certificate of Proper Installation stating that the equipment or system has been installed in accordance with the manufacturer's instructions and has been inspected by a manufacturer's authorized representative, that it has been serviced with the proper initial lubricants, that applicable

safety equipment has been properly installed, that the proper electrical and mechanical connections have been made, and that any other manufacturer requirements have been met. This certification shall be provided to ENGINEER and OWNER prior to the start-up. This certificate is in addition to the manufacturer's standard startup reports, checklists, and other pertinent information.

- C. Functional (or run) testing is required for all equipment and systems. The manufacturer's representative shall supervise the functional test, which shall include checking for proper rotation, alignment, speed, excessive vibration, and noisy operation. The Manufacturer's Certificate of Proper Installation shall state that proper adjustments have been made and that the equipment or system is ready for start-up.
- D. Manufacturer shall demonstrate, using laser alignment equipment, if appropriate, that the installed equipment has been aligned properly. Final acceptance of equipment will not be granted until manufacturer has demonstrated to ENGINEER that acceptable alignment to tolerances have been achieved. For pumps with motors 7.5 hp and larger, the acceptable shaft alignment tolerances shall be as recommended in the pump manufacturer's written instructions and shall include parallel offset and angular gap measurements.

#### 1.04 STARTING EQUIPMENT AND SYSTEMS

- A. Where field testing and start-up services are called for in the Specifications, or when technical assistance is necessary as a result of any malfunction of the equipment or system furnished, the manufacturer's representative shall provide such services.
- B. Manufacturer's representative shall also conduct and/or assist with performance testing, as required by the Specifications. These services shall continue until such times as the applicable equipment or system has been successfully tested for performance and has been accepted by OWNER for full-time operation.
- C. Coordinate schedule for start-up of various equipment and systems. Coordination includes, but is not limited to, communication with subcontractors, suppliers, OWNER, and ENGINEER. CONTRACTOR shall confirm that all necessary work is complete and that the equipment and systems can be operated in conjunction with all associated processes.
- D. Notify ENGINEER and OWNER a minimum of 7 days prior to start-up of each item using the attached Equipment Startup and O&M Training Scheduling form. CONTRACTOR shall submit form to ENGINEER.
- E. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions that may cause damage.
- F. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- G. Verify wiring and support components for equipment are complete and tested.
- H. Execute start-up under supervision of applicable manufacturer's representative and CONTRACTOR's personnel in accordance with manufacturers' instructions.
- I. Require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up and to supervise

placing equipment or system in operation. Authorized representative shall provide approval for starting of systems in writing where specified.

- J. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start-up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report. In addition, CONTRACTOR shall submit a fully executed Certificate of Proper Installation form if required in Paragraph 3.01 of this section.

#### 1.05 DEMONSTRATION, INSTRUCTIONS, AND OPERATOR TRAINING

- A. For all mechanical equipment and systems and where called for in the Specifications, provide a qualified technical representative to provide detailed instructions to OWNER's personnel for operation and maintenance of equipment and associated instrumentation. Training services shall include pre-start-up classroom instruction and start-up on-site instruction, as stated in the Specifications.
- B. Refer to the Specifications for additional training requirements.
- C. CONTRACTOR shall coordinate the pre-start-up training periods with OWNER's operating personnel and manufacturers' representatives.
  - 1. Schedule training dates and times with OWNER, that are acceptable to the OWNER, using equipment, startup, and O&M training form. Normal hours available for training are between 7:30 A.M. to 3 P.M., Monday through Friday, except for holidays.
  - 2. Submit outline and presentation to ENGINEER at least 7 days in advance of training.
  - 3. Provide name, contact information, and brief synopsis of qualifications of the trainer.
  - 4. If materials above are not provided at least 7 days in advance, training may be canceled.
  - 5. Failure of supplier's or manufacturer's representative to appear for scheduled training, failure to notify OWNER 24 hours in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to OWNER for time lost by OWNER's personnel in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hour for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late, up to 1 hour, after 1 hour, training will be rescheduled. CONTRACTOR shall reimburse OWNER via a change order.
  - 6. During the training, instructor will dedicate its time solely to training and not start-up services.
  - 7. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with OWNER's personnel in detail to explain all aspects of operation and maintenance.
  - 8. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment.
  - 9. Prepare and insert additional data in operation and maintenance manuals when need for additional data becomes apparent during instruction.
  - 10. OWNER may videorecord the training for future internal use. Provide to OWNER paper and electronic copies of any media used as part of training.
  - 11. Provide training handouts for each of OWNER's personnel present.

12. Provide one follow-up on-site training session to be scheduled for about one month following OWNER's initial use of new equipment. This shall include each new UV system and new submersible pumps provided in this Contract.
- D. CONTRACTOR shall provide attached Certificate of Operator Training cosigned by OWNER and supplier's representative verifying training was accomplished to satisfaction of all parties.
- E. Operation and maintenance manual submitted in accordance with Section 01 33 00—Submittals shall be provided prior to operator training.
- F. For equipment or systems requiring seasonal operation, perform demonstration for dormant season at start of dormant season.
- G. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to OWNER's satisfaction.
- H. Where items of equipment are placed into service at different times or sequence, manufacturer's services for start-up, field testing, and supervision shall be provided for each time or sequence. Training shall be provided prior to or at the time the first similar item of equipment is placed in service.

#### 1.06 START-UP AND TESTING

- A. Prior to acceptance of any portion of the Work, start-up and testing of all equipment and testing of all materials furnished on the Project by CONTRACTOR shall have been conducted in the presence of representatives of CONTRACTOR, OWNER, and ENGINEER and also manufacturer if requested by OWNER or ENGINEER.
- B. CONTRACTOR shall provide whatever temporary installations and conditions are necessary in order to perform start-up and testing operations on all equipment and materials furnished under the Contract. Temporary connections and equipment necessary during start-up and testing operations shall include, but not be limited to, temporary piping and electrical power and control equipment and devices, temporary connection from various parts of the systems and any other labor, materials, fuel, devices, or items that may be required for start-up and testing operations. Temporary conditions shall include filling with water, if necessary, to check equipment and materials.
- C. All temporary installations and conditions shall be removed by CONTRACTOR upon completion of start-up and testing.

### PART 2—PRODUCTS

NOT APPLICABLE

### PART 3—EXECUTION

#### 3.01 EQUIPMENT SYSTEMS REQUIRING CERTIFICATION OF PROPER INSTALLATION

- A. All space and process related heating, cooling, and ventilation equipment and systems specified in Division 23.

- B. Section 26 09 00—Controls and Instrumentation.
- C. Section 26 32 13—Standby Power System West Hickman WTP.
- D. Section 26 36 23—Automatic Transfer Switches.
- E. Section 40 05 59.23—Slide Gates.
- F. All equipment specified in Divisions 43 and 46.

### 3.02 EQUIPMENT SYSTEMS REQUIRING ADDITIONAL DOCUMENTATION

- A. Section 26 09 00—Controls and Instrumentation: Documented date(s) of CONTRACTOR written request for On-Site Acceptance Test.

END OF SECTION

TS No. \_\_\_\_\_

EQUIPMENT START-UP AND O&M TRAINING SCHEDULING FORM  
STRAND ASSOCIATES, INC.®

PROJECT \_\_\_\_\_ CLIENT \_\_\_\_\_

CONTRACT \_\_\_\_\_

CONTRACTOR \_\_\_\_\_ Date: \_\_\_\_\_

The following equipment is scheduled for start-up on \_\_\_\_\_

EQUIPMENT NAME: \_\_\_\_\_ SPECIFICATION SECTION: \_\_\_\_\_

MANUFACTURER: \_\_\_\_\_ MINIMUM HOURS OF TRAINING: \_\_\_\_\_

DATE O&M MANUALS SUBMITTED: \_\_\_\_\_

Specification Section 01 91 00 requires that start-up and operation and training be conducted by a qualified manufacturer's representative prior to placing equipment in operation. Review Specification Sections 01 33 00 and 01 45 00 and the individual equipment sections for start-up and training requirements. OWNER may find it necessary to propose alternate dates for training based on conflicts with other training and staff availability. The Operation and Maintenance Manuals must be submitted prior to training.

After the equipment or system has been properly installed and is functioning correctly, submit a written report in accordance with Specification Section 01 45 00.

Submit the completed form to ENGINEER and OWNER at least 7 days prior to start-up and training.

Proposed Training Date: \_\_\_\_\_ Time of Training: \_\_\_\_\_

Factory-trained representative giving training:

Name(s): \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_

## CERTIFICATE OF PROPER INSTALLATION

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\_\_\_\_\_

This form shall be completed and submitted to ENGINEER prior to OWNER training.



## CERTIFICATE OF OPERATOR TRAINING

Project\_\_\_\_\_

Equipment\_\_\_\_\_

Specification Section\_\_\_\_\_

Contract\_\_\_\_\_

I hereby certify the equipment supplier/manufacture has instructed OWNER's personnel in the start-up operation and maintenance of this equipment as required in the Specifications.

### MANUFACTURER'S REPRESENTATIVE

Signature\_\_\_\_\_Date\_\_\_\_\_

Name (print)\_\_\_\_\_

Title\_\_\_\_\_

Representing\_\_\_\_\_

### CONTRACTOR

Signature\_\_\_\_\_Date\_\_\_\_\_

Name (print)\_\_\_\_\_

Title\_\_\_\_\_

### OWNER

I hereby state that my operating personnel received instruction for start-up, operation, and maintenance of this equipment.

Signature\_\_\_\_\_Date\_\_\_\_\_

Name (print)\_\_\_\_\_

Title\_\_\_\_\_

END SECTION

## PERMITS



**Andy Beshear**  
GOVERNOR

**ENERGY AND ENVIRONMENT CABINET**  
**DEPARTMENT FOR ENVIRONMENTAL PROTECTION**

300 Sower Boulevard  
Frankfort, Kentucky 40601  
Phone: (502) 564-2150  
Fax: 502-564-4245

**Rebecca W. Goodman**  
SECRETARY

**Anthony R. Hatton**  
COMMISSIONER

July 3, 2024

Mr. Charles H Martin  
LFUCG  
125 Lisle Industrial Ave Ste 180  
Lexington, KY 40511

Re: Town Branch UV Disinfection Process Replacement  
Fayette County, Kentucky  
Lexington Town Branch WWTP  
Activity ID #: 1073, APE20230035  
Receiving Treatment Plant KPDES #: KY0021491

Dear Mr. Martin:

We have reviewed the plans and specifications for the above referenced project. The plans include the construction of a UV disinfection system with a temporary peracetic acid installation to be utilized during construction. The UV disinfection system consists of:

- Installation of complete UV disinfection system and all related appurtenances
- 2 UV channels
- 5 UV banks per channel
- Removal and replacement of non-potable water pumps
- 4 submersible pumps capable of 400 gpm at 240 ft TDH each
- New chemical feed systems for non-potable water
- All associated yard piping and appurtenances

This is to advise that plans and specifications for the above referenced project are APPROVED with respect to sanitary features of design, as of this date with the requirements contained in the attached construction permit.

If we can be of any further assistance or should you wish to discuss this correspondence, please do not hesitate to contact Daniel Kulik at 502-782-6998.

Sincerely,

---

Terry Humphries, P.E.  
Supervisor, Engineering Section  
Water Infrastructure Branch  
Division of Water

TH / DK  
Enclosures

c: Fayette County Health Department  
Strand Associates Inc  
Division of Plumbing

## Wastewater Treatment Plant Construction

Lexington Town Branch WWTP

Facility Requirements

Activity ID No.:APE20230035

Page 1 of 3

### TRMT0000000006 (Town Branch UV Disinfection Process Replacement) UV Disinfection Process Replacement:

#### Submittal/Action Requirements:

Condition No.	Condition
S-1	When the construction of the system is completed, the permittee shall submit written certification: Due 30 calendar days after Completion of Construction to the Division of Water that the facilities have been constructed and tested in accordance with the approved plans and specifications and the above approval conditions. Such certification shall be signed by a registered professional engineer. Failure to certify may result in penalty assessment and/or future approvals being withheld. [401 KAR 5:005 Section 24(2)]

#### Narrative Requirements:

Condition No.	Condition
T-1	Facilities, except extended aeration package WWTPs with an average daily design capacity less than 100,000 gpd, shall be designed in accordance with the "Recommended Standards for Wastewater Facilities" of the Great Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers, commonly referred to as "Ten States' Standards", 2014 edition. [401 KAR 5:005 Section 7(1)(a)]
T-2	The permit is issued to the applicant and the permittee shall remain the responsible party for compliance with all applicable statutes and administrative regulations until a notarized applicable change in ownership certification is submitted and the transfer of ownership is acknowledged by the cabinet. [401 KAR 5:005 Section 24(3)]
T-3	Construction is limited to the following: Town Branch UV Disinfection Process Replacement - Installation of complete UV Disinfection system and all related appurtenances - 2 UV channels - 5 UV Banks per Channel - Removal and replacement of non-potable water pumps - 4 submersible pumps capable of 400 gpm at 240 ft TDH each - New chemical feed systems for nonpotable water. [401 KAR 5:005 Section 1]
T-4	There shall be no deviations from the plans and specifications submitted with the application or the conditions specified unless authorized in writing by the cabinet. [401 KAR 5:005 Section 24(4)(b)1]

## Wastewater Treatment Plant Construction

Lexington Town Branch WWTP

Facility Requirements

Activity ID No.:APE20230035

Page 2 of 3

### TRMT0000000006 (Town Branch UV Disinfection Process Replacement) UV Disinfection Process Replacement:

#### Narrative Requirements:

Condition No.	Condition
T-5	The issuance of a permit by the cabinet does not convey any property rights of any kind or any exclusive privilege. [401 KAR 5:005 Section 24(6)]
T-6	All rights of inspection by representatives of the Division of Water are reserved. [401 KAR 5:005 Section 24(4)(a)]
T-7	A water supply with suitable backflow preventer shall be provided to facilitate cleaning and maintenance of the wastewater treatment plant. [401 KAR 5:005 Section 10 (6)]
T-8	Fencing and/or other adequate protection shall be provided around the wastewater treatment plant. [401 KAR 5:005 Section 10(7)]
T-9	An all-weather access road shall be provided to the wastewater treatment plant. [401 KAR 5:005 Section 10(8)]
T-10	Water quality standards govern the treatment requirements; the following standards apply: a. Dissolved Oxygen in the stream; 5 mg/l or higher. b. Un-ionized Ammonia in the stream; 0.05 mg/l or less. [401 KAR 10:031 Section 4]
T-11	The permittee shall ensure that the effluent is of satisfactory quality to prevent violations of the standards in 401 KAR Chapter 5. If violations of the standards of 401 KAR Chapter 5 result from the discharge of the treated effluent, the owner shall provide additional treatment or an extension of the effluent line. [401 KAR 5:005 Section 24(4)(c)1]
T-12	Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits or licenses required by this Division of Water and other state, federal, and local agencies. [401 KAR 5:005 Section 24(4)(c)3]
T-13	Additional effluent limitations and water quality standards are contained in the Division of Water Regulations. [401 KAR 5:005 Section 24(4)(a)]
T-14	The division will review the reported monthly flows and organic loads for the most recent twelve (12) months for the Wastewater Treatment Plant (WWTP). If the lowest monthly flow or associated organic loads exceed ninety (90) percent of the WWTP's design capacity, the division may deny the approval of any sewer line extension until the owner of the WWTP commits to address the potential overload condition. [401 KAR 5:005 Section 9]
T-15	A permit to construct a facility shall be effective upon issuance unless otherwise conditioned. Construction shall be completed within twenty-four (24) months. If construction is not commenced within the twenty-four (24) months following a permit's issuance, a new permit shall be obtained before construction may begin. [401 KAR 5:005 Section 24(1)]

## Wastewater Treatment Plant Construction

Lexington Town Branch WWTP

Facility Requirements

Activity ID No.:APE20230035

Page 3 of 3

**TRMT0000000006 (Town Branch UV Disinfection Process Replacement) UV Disinfection Process Replacement:**

### Narrative Requirements:

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Condition No.	Condition
T-16	The Construction Permit is effective on July 3, 2024 and expires on July 3, 2026. [401 KAR 5:005 Section 24(1)]

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**Andy Beshear**  
GOVERNOR

**ENERGY AND ENVIRONMENT CABINET**  
**DEPARTMENT FOR ENVIRONMENTAL PROTECTION**

300 Sower Boulevard  
Frankfort, Kentucky 40601  
Phone: (502) 564-2150  
Fax: 502-564-4245

**Rebecca W. Goodman**  
SECRETARY

**Anthony R. Hatton**  
COMMISSIONER

July 15, 2024

Charlie Martin, PE  
LFUCG  
301 Lisle Industrial Ave  
Lexington, KY 40511

Re: West Hickman UV Disinfection Process Replacements  
Jessamine County, Kentucky  
Lexington West Hickman WWTP  
Activity ID #: 2295, APE20230014  
Receiving Treatment Plant KPDES #: KY0021504

Dear Charlie Martin:

We have reviewed the plans and specifications for the above referenced project. The plans include:

- o Installation of complete UV disinfection system and all related appurtenances
- o 4 UV channels
- o 3 UV banks per channel
- o Chlorine Contact Tank will be changed into Post Aeration Tanks
- o New chemical feed systems for non-potable water
- o All associated yard piping and appurtenances.

This is to advise that plans and specifications for the above referenced project are APPROVED with respect to sanitary features of design, as of this date with the requirements contained in the attached construction permit.

If we can be of any further assistance or should you wish to discuss this correspondence, please do not hesitate to contact Daniel Kulik at 502-782-6998.

Sincerely,

Terry Humphries, P.E.  
Supervisor, Engineering Section  
Water Infrastructure Branch  
Division of Water

TH / DK  
Enclosures

c: Jessamine County Health Department  
Strand Associates Inc  
Division of Plumbing

## Wastewater Treatment Plant Construction

Lexington West Hickman WWTP

Facility Requirements

Activity ID No.:APE20230014

Page 1 of 3

### TRMT0000000007 (West Hickman UV Disinfection Process Replacement) West Hickman UV Disinfection Process Replacement:

#### Limitation Requirements:

Condition No.	Parameter	Condition
L-1	Flow, in conduit or thru treatment plant	The design capacity of the WWTP is based on the following: Flow, in conduit or thru treatment plant $\leq$ 33.8 MGD (MA) Daily average. [401 KAR 5:005 Section 24(4)(a)] This requirement is applicable during the following months: All Year. Statistical basis: Daily average.
L-2	Oxygen, Dissolved	Effluent: Oxygen, Dissolved $\geq$ 7 mg/L. [401 KAR 10:031 Section 4] This requirement is applicable during the following months: All Year. Statistical basis: Monthly average (AV).

#### Submittal/Action Requirements:

Condition No.	Condition
S-1	When the construction of the system is completed, the permittee shall submit written certification: Due 30 calendar days after Completion of Construction to the Division of Water that the facilities have been constructed and tested in accordance with the approved plans and specifications and the above approval conditions. Such certification shall be signed by a registered professional engineer. Failure to certify may result in penalty assessment and/or future approvals being withheld. [401 KAR 5:005 Section 24(2)]

#### Narrative Requirements:

Condition No.	Condition
T-1	Facilities, except extended aeration package WWTPs with an average daily design capacity less than 100,000 gpd, shall be designed in accordance with the "Recommended Standards for Wastewater Facilities" of the Great Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers, commonly referred to as "Ten States' Standards", 2014 edition. [401 KAR 5:005 Section 7(1)(a)]
T-2	The permit is issued to the applicant and the permittee shall remain the responsible party for compliance with all applicable statutes and administrative regulations until a notarized applicable change in ownership certification is submitted and the transfer of ownership is acknowledged by the cabinet. [401 KAR 5:005 Section 24(3)]



## Wastewater Treatment Plant Construction

Lexington West Hickman WWTP

Facility Requirements

Activity ID No.:APE20230014

Page 2 of 3

### TRMT0000000007 (West Hickman UV Disinfection Process Replacement) West Hickman UV Disinfection Process Replacement:

#### Narrative Requirements:

Condition No.	Condition
T-3	Construction is limited to the following: <ul style="list-style-type: none"><li>• UV Disinfection Process Replacement<ul style="list-style-type: none"><li>o Installation of complete UV disinfection system and all related appurtenances</li><li>o 4 UV channels</li><li>o 3 UV banks per channel</li><li>o Chlorine Contact Tank will be change into Post Aeration Tanks</li><li>o New chemical feed systems for nonpotable water</li><li>o All associated yard piping and appurtenances. [401 KAR 5:005 Section 1]</li></ul></li></ul>
T-4	There shall be no deviations from the plans and specifications submitted with the application or the conditions specified unless authorized in writing by the cabinet. [401 KAR 5:005 Section 24(4)(b)1]
T-5	The issuance of a permit by the cabinet does not convey any property rights of any kind or any exclusive privilege. [401 KAR 5:005 Section 24(6)]
T-6	All rights of inspection by representatives of the Division of Water are reserved. [401 KAR 5:005 Section 24(4)(a)]
T-7	A water supply with suitable backflow preventer shall be provided to facilitate cleaning and maintenance of the wastewater treatment plant. [401 KAR 5:005 Section 10 (6)]
T-8	Fencing and/or other adequate protection shall be provided around the wastewater treatment plant. [401 KAR 5:005 Section 10(7)]
T-9	An all-weather access road shall be provided to the wastewater treatment plant. [401 KAR 5:005 Section 10(8)]
T-10	Water quality standards govern the treatment requirements; the following standards apply: <ul style="list-style-type: none"><li>a. Dissolved Oxygen in the stream; 5 mg/l or higher.</li><li>b. Un-ionized Ammonia in the stream; 0.05 mg/l or less. [401 KAR 10:031 Section 4]</li></ul>
T-11	The permittee shall ensure that the effluent is of satisfactory quality to prevent violations of the standards in 401 KAR Chapter 5. If violations of the standards of 401 KAR Chapter 5 result from the discharge of the treated effluent, the owner shall provide additional treatment or an extension of the effluent line. [401 KAR 5:005 Section 24(4)(c)1]

## Wastewater Treatment Plant Construction

Lexington West Hickman WWTP

Facility Requirements

Activity ID No.:APE20230014

Page 3 of 3

### TRMT0000000007 (West Hickman UV Disinfection Process Replacement) West Hickman UV Disinfection Process Replacement:

#### Narrative Requirements:

Condition No.	Condition
T-12	Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits or licenses required by this Division of Water and other state, federal, and local agencies. [401 KAR 5:005 Section 24(4)(c)3]
T-13	Additional effluent limitations and water quality standards are contained in the Division of Water Regulations. [401 KAR 5:005 Section 24(4)(a)]
T-14	The division will review the reported monthly flows and organic loads for the most recent twelve (12) months for the Wastewater Treatment Plant (WWTP). If the lowest monthly flow or associated organic loads exceed ninety-five (95) percent of the WWTP's design capacity, the division may deny the approval of any sewer line extension until the owner of the WWTP commits to address the potential overload condition. [401 KAR 5:005 Section 9]
T-15	A permit to construct a facility shall be effective upon issuance unless otherwise conditioned. Construction shall be commenced within twenty-four (24) months. If construction is not commenced within the twenty-four (24) months following a permit's issuance, a new permit shall be obtained before construction may begin. [401 KAR 5:005 Section 24(1)]
T-16	The Construction Permit is effective on July 15, 2024 and expires on July 15, 2026. [401 KAR 5:005 Section 24(1)]

## SECTION 02 41 00

### DEMOLITION

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: All demolition, removal, and salvage work as shown on the drawings or specified herein to include, but not necessarily limited to the following:
  - 1. Town Branch:
    - a. Chlorine contact tank walls and walkways as shown on the Drawings.
    - b. Non-potable water station pumps.
    - c. Decant pipe.
    - d. Slide gates as shown on the Drawings.
    - e. Non-potable water valves as shown on the Drawings.
  - 2. West Hickman:
    - a. Chlorine contact tank walls as shown on the Drawings.
    - b. Cascade steps as shown on the Drawings.
    - c. Decant pipe.
    - d. Effluent weir.
    - e. Chlorination building scales, railing, chlorine tanks, and control equipment.
    - f. Scum line as shown on the Drawings.
    - g. Motor control centers and variable frequency drives, where shown on the Drawings.
    - h. Electrical conduit and conductors where shown on the Drawings.
    - i. Diffusers as shown on the Drawings.
    - j. Air piping as shown on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. CONTRACTOR shall submit permits and notices, if required, authorizing building demolition.

##### 1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform demolition, removal, and salvage in conformity with applicable federal, state, and local safety practices and code requirements.
- B. CONTRACTOR shall contact all public utilities and shall shut off, cut and cap all utility services in accordance with utility requirements, codes, rules and regulations.
- C. Obtain and pay for all necessary permits, licenses and certificates required.

##### 1.04 SEQUENCE

- A. No demolition, removal, or salvage work shall commence until approval to proceed has been granted by OWNER. Such work shall be completed in accordance with the construction sequence included in Division 01 of these specifications and in accordance with the construction phases of this project and work to be done by other contractors.

## PART 2-PRODUCTS

### 2.01 GENERAL

- A. Compacted fill shall meet the requirements of Section 31 23 00-Excavation, Fill, Backfill, and Grading.
- B. Pipe fittings and materials shall meet the requirements of Section 33 00 10-Buried Piping and Appurtenances and Section 40 05 00-Piping and Appurtenances.

## PART 3-EXECUTION

### 3.01 BREAKING DOWN AND REMOVING STRUCTURES

- A. General:
  - 1. All existing structures, with all attached parts and connections, shown on the drawings or specified to be removed or that interfere with the new construction, shall be entirely removed within the limits shown or specified, unless otherwise provided.
  - 2. When a portion of any existing structure is to be retained, CONTRACTOR shall take care during construction operations so as not to impair the value of the retained portion.
    - a. Complete all operations necessary for the removal of any existing structure which might endanger the new construction prior to the construction of the new work.
    - b. Do not use any equipment or devices which might damage structures, facilities, or property which are to be preserved and retained.
  - 3. When existing reinforcing is exposed at the surface of removal areas, CONTRACTOR shall burn back the reinforcing bars 2 inches and patch with nonshrink grout, unless noted otherwise.
- B. Pavement, Curb, Gutter, Sidewalk, Driveways, Crosswalk, and Similar Structures:
  - 1. Where portions of the existing structure are to be left in the surface of the finished work, CONTRACTOR shall remove the structure to an existing joint, or saw and chip the structure to a true line.
  - 2. Sufficient removal shall be made to provide for proper grades and connections in the new work.
- C. Walls, Piers, Surface Drains, Foundations, and Similar Masonry Structures:
  - 1. Remove entirely or break down to an elevation at least 2 feet below the earth subgrade within the areas of a road bed and elsewhere to 2 feet below the finished slopes or natural ground, as the case may be.
  - 2. Remove existing construction as required to clear new construction.
- D. Pipe Culverts:
  - 1. Remove entirely all culverts that are to be removed, except as hereinafter provided for closing culverts.
  - 2. Remove sidewalls or substructure units in water to an elevation no higher than the elevation of the natural stream or lake bed.
    - a. Where grading of the channel is required, remove such units to the proposed finished grade of the stream or lake bed.
    - b. Remove all other endwalls or substructure units down to at least 2 feet below natural or finished ground line, as the case may be.

3. Where existing culverts are to be extended or otherwise incorporated into the new work, remove only such part or parts of the existing culvert as necessary to provide a proper connection to the new work.
4. Remove pipe culverts designated for salvage in a manner that will preclude damage to the culverts.
5. Closing culverts:
  - a. A culvert may be closed instead of being removed if the following conditions apply:
    - (1) If the diameter of the culvert is less than 48 inches.
    - (2) If the top thereof does not come within 5 feet of the elevation of the finished grade line.
    - (3) If the culvert is in suitable condition.
  - b. Remove the headwall and such parts as would be within 2 feet of the finished grade line.
  - c. Completely fill each end of the culvert with concrete for a distance from each end of at least 2 feet plus the height of the opening of the structure.

### 3.02 ABANDONING STRUCTURES

- A. Tanks, Manholes, Catch Basins, and Inlets:
  1. CONTRACTOR shall thoroughly clean structures to be abandoned.
  2. CONTRACTOR shall plug existing pipe connections with brick or concrete block masonry or with any grade of concrete having a 28-day compressive strength in excess of 2,000 psi.
  3. CONTRACTOR shall remove the walls of the structures to an elevation at least 2 feet below the finished grade line, or to such elevation that may be designated on the drawings or as necessary to clear new construction.

### 3.03 ABANDONING AND REMOVING UTILITIES AND UNDERGROUND PROCESS PIPING

- A. CONTRACTOR shall be responsible for the turning off or unhooking of all utilities and process piping before starting the demolition work. Remove all utility lines, including electrical services and process piping that are shown or specified to be removed. Remove utility lines that are to be abandoned as needed to clear new construction.
- B. The ends of utility lines and process piping shown or specified to be abandoned that are exposed by excavation shall be plugged with concrete to prevent soil infiltration into the pipes.

### 3.04 EQUIPMENT

- A. CONTRACTOR shall remove all equipment specified herein or indicated.
- B. CONTRACTOR shall remove associated exposed conduit, power wiring, controls, switches, instrumentation, control wiring, control boxes, appurtenances, and their supports serving equipment to be removed. Electrical items shall be removed to their junction with motor control center, control panel, or their junction with conduit serving other equipment that is to remain.
- C. CONTRACTOR shall remove all piping and appurtenances and their supports serving equipment indicated to be removed. Piping shall be removed to its junction with the main service header serving other equipment that is to remain or new equipment as indicated.

Remaining piping and tubing shall be fitted with an appropriate blind flange or plug and insulated as required.

- D. CONTRACTOR shall remove equipment bases, anchor bolts, and other supports serving equipment to be removed. Concrete bases shall be removed to 1 inch below floor elevation and repaired with nonshrink grout plus surfacing to match existing.
- E. CONTRACTOR shall patch floors, walls, and ceilings as required to match existing or as indicated where equipment, piping, electrical, bases, or supports are removed.
- F. CONTRACTOR shall remove the following major equipment items or systems. The following list is not intended to be all-inclusive. CONTRACTOR shall remove all items indicated or specified to be removed.
  - 1. Non-potable water pumps and variable frequency drive equipment.
  - 2. MCC-B and MCC-H.
  - 3. Chlorine building meter panel and termination cabinets.

### 3.05 INTERIOR PIPING, DUCTWORK, AND APPURTENANCES

- A. CONTRACTOR shall remove all piping, ductwork, and appurtenances as indicated. The location and elevations of existing piping are approximate.
- B. CONTRACTOR shall remove all supports for piping, ductwork, and appurtenances indicated to be removed. Repiping and connections to new piping shall be as specified for new piping. Remaining piping and tubing, not reconnected for new piping, shall be fitted with an appropriate blind flange or plugged and insulated as required.
- C. CONTRACTOR shall patch all holes resulting from removal of piping, ductwork, appurtenances, and their supports. Patching of concrete shall be with nonshrink grout and as indicated. Patching of masonry shall be with matching material toothed in. Patch other material as indicated.

### 3.06 SALVAGE

- A. OWNER has first right of refusal to all material, piping, and equipment removed.
- B. All equipment, material, and piping, except as specified hereinafter, within the buildings and structures to be demolished and additional items as noted shall be removed by CONTRACTOR. CONTRACTOR shall inspect each structure and determine the type and amount of equipment, materials, and piping to be removed.
- C. All equipment, material, and piping, except as specified hereinafter, within the limits of the demolition and additional items noted to be removed, will become the property of CONTRACTOR if OWNER does not claim under first right of refusal and shall be removed from the project site. Comply with State and local ordinances and regulations for disposing of materials.
- D. The following equipment and materials shall be removed and reused in the new facilities:
  - 1. Fine Bubble Diffusers.
  - 2. Twelve-inch Chlorine Drawoff piping and fittings.

- E. The following equipment and materials shall be removed and turned over to OWNER:
  - 1. PLCs.
  - 2. Actuator from Town Branch cascade bypass gate.

### 3.07 BACKFILL

- A. CONTRACTOR shall fill all abandoned structures and excavations resulting from removal of structures and utilities with compacted fill. See Section 31 23 00—Excavation, Fill, Backfill, and Grading for required degree of compaction.
- B. Prior to filling, CONTRACTOR shall break one opening in the floor or wall near the base of each compartment to allow groundwater to freely migrate through the structure.

END OF SECTION

SECTION 03 11 00  
CONCRETE FORMWORK

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Forms for cast-in-place concrete.
  - 2. Form accessories.
  - 3. Openings for other work.
  - 4. Form stripping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 117–Tolerances for Concrete Construction.
- B. ACI 301–Structural Concrete for Buildings.
- C. ACI 318–Building Code Requirements for Reinforced Concrete.
- D. ACI 347–Recommended Practice for Concrete Formwork.
- E. PS1–Construction and Industrial Plywood.

1.03 DESIGN

- A. All formwork shall comply with ACI 347 and ACI 301.
- B. CONTRACTOR shall assume the responsibility for the complete design and construction of the formwork.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00–Submittals for form ties, form coatings, form liners (if any), and any other form accessories.
- B. Submit geometry of forms for circular structures.

PART 2–PRODUCTS

2.01 FORMS

- A. Forms shall be of wood, plywood, steel, fiberboard lined, or other approved materials which will produce concrete which meets the specified requirements. The type, size, quality, and shape of all materials of which the forms are made are subject to the review of ENGINEER.



- B. Caution shall be exercised in the use of wood or composition forms or form liner to be certain that no chemical reaction will take place which causes a damaging effect on the concrete surface.

## 2.02 FORM TIES–NONREMOVABLE

- A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the tie shall be adjustable in length. Ties shall have cones on the water side of water-containing structures. Ties shall also have cones on the exterior side of all structures which have PVC water-stopped construction joints. Ties shall provide a positive disconnection on both ends 1 to 1 1/2 inches inside the finished face of the concrete.
- B. All wall ties used in the placement of structures which have PVC or hydrophilic water-stopped construction joints shall contain integral waterstops. All such ties shall be crimped or deformed in such a manner that the bond between concrete and tie cannot be broken in removal of the outer units. This portion of the tie shall not be removed prior to 24 hours after completion of the concrete placement.
- C. The use of wood spacers and wire ties will not be approved.

## 2.03 FORM TIES–REMOVABLE

- A. Taper ties which are designed to be removed entirely from the wall may be used with forms designed for this tie type and spacing.
- B. Tie holes shall be plugged with either a neoprene plug, Sure-Plug by Dayton Superior, Inc., or an EPDM rubber plug, X-Plug by Sika Greenstreak, or equal.
- C. Cementitious waterproofing material for patching taper tie holes shall be Hey Di K-11, Xypex Patch-N-Plug, or equal. Taper tie holes above the normal operating water surface shall be patched with mortar mix as specified in Section 03 30 00–Cast-In-Place Concrete for patching tie holes.

## 2.04 FORM COATINGS

- A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

## 2.05 CHAMFER STRIPS

- A. Provide 3/4-inch by 3/4-inch wood or plastic chamfer strips at all exposed corners, except as noted.

## 2.06 KEYWAYS

- A. Keyways shall be formed with wood inserts.

## PART 3-EXECUTION

### 3.01 CONSTRUCTION

- A. Forms shall conform to the shape, line, grade, and dimensions as shown on the drawings. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall support the loads and pressures without deflection from the prescribed lines. They shall be properly braced or tied together so as to maintain position and shape. Spacing of ties shall be recommended by the tie manufacturer.
- B. Formwork and finished concrete construction shall meet the tolerances specified in ACI 117.
- C. All exposed curved surfaces shall be formed to the continuous surface of the radius specified. Where segmented forms are proposed, a form system which deviates more than 3/8 inch from a circle through pan edges will not be allowed.
- D. Architectural surfaces and surfaces to be fitted with equipment shall be formed to match the shape intended. Where indicated on the drawings, the form shall be lined with minimum 3/8-inch masonite and shimmed as required.
- E. When forms are placed for successive concrete placement, thoroughly clean concrete surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.
- F. At the request of ENGINEER, temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before depositing concrete.
- G. Provide inserts and provide openings in concrete form work to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Securely support items to be built into forms.
- H. Provide top forms for inclined surfaces where the slope is too steep to place and vibrate concrete.
- I. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to allow for ease of removal. Inserts shall be securely held in place prior to concrete placement. Unless otherwise shown, chamfer strips shall be placed in the angles of the forms to provide 3/4-inch bevels at exterior edges and corners of all exposed concrete.
- J. The forms shall be oiled with a field-applied commercial form oil or a factory-applied nonabsorptive liner. Oil shall not stain or impede the wetting of surfaces to be cured with water or curing compounds. The forms shall be coated prior to placing reinforcing steel. Oil on reinforcement will not be permitted.
- K. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to review of ENGINEER.

### 3.02 FORM REMOVAL

- A. Supporting forms and shoring shall not be removed until the member has acquired sufficient strength to support its own weight and the construction live loads on it.
- B. All form removal shall be accomplished in such a manner that will prevent injury to the concrete.
- C. Forms shall not be removed before the expiration of the minimum times as stated below or until the concrete has attained its minimum 28-day design strength as confirmed by concrete cylinder tests, unless specifically authorized by ENGINEER.
  - 1. Wall and vertical faces: 24 hours.
  - 2. Columns: 24 hours.
  - 3. Beams and elevated slabs: 14 days.

END OF SECTION

## SECTION 03 20 00

### CONCRETE REINFORCEMENT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes providing complete, in-place, all steel and fibers required for reinforcement of cast-in-place concrete as shown on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. Applicable standards listed in this section include, but are not necessarily limited to the following:
  - 1. ACI 315—Manual of Standard Practice for Detailing Reinforced Concrete Structures.
  - 2. ACI 318—Building Code Requirements for Reinforced Concrete.
  - 3. ASTM A1064—Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - 4. ASTM A615—Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 5. ASTM A996—Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcing.
  - 6. ASTM C1116—Standard Specification for Fiber-Reinforced Concrete.
  - 7. CRSI—Manual of Standard Practice.

##### 1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Provide complete shop drawings of all material to be furnished and installed under this section:
  - 1. Before fabrication of the reinforcement is begun, CONTRACTOR shall obtain the approval of ENGINEER on reinforcing bar lists and placing drawings.
  - 2. These drawings and lists shall show in detail the number, size, length, bending, and arrangement of the reinforcing. Reinforcing supports shall also be located on the shop drawings.
  - 3. Shop drawings shall be in accordance with ACI 315.

##### 1.04 PRODUCT HANDLING

- A. Delivery:
  - 1. Deliver reinforcement to the job site bundled, tagged, and marked.
  - 2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Storage: Store reinforcement at the job site on blocks and in a manner to prevent damage and accumulation of dirt and excessive rust.

## PART 2-PRODUCTS

### 2.01 MATERIALS

- A. Reinforcing bars shall comply with ASTM A615 or A996 Type R, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.
- B. Steel wire and welded wire fabric shall comply with ASTM A1064. Fabric shall be provided in flat sheets. Rolled fabric shall not be used.
- C. Reinforcement supports including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be:
  - 1. Wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.
  - 2. For slabs on grade, supports with sand plates, or horizontal runners where base material will not support chair legs.
  - 3. For exposed-to-view concrete surfaces or where the concrete surface will be exposed to weather or moisture, where legs of supports are in contact with forms, supports with either hot-dipped galvanized or plastic protected legs.
  - 4. When supports bear directly on the ground and it is not practical to use steel bar supports, precast concrete blocks may be used to support only the bottom lift of reinforcement. The precast blocks must be solid, be of an equal or higher strength than the concrete being placed, must provide adequate support to the reinforcement, and be of proper height to provide specified reinforcing cover. The use of face bricks, hollow concrete blocks, rocks, wood blocks, or other unapproved objects will not be permitted.
- D. Fibrous Reinforcing:
  - 1. Fibrous concrete reinforcement shall be Fibermesh 300, manufactured by Propex Concrete Systems, or equal.
  - 2. Reinforcement shall be 100% virgin polypropylene fibrillated, multi-length graded fiber containing no reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.
  - 3. Physical Characteristics:
    - a. Specific Gravity: 0.91.
    - b. Fiber Length: Multidesign gradation.
- E. Mechanical Splices and Threaded Couplers:
  - 1. Mechanical splices shall be Zap Screwlok by Bar Splice Products, Inc., or equal.
  - 2. Threaded couplers and dowel bar replacements shall be Dowel Bar Splicer System by Dayton/Richmond, or equal.
  - 3. Mechanical splices and couplers shall be capable of developing at least 125% of the yield strength of the reinforcing bar.

### 2.02 FABRICATION

- A. General:
  - 1. Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances which comply with CRSI Manual.
  - 2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
  - 3. Unless otherwise shown on the Drawings, all end hook dimensions shall conform with "ACI Standard Hooks."

- B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work:
  - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
  - 2. Bend or kinks not indicated on Drawings or final shop drawings.
  - 3. Bar with reduced cross section because of excessive rusting or other cause.

## PART 3—EXECUTION

### 3.01 INSPECTION

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed.
- B. Correct conditions detrimental to the proper and timely completion of the work.
- C. Do not proceed until unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. General:
  - 1. Comply with the specified standards for details and methods of placing reinforcement and supports.
  - 2. Clean reinforcement to remove loose rust, mill scale, earth, and other materials which reduce or destroy bond with concrete.
- B. Placing Reinforcement:
  - 1. All reinforcing shall be placed in accordance with Contract Drawings and with shop drawings stamped and approved by ENGINEER.
  - 2. Position, support, and secure reinforcing against displacement by formwork, construction, or concrete placement operations.
  - 3. Support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as needed.
  - 4. Unless otherwise shown on the Drawings, the reinforcement is to be so detailed and placed as to allow the following concrete protection:
    - a. Three inches of cover where the concrete is placed directly against ground.
    - b. Two inches of cover where the concrete is placed in forms but is to be exposed to weather, liquid, or the ground.
    - c. One-inch cover in slabs and walls not exposed to weather, liquid, or the ground.
    - d. One and one-half-inch cover in beams, girders, and columns not exposed to weather, liquid, or the ground. This cover applies to beam stirrups and column ties where applicable.
  - 5. Reinforcement shall be positioned within  $\pm 3/8$  inch for members with depth to tension reinforcing from compression face less than or equal to 8 inches. Tolerance shall be  $\pm 1/2$  inch for members with depth to tension reinforcing from compression face greater than 8 inches. Tolerance on dimension between adjacent bars in slab and wall reinforcing mats shall be 1 inch. Secure against displacement by anchoring at the supports and bar intersections with wire or clips.
  - 6. Bars shall be securely tied at all intersections except where spacing is less than 1 foot in each direction when alternate intersections shall be tied. To avoid interference with embedded items, bar spacing may be varied slightly if acceptable to ENGINEER. Tack welding of reinforcing will not be permitted.
  - 7. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.

8. If reinforcing must be cut because of openings or embedded items in the concrete, additional reinforcing must be provided adjacent to the opening at least equal in cross sectional area to that reinforcing which was cut, and it shall extend a minimum of 36 bars diameters beyond the opening on each side or as shown on the Drawings. At sumps or depressions in slabs, bars shall be bent and/or extended under sumps or depressions.
  9. Wall reinforcing mats shall be secured in a vertical plane by providing clearance from forms with bar supports and by using Z-shaped bars at  $\pm 4$  feet on center wired between two mats of steel, spacing and staying both of them. Nails shall not be driven into the forms to support reinforcement and neither shall wire for this purpose come in contact with the forms. Alternate top transverse bars in slab shall be supported by individual bar chairs at approximately 3-foot 0-inch centers. Bottom longitudinal bars shall be supported by continuous bar chairs at approximately 4-foot 0-inch centers.
  10. If carrier bars are to be used, CONTRACTOR shall provide reinforcing bars for this purpose in addition to the reinforcing called for by the Drawings and Specifications.
- C. Reinforcement Supports:
1. Strength and number of supports shall be sufficient to carry reinforcement.
  2. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support.
  3. Do not use supports as bases for runways for concrete-conveying equipment and similar construction loads.
- D. Welded Wire Fabric:
1. Install welded wire fabric in as long of lengths as practicable.
  2. Lap adjoining pieces at least one full mesh.
  3. Fabric shall be supported with bar supports.
- E. Splices:
1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
  2. Lap splices in reinforcing shall be provided as shown on the Drawings. Where lap splice lengths are not shown on the Drawings, provide Class B, Category 1 lap splices in accordance with ACI 318.
  3. Adjacent splices of tangential bars in circular slabs and horizontal bars in circular walls shall be staggered a minimum of one full lap splice length or 3 feet, whichever is greater, unless otherwise shown. Stagger dimension shall be measured from center to center of lap splices.
  4. For circular walls, horizontal bar lap splices shall not coincide in vertical arrays more frequently than every third bar.
  5. Mechanical splices and threaded dowel bar inserts may be used where acceptable to ENGINEER.
- F. Embedded Items:
1. Allow other trades to install embedded items as necessary.
  2. Particularly after bottom layer of reinforcing is placed in slabs, allow electrical contractors to install conduit scheduled for encasement in slabs prior to placing upper layer of reinforcing.
- G. Minimum Reinforcing: Where reinforcing is not shown, provide a minimum of No. 4 at 8-inch centers each way in members 10 inches or less in thickness and No. 5 at 12-inch centers each way in each face in members greater than 10 inches thick.

H. Fibrous Reinforcing:

1. Fibrous concrete reinforcing shall be used in all building interior slab-on-grade concrete and all precast concrete topping, and where shown on the Drawings.
2. Add fibers at a minimum rate of 1.5 pounds per cubic yard.
3. Mix concrete in strict accordance with reinforcement manufacturer's recommendations.

END OF SECTION



SECTION 03 30 00  
CAST-IN-PLACE CONCRETE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. All cast-in-place concrete as shown except as noted otherwise.
  - 2. PVC and hydrophilic waterstops, expansion joint fillers, bonding agents, patching mortars, curing compounds, nonshrink grout, concrete topping, and other related items and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301—Specifications for Structural Concrete.
- C. ACI 304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 305R—Guide to Hot Weather Concreting.
- E. ACI 306R—Guide to Cold Weather Concreting.
- F. ACI 308—Specification for Curing Concrete.
- G. ACI 309—Guide for Consolidation of Concrete.
- H. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
- I. ASTM C31—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- J. ASTM C33—Standard Specification for Concrete Aggregates.
- K. ASTM C39—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C40—Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- M. ASTM C88—Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- N. ASTM C94—Standard Specification for Ready-Mixed Concrete.
- O. ASTM C143—Standard Test Method for Slump of Hydraulic-Cement Concrete.
- P. ASTM C150—Standard Specification for Portland Cement.

- Q. ASTM C156—Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.
- R. ASTM C172—Standard Practice for Sampling Freshly Mixed Concrete.
- S. ASTM C231—Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- T. ASTM C260—Standard Specification for Air-Entraining Admixtures for Concrete.
- U. ASTM C309—Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- V. ASTM C494—Standard Specification for Chemical Admixtures for Concrete.
- W. ASTM C595—Standard Specification for Blended Hydraulic Cements.
- X. ASTM C618—Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- Y. ASTM C652—Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
- Z. ASTM D994—Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- AA. ASTM D1752—Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

### 1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00—Submittals.
- B. Submit the following information:
  - 1. Gradation of fine and coarse aggregate—ASTM C33.
  - 2. Specific gravity and dry rodded density of each aggregate.
  - 3. Test of deleterious substances in fine and coarse aggregate—ASTM C33.
  - 4. Design mix of each individual concrete mix to be used.
  - 5. Previous test results or trial batch results with 7- and 28-day compressive strengths for each concrete mix proposed.
  - 6. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
  - 7. Brand, type, principal ingredient, and amount of each admixture to be used.
- C. It is important that the above data be submitted to ENGINEER well in advance of anticipated concreting operations to avoid any delay in construction.

## PART 2—PRODUCTS

### 2.01 CEMENT

- A. Cement shall be Portland cement Type I/II conforming to ASTM C150 or Portland limestone

cement Type IL conforming to ASTM C595. All cement shall be the product of one reputable manufacturer and mill.

- B. Cement shall be stored in a dry, weathertight, properly ventilated structure with the floor raised not less than 1 foot above the ground.

## 2.02 FLY ASH

- A. All fly ash used as an admixture in Portland cement or Portland limestone cement concrete shall be Class C or F conforming to the requirements of ASTM C618.

## 2.03 AGGREGATE

- A. All aggregates shall be washed and shall consist of natural sand, gravel, or crushed rock and shall have clean, hard, durable, uncoated grains of strong minerals. The amounts of deleterious substances present in the fine and coarse aggregate expressed in percentages by weight shall not exceed the following:

Deleterious Substance	Aggregate	
	Fine	Coarse
Clay Lumps and Friable Particles	3.0	3.0
Coal and Lignite	0.5	0.5
Mineral finer than No. 200 sieve	3.0	
Soft Fragments	3.0	3.0
Chert*	---	5.0
Sum of Chert and Clay Lumps		5.0

\* Material classified as chert and having a bulk specific gravity of less than 2.45. The percentage of chert shall be determined on the basis of the weight of chert in the sample retained on a 3/8-inch sieve divided by the weight of the total sample.

- B. The combined amount of all deleterious substances in an aggregate shall not exceed 5% of the weight of the aggregate.
- C. If requested by ENGINEER, sodium sulfate soundness tests (ASTM C88) shall be performed on the aggregate. When the aggregate is subjected to 5 cycles, the weight loss shall not exceed 12%. Samples of proposed aggregates shall be submitted to an independent laboratory for testing in advance of concrete work. All testing shall be performed in accordance with ASTM C33. Certified test results shall be submitted to ENGINEER confirming that aggregate complies with all stated specifications. Report shall identify source of aggregate and absorbed water.
- D. Fine aggregate shall be well-graded from coarse to fine and shall conform to the following requirements:

Percentage by Weight	
Passing 3/8-inch sieve	100
Passing No. 4 sieve	95-100
Passing No. 8 sieve	80-100
Passing No. 16 sieve	50-85
Passing No. 30 sieve	25-60

Percentage by Weight	
Passing No. 50 sieve	5-30
Passing No. 100 sieve	0-10

- E. Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. The fineness modulus shall be not less than 2.3 or more than 3.1, nor shall the fineness modulus of any sample vary by more than +0.20 from the fineness modulus of the representative sample used in proportioning the concrete.
- F. If requested by ENGINEER, fine aggregate shall be subjected to the color-metric test for organic impurities (ASTM C40) and shall not produce a color darker than Figure 1, unless they pass the mortar strength test. Aggregate producing color darker than Figure 2 shall not be used in any event.
- G. Coarse aggregate shall be well-graded from coarse to fine, and when tested by laboratory sieves having square openings, shall conform to the following requirements:

	Percentage by Weight Aggregate	
	3/4-Inch Stone	1 1/2-Inch Stone
Passing 2-inch sieve	---	100
Passing 1 1/2-inch sieve	---	90-100
Passing 1-inch sieve	100	20-55
Passing 3/4-inch sieve	90-100	0-15
Passing 3/8-inch sieve	20-55	0-5
Passing No. 4 sieve	0-10	---
Passing No. 8 sieve	0-5	---

- H. The 3/4-inch aggregate shall be used in concrete members no thinner than 4 inches and less than 10 inches thick. A blend of 3/4-inch and 1 1/2-inch aggregate shall be used in members 10 inches thick and thicker with the 3/4-inch aggregate comprising between 35% and 65% of the total coarse aggregate. When members thinner than 10 inches are placed monolithically with members thicker than 10 inches, the aggregate requirements for the thinner member shall apply.
- I. Aggregates must be allowed to drain for at least 12 hours before being used. The ground upon which aggregates are stored must be hard, firm, well-drained, and free from all vegetable matter. Various sizes of aggregates must be stored separately, and if they have become contaminated or merged with each other, they shall not be used.

## 2.04 WATER

- A. Water used in mixing concrete shall be clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious substances.

## 2.05 ADMIXTURES

- A. Water Reducing Admixture shall be Master Pozzolith® 200 by Master Builders Solutions, Daracem 19 by Grace, or equal. Water reducing admixture shall conform to ASTM C494, Type A and Type F. Water reducing admixture shall not reduce durability, shall increase strength 10%, and shall not affect bleeding characteristics over reference mix.

- B. Air-Entraining Admixture shall be equal to MasterAir® AE 90 by Master Builders Solutions, Darex by Grace Construction Products, or equal. Air-entraining admixture shall conform to ASTM C260.
- C. No other admixture will be allowed without written approval of ENGINEER. All admixture shall be compatible with cement, aggregate, and water used.

## 2.06 PROPORTIONING

- A. The proportions of aggregate to cement shall be such as to produce a workable mixture that can be thoroughly compacted and that will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the surfaces. The combined aggregates shall be such that when separated on the No. 4 sieve, the weight passing the sieve shall not be less than 30% nor greater than 50%.
- B. Concrete of various classes shall have the following maximum water/cement or water/(cement + fly ash) ratio minimum compressive strengths at 28 days and minimum cement and fly ash contents:

Class	Maximum Water/ Cement or Water/ (Cement+Fly Ash)	Minimum 28 Day Strength-Pounds per Square Inch	Cement Content-Pounds per Cubic Yard	Fly Ash- Pounds per Cubic Yard	
				Type C	Type F
A	0.45	4,000	564	---	---
A-FA	0.45	4,000	480	110	125
X	---	2,000	376	---	---

- C. Except as otherwise indicated on the Drawings or specified, all concrete shall be Class A or Class A-FA concrete.
- D. Concrete topping for UV Channel bottoms shall contain pea gravel, crushed stone, or other suitable coarse aggregate graded from 1/8 inch to 3/8 inch in addition to well-graded sand. Use six bags of Portland cement and 100 pounds of Class C fly ash per cubic yard. Not more than 35 gallons of mixing water per cubic yard, including free water in aggregate, shall be used. Minimum 28-day design strength shall be 4,000 psi. Provide similar mix with fibrous reinforcing added for concrete topping over precast plank.
- E. All concrete mixes shall be designed for a strength of 15% above that specified to allow for job variations. All mixes shall be designed in accordance with ACI 211.1 by a qualified concrete engineer or qualified laboratory technician. Required materials test data shall be submitted with design mixes for review and approval by ENGINEER. Mix computations shall be submitted if requested by ENGINEER.
- F. The slump for all concrete shall be 3 inches and concrete with a slump within the range of 2 to 3 1/2 inches will be acceptable unless otherwise stated.
- G. A water-reducing admixture shall be used in all concrete. A qualified representative of the manufacturer shall be available to assist in proportioning the concrete, advise on the proper addition of the admixture to the concrete, and advise on adjustments of concrete proportions to suit job conditions.

- H. An air-entraining admixture shall be used in all concrete except as noted. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between 4% to 7% by volume. An air-entraining admixture is not required for concrete patching and for concrete floors, equipment pads, and supports in interior heated buildings where the concrete will be protected from freezing during and after construction.
- I. CONTRACTOR shall submit to ENGINEER concrete cylinder compressive strength results from previous projects for the same concrete mixes proposed on the current project. If this information is not available, one cubic yard trial batches of each individual mix proposed for use shall be made prior to use in the work. Four test cylinders shall be made for each trial batch, two to be tested at 7 days and two at 28 days. The trial batches shall be made preceding actual placement operations so that the results of the 7-day tests can be obtained. All costs for material, equipment, and labor incurred during design of concrete mixes shall be borne by CONTRACTOR.
- J. All aggregates shall be measured by weight. The concrete mixer is to be equipped with an automatic water-measuring device that can be adjusted to deliver the desired amount of water.

## 2.07 WATERSTOPS

- A. Hydrophilic waterstop shall be a flexible hydrophilic natural rubber strip composed of nonvulcanized rubber and urethane polymer hydrophilic agent creating a moisture-activated, self-healing waterproofing compound.
- B. Hydrophilic waterstop shall be Adeka Ultraseal, or equal, products as follows:
  - 1. Construction Joints:
    - a. Wall/slab thickness greater than 9 inches with double mat of reinforcing: MC-2010MN (3/4 inch by 3/8 inch) with embedded stainless steel wire mesh for expansion control. The waterstop shall develop a minimum of 400 psi expansion pressure and withstand a minimum 150-foot hydrostatic head. Expansion amount shall not exceed 120%.
    - b. Wall/slab thickness between 4 inches and 9 inches with 1-inch minimum cover and single or double mat of reinforcing: KBA-1510FP (9/16 inch by 3/8 inch). Expansion amount shall not exceed 30%.
  - 2. Pipe Penetrations:
    - a. Wall/slab thickness between 4 inches and 9 inches and pipe diameter greater than 4 inches and less than or equal to 24 inches: KBA-1510FP (9/16 inch by 3/8 inch).
    - b. Wall/slab thickness greater than 9 inches with double mat of reinforcing and pipe diameter greater than 4 inches and less than or equal to 24 inches: MC-2005T (3/4 inch by 3/16 inch).
    - c. Wall/slab thickness greater than 9 inches with double mat of reinforcing and pipe diameter greater than 24 inches: MC-2010MN (3/4 inch by 3/8 inch) with embedded stainless steel wire mesh for expansion control.

## 2.08 JOINT FILLER

- A. Expansion joints shall have standard 1/2-inch-thick cork expansion joint filler, W. R. Meadows, or equal, meeting ASTM D1752–Type II. Exceptions to this are expansion joints in exterior concrete walks and between concrete walks and other structures which shall be asphalt expansion joint filler, 1/2-inch-thick, Grace, W.R. Meadows, or equal, meeting ASTM D994.

## 2.09 BONDING AGENT

- A. Bonding agent for bonding new concrete to existing concrete at construction joints and for bonding concrete overlays to existing concrete shall be a liquid latex product meeting ASTM C1059, Type II. Acceptable products include Euroweld 2.0 by Euclid Chemical, Acrylic Bonding Agent J40 by Dayton Superior, or equal.

## 2.10 PATCHING ADDITIVE

- A. Acceptable manufacturers include MasterEmaco® A 660 by Master Builders Solutions, Sonocrete by Sonneborn Contech Co., or equal.

## 2.11 NONSHRINK GROUT

- A. Acceptable manufacturers include Dayton Superior, Master Builders Solutions, or equal. Grout shall be nonshrink, nonmetallic and shall achieve a strength of 7,500 psi in 28 days.

## 2.12 POLYETHYLENE BEARING STRIP

- A. Polyethylene bearing strip for use where cast-in-place concrete elevated walkways bear on the concrete walls of the activated sludge tanks shall be comprised of two layers of dense extruded polyethylene sheet providing a static coefficient between concrete surfaces of 0.15.
- B. Acceptable products include Slipstrip2 by GCP Applied Technologies, Soltex Slip membrane by Solco, or equal.

# PART 3—EXECUTION

## 3.01 MIXING

- A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304R. In general, concrete shall be mixed 50 revolutions at plant, 20 upon arrival at site, and 20 each time water is added; maximum of 110 revolutions at mixing speed. Concrete shall be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates or the cement to the aggregates. Truck mixers shall be equipped with drum revolution counters. In no event shall concrete which has taken its initial set be allowed to be used. Retempering of concrete is not permitted.
- B. A representative of ENGINEER may be at the batching plant periodically to observe the batching and mixing.
- C. No water shall be added on the job unless required by CONTRACTOR and with the knowledge of ENGINEER; the amount of water, if added, shall be recorded on all copies of the delivery tickets. If water is added, CONTRACTOR shall verify that the required water-cement ratio is not exceeded.
- D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the jobsite.
- E. With each load of concrete, CONTRACTOR shall obtain delivery tickets and shall make these tickets available for review by ENGINEER. Delivery tickets shall provide the following information:

1. Date.
  2. Name of ready-mix concrete plant, job location, and CONTRACTOR.
  3. Type of cement and admixtures, if any.
  4. Specified cement content in sacks per cubic yard of concrete and approved concrete mix number or designation.
  5. Amount of concrete in load, in cubic yards.
  6. Water-cement ratio.
  7. Water added at job, if any.
  8. Truck number and time dispatched.
  9. Number of mixing drum revolutions.
- F. For job-mixed concrete, all concrete materials shall be mixed in a machine batch mixer for at least 1 1/2 minutes after all ingredients are in the mixer and shall continue until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. The mixer shall not be loaded beyond the capacity given by the manufacturer and shall be rotated at the speed recommended by the manufacturer. The mixer is to be provided with positive timing device that will positively prevent discharging the mixture until the specified mixing time has elapsed.

### 3.02 JOINTS

- A. CONTRACTOR shall place all joints as shown on the Drawings or specified herein. If acceptable to ENGINEER, CONTRACTOR may, at its own expense, place construction joints in addition to and at places other than those shown on the Drawings. Unless otherwise shown, all joints shall be straight, truly vertical or horizontal, and proper methods shall be employed to obtain this result.
- B. Where construction joints are not shown on the Drawings or specified elsewhere, CONTRACTOR shall provide construction joints in walls as follows:
1. Vertical construction joints at 60 feet on center maximum but not more than 15 feet from corners or intersections.
  2. Horizontal construction joints at 18 feet on center maximum for walls 12 inches or more in thickness.
  3. Horizontal construction joints of 8 feet on center maximum for walls 10 inches or less in thickness.
- C. Immediately after completion of the first pour at a joint, the concrete surface, reinforcement, and waterstop projecting beyond the joint shall be thoroughly cleaned and laitance removed. The waterstops shall not be disturbed after the concrete in the first pour at a joint has set. Concrete around waterstops shall be thoroughly compacted by hand spading and vibrating. Immediately before the second pour, all extraneous matter shall be removed from the joint, the waterstop and steel cleaned, and the surface thoroughly wetted.
- D. Concrete at all joints shall have been in place at least 48 hours before abutting concrete is placed. At least two hours must elapse after depositing concrete in columns or walls before depositing in beams, girders, or slab supported thereon. Beams, girders, brackets, column capital, and haunches shall be considered as part of the floor system and shall be placed integrally therewith.

### 3.03 WATERSTOPS

- A. Unless noted otherwise, PVC waterstops shall be provided at all expansion joints and at construction joints in floors and walls of structures exposed to ground or liquid on one side and occupied by personnel or nonsubmerged equipment on the other side.



- B. PVC waterstops shall be made continuous by splicing. Waterstops shall be spliced using a corner, tee, or cross splice, as applicable, at intersections. Waterstops shall be mitered to maintain the continuity of the ribs and center bulb. Splices shall be made using a hot metal plate or an electric splicer and full butt weld. Direct flame will not be allowed. Sample field-splices shall be submitted to ENGINEER for review prior to construction.
- C. PVC waterstops placed in all joints shall be securely held in place by an acceptable method or as shown on the Drawings. PVC waterstops shall be installed and secured prior to concrete placement. PVC waterstops shall not be inserted into wet concrete. No nails will be permitted through the waterstop. Great care shall be taken when concrete is placed so that the waterstop remains erect and is not bent over.
- D. Either hydrophilic or PVC waterstop shall be provided at all construction joints in liquid holding tanks and channels that are not adjacent to areas occupied by personnel and at joints between new and existing concrete. Waterstop shall be placed as shown on drawing details, if any, and in accordance with the manufacturer's recommendations. Where not shown on the Drawings, waterstops shall be approximately centered in walls and slabs.

#### 3.04 BONDING TO EXISTING CONCRETE

- A. When placing new concrete adjacent to existing concrete, the existing concrete shall be thoroughly roughened, cleaned, and saturated with water 24 hours before pouring new concrete. Existing concrete is defined as concrete more than six months old. At time of new pour, remove any standing water and apply bonding agent. Bonding agent shall be applied in accordance with manufacturer's recommendations.

#### 3.05 PATCHING EXISTING CONCRETE

- A. When patching existing concrete, remove poor concrete until firm hard concrete is exposed; roughen and clean surface of the existing concrete, clean any exposed reinforcing bars, and pour new concrete. Concrete finish shall match existing concrete. New concrete shall be 4,000 psi 28-day strength mixed with patching additive, mixed according to manufacturer's instructions. Concrete shall not be air-entrained.

#### 3.06 EMBEDDED ITEMS IN CONCRETE

- A. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.
- B. All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.
- C. Embedded items shall be positioned accurately and supported against displacement. Reinforcing bars shall clear embedded items a minimum of 2 inches.

#### 3.07 PLACING CONCRETE

- A. Before placing concrete, all equipment, forms, ground, reinforcements, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned of all debris, ice, and water. Ground shall be wetted prior to placement of concrete on it.
- B. After reinforcement is placed and before concrete is placed over it, ENGINEER shall be allowed sufficient time to observe the reinforcing.

- C. Unless otherwise authorized by ENGINEER, all concrete shall be placed in the presence of ENGINEER.
- D. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the segregation or loss of materials. Chuting for conveying purposes must be accomplished in such a manner as to prevent segregation or loss of materials. Receiving hoppers shall be installed at the chute discharge and at no point in its travel from the mixer to place of final deposit shall the concrete pass through a free vertical drop of more than 3 feet. Elephant trunks or tremies shall be used in all wall pours to prevent coating of forms and reinforcing bars.
- E. Care shall be taken to avoid an excess of water on the concrete surface. Excess water shall be drained or otherwise removed from the surface. Dry cement or a mixture of cement and sand shall not be sprinkled directly on the surface to absorb water.
- F. Concrete in wall and beam pours shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness. Each layer shall be well worked into the preceding layer while both layers are still soft.
- G. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation from rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. Once concreting is started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.
- H. All concrete shall be placed with the aid of mechanical vibrating equipment in accordance with ACI 309. In congested areas, vibration shall be supplemented by hand spading adjacent to the forms. Vibration should secure the desired results within 5 to 15 seconds at intervals of 18 inches apart maximum. The vibrator shall penetrate the preceding layer of concrete. Vibrators shall have a frequency of not less than 10,000 impulses per minute when in operation submerged in concrete.
- I. A sufficient number of spare vibrators shall be kept in ready reserve to provide adequate vibration in case of breakdown of those in use.
- J. In placing concrete in beams where it is intended to be continuous and monolithic with the slab above, a delay to provide for settlement of the deep concrete shall be scheduled before placing the upper concrete in the slab. The length of delay shall be as long as possible and still permit the revibration of the deep concrete.
- K. Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete pour has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- L. No extra payment will be allowed for dewatering, undercutting, and gravel fill.

### 3.08 MOIST CURING

- A. All concrete shall be maintained in a moist condition for at least 7 days after being deposited except that for high-early strength concrete, a 3-day period will be sufficient. Moist curing shall be accomplished by one of the following methods:

1. Wood forms left in place and kept wet at all times. If wood forms are not going to be kept wet or if metal forms are used, they shall be removed as soon as practicable and other methods of moist curing shall be started without delay.
  2. Use of a curing compound conforming to ASTM C309, Type I as approved by ENGINEER. Curing compound shall be applied at a uniform rate as indicated by the manufacturer sufficient to comply with the requirements of the test water retention of ASTM C156. Curing compound applied to vertical concrete surfaces after forms are removed shall be specially adapted to provide required coverage on the vertical surface. On nonformed surfaces, the curing compound shall be applied immediately after the disappearance of the water sheen after finishing of the concrete. Curing compound shall not be used on concrete surfaces that are to be painted, receive ceramic tile or resilient flooring, or be waterproofed. Care shall be taken not to get curing compound on construction joints, reinforcing steel, and other surfaces against which new concrete will be poured.
  3. Use of plastic film. Plastic film shall have a minimum thickness of 4 mils. It shall be placed over the wet surface of the fresh concrete as soon as possible without marring the surface and shall be weighted so that it remains in contact with all exposed surfaces of the concrete. All joints and edges shall be lapped and weighted. Any tears in the film shall be immediately repaired.
  4. Application of wet coverings weighing 9 ounces per square yard such as burlap, cotton mats, or other moisture-retaining fabrics. The covering system shall include two layers and shall be kept continuously moist so that a film of water remains on the concrete surface throughout the curing period.
  5. Use of an approved waterproof curing paper. Edges of adjacent sheets shall be overlapped several inches and tightly sealed.
  6. Ponding of water or continuous sprinkling of water is permitted. Sprinkling at intervals will not be permitted.
  7. Construction joints shall be moist cured by one of the methods listed above except by Method "2."
- B. The use of moist earth, sand, hay, or another method that may discolor hardened concrete will not be permitted.

### 3.09 HOT WEATHER CONCRETING

- A. When the atmospheric temperature exceeds 80°F during concrete placement, this section and ACI 305 shall apply in addition to all other sections of the specifications.
- B. The temperature of the delivered concrete shall not exceed 85°F.
- C. Care shall be exercised to keep mixing time and elapsed time between mixing and placement at a minimum. Ready-mix trucks shall be dispatched so as to avoid delay in concrete placement, and the work shall be organized to use the concrete promptly after arrival at the jobsite.
- D. The subgrade, forms, and reinforcing shall be sprinkled with cool water just prior to placement of concrete. Prior to placing concrete, there shall be no standing water or puddles on the subgrade.
- E. If approved by ENGINEER, an admixture for retarding the setting of the concrete may be used.
- F. Exposed concrete surfaces shall be carefully protected from drying. Continuous water curing is preferred. Curing compounds shall be white pigmented.

### 3.10 COLD WEATHER CONCRETING

- A. Conditions of this section shall apply, in addition to all other sections of the specifications, when placing concrete in cold weather. Cold weather is defined as a period when, for more than three successive days, the average daily temperature drops below 40°F. When temperatures above 50°F occur during more than half of any 24-hour period, the period will no longer be regarded as cold weather. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. Cold weather concreting shall conform to all requirements of ACI 306.1, except as modified by the requirements of these Specifications.
- B. Detailed procedures for the production, placement, protection, curing, and temperature monitoring of concrete during cold weather shall be submitted to ENGINEER. Cold weather concreting shall not begin until these procedures have been reviewed for conformance with ACI 306.1.
- C. All concrete materials, forms, ground, mixing equipment, and other surfaces with which the concrete is to come in contact shall be free from frost, and the temperature of contact surfaces shall be 35°F or above. Ground upon which concrete is to be placed shall not be frozen at any depth.
- D. The mixing water and aggregates shall be heated and when entering the mixer shall have temperatures not exceeding 175°F and 80°F, respectively. Concrete temperature as mixed shall not exceed 80°F and shall typically be between 55°F and 70°F. Concrete, when placed in the forms, shall have a temperature of not less than 50°F.
- E. Freshly placed concrete shall be protected by adequate covering, insulating, or housing and heating. If heating is used, ambient temperature inside the housing shall be maintained at a minimum of 70°F for 3 days or 50°F for 5 days. The maximum ambient temperature during curing shall not exceed 80°F. If insulating methods are used, recommendations contained in ACI 306R shall be followed. Surface temperature shall be maintained at 50°F for 7 days. After the curing period, the temperature of the concrete shall be reduced uniformly at a rate not to exceed 40°F per 24 hours until outside air temperature is reached. Heating of enclosure shall continue if it is anticipated that the outside air temperature will drop more than 20°F in the next 24 hours. The concrete temperature shall be obtained by attaching a thermometer provided by CONTRACTOR to the concrete surface. Concrete shall be kept moist.
- F. If heating is used, the housing shall be constructed weathertight and shall be constructed in a manner that will provide uniform air circulation and air temperatures over the complete concrete area that is being cured. Special attention shall be given to the edges and ends of a concrete pour with the housing extending at least 5 feet beyond any concrete surface being protected. The housing shall be in place and heat applied within 2 hours after concrete placement.
- G. Heating may be by steam or hot air. Heaters shall be vented to outside of the housing. Open burning salamanders will not be permitted. Heating devices shall not be placed so close to the concrete as to cause rapid drying or discoloration from smoke.
- H. If heating is used, CONTRACTOR shall provide sufficient 24-hour inspection of the heaters to provide compliance with the above-specified temperature requirements during the curing period. CONTRACTOR shall provide maximum-minimum thermometers for ENGINEER's use.

- I. The use of calcium chloride, salts, or other chemical admixtures for the prevention of freezing is prohibited.
- J. Salts or other deleterious materials shall not be used on temporary or permanent structures above concrete surfaces that are being placed, finished, or cured.

### 3.11 FINISHING

#### A. Flat Work:

1. Floated Finish: Place, consolidate, strike off, and level concrete eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Immediately refloat the slab to a uniform texture.
2. Light Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks.
3. Hard Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
4. Tolerance for concrete floors shall be 1/4 inch within 10 feet in any direction. Straight edge shall be furnished by CONTRACTOR.
5. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.
6. The above finishes shall be used in the following locations:
  - a. Float Finish: Surface to receive roofing, waterproofing, or sand bed terrazzo.
  - b. Light Troweled Finish: Submerged tank slabs.
  - c. Hard Troweled Finish: Building floors.
  - d. Broom or Belt Finish: Exterior slabs, sidewalks, tops of walls, and tank slabs to receive grout topping.

#### B. Formed Surfaces:

1. Within 2 days after removing forms and prior to application of a curing compound, all concrete surfaces shall be observed and any poor joints, voids, stone pockets, or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to remove all loose and partially bonded aggregate. The area shall be thoroughly wetted and filled with as dry as practical mortar mix placed to slightly overfill the recess. Mortar shall include a bonding agent. After partial set has taken place, the excess mortar shall be removed flush with the surface on the concrete using a wood float. All patching shall be cured, protected, and covered as specified for concrete. All cracks, leaks, or moist spots that appear shall be repaired. No extra compensation will be allowed CONTRACTOR for such work.
2. The exterior or removal portion of nonremovable ties shall be removed with the use of a special tool designed for this purpose. Cutting or chipping of concrete to permit removal of exterior portion will not be permitted.
3. For nonremovable ties, tie rod holes left by the removal of the exterior portion of the tie and cone shall be thoroughly wetted and filled by ramming with as dry as practical mortar mix in such a manner such that it completely fills the hole. Mortar shall include a bonding agent. All patching shall be cured, protected, and covered as specified for concrete. The holes are to be filled immediately after removal of the exterior portion of the tie.
4. Holes left by removable ties shall be filled by installing a neoprene plug near the center of the wall. The balance of the hole shall be filled with mortar as specified above to within 1 inch of the face of the wall. The remainder of the hole shall be filled with a waterproofing compound.

5. All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections as shown or prescribed by ENGINEER. All surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness. All sharp angles, where required, shall be rounded or beveled. Any formed surface to be painted shall be free of any material that will be detrimental to the paint. The surface of the concrete shall be given one of the following finishes immediately after form stripping:
  - a. Finish A shall be referred to as a sack finish. Surfaces shall be free of contaminants prior to sacking. After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a continuous, hard, dust-free uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all unpainted surfaces (See Section 09 91 00—Painting for painted surfaces), interior surfaces of equipment rooms, operation areas, and permanently exposed vertical surfaces. Where steel-faced forms are used to form walls, the portion of wall to receive the sack finish shall first be roughened by brush blasting or other acceptable method to achieve a texture similar to 40 to 60 grit sandpaper.
  - b. Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the surface. Finish B shall be provided for waterproof- and moistureproof-coated surfaces.
  - c. Finish C shall be referred to as a finish that has surface imperfections less than 3/8 inch in any dimension. Surface imperfections greater than 3/8 inch shall be repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.
  - d. Finish D shall be the finish for surfaces that may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired. Finish D shall be provided for surfaces to be buried or covered by other construction such as masonry veneer.
- C. All precautions shall be taken to protect the concrete from stains or abrasions, and any such damage shall be removed or repaired under this Contract.

### 3.12 LOADING OF CONCRETE STRUCTURES

- A. No concrete structure or portion thereof shall be loaded with its design load until the concrete has obtained its specified 28-day compressive strength. This shall include but not be limited to vertical live load, equipment loading, water loading, groundwater loading, and backfill load. Concrete strength at time of loading shall be determined by testing field-cured concrete cylinders.
- B. Extreme care shall be taken so that construction loads do not exceed design loading of the structure.

### 3.13 NONSHRINK GROUT

- A. Nonshrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by ENGINEER. Store, mix, and place the nonshrinking compound as recommended by the manufacturer. The minimum compressive strength shall be 5,000 psi at age 7 days and 7,500 psi at age 28 days.

### 3.14 TESTING AND SAMPLING

- A. The following tests of fresh concrete shall be performed by the SPECIAL INSPECTOR. The SPECIAL INSPECTOR shall prepare, protect, transport, and have tested all cylinders at its expense.
1. Sampling of concrete for slump tests, air tests, temperature tests, and for making concrete test cylinders shall be performed in accordance with ASTM C172.
  2. Cylinders:
    - a. Three test cylinders shall be made for each pour less than 25 cubic yards, four test cylinders shall be made for each pour between 25 and 100 cubic yards, and eight test cylinders shall be made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least four cylinders for the entire job. Concrete for cylinders shall be collected near the middle of the load and/or as requested by ENGINEER.
    - b. Cylinders shall be made and tested in accordance with ASTM C31 and ASTM C39, respectively. The cylinders must be kept moist and at temperatures between 60°F and 80°F and shall remain undisturbed and stored in a location free from vibration. In hot weather, the cylinders shall be covered with wet burlap and stored in a shaded area. It is CONTRACTOR's responsibility to provide a suitable protected location for storing cylinders on the jobsite.
    - c. After 24 hours, the cylinders shall be transferred to an independent testing laboratory acceptable to OWNER. The cylinders shall be packed in sawdust or other cushioning material for transit to avoid any bumping or jarring of the cylinders.
    - d. Cylinders shall be broken at 7 and 28 days or as requested by ENGINEER. Test results shall be transmitted immediately and directly to ENGINEER and OWNER. Test data shall include date and location of pour and concrete mix used.
  3. Slump Test: The SPECIAL INSPECTOR shall make one slump test near the beginning of all pours with two tests being made for all pours in excess of 25 yards or as requested by ENGINEER. Slump tests shall conform to ASTM C143.
  4. Air Test:
    - a. When air-entrained concrete is used, the air content shall be checked by CONTRACTOR near the beginning of all pours with at least two checks being made for all pours in excess of 25 cubic yards, or as requested by ENGINEER.
    - b. The air contents shall be checked using the pressure method in accordance with ASTM C231. The pocket-sized alcohol air indicator shall not be used unless it is first used in conjunction with the pressure method test.
- B. All costs of additional testing and sampling of fresh or hardened concrete needed because of suspected or actual violation of the specifications shall be borne by CONTRACTOR.

### 3.15 RECORDS

- A. A record is to be kept of all concrete work. The record shall include the date, location of pour, concrete mix, slump, air content, test cylinder identification, concrete temperature, and ambient air temperature. In addition, for cold weather concreting the record shall include the daily maximum-minimum thermometer readings of all thermometers during the entire curing period for all concrete pours. The Resident Project Representative will keep this record, and CONTRACTOR shall assist in obtaining needed information.

### 3.16 CONCRETE TOPPING

- A. The UV Channel base slabs shall receive concrete topping, where shown on the Drawings, as specified below. After striking off, a light steel troweled finish shall be applied. CONTRACTOR shall run the clarifier mechanism.

- B. Before the concrete topping is applied, the base slab shall be thoroughly cleaned. The base slab shall be wetted and kept saturated prior to placing the topping. A thin coat of cement grout shall be broomed into the base slab for a short distance ahead of the topping. The topping shall be applied before the grout is hardened.

### 3.17 SIDEWALKS AND EXTERIOR SLABS

- A. Sidewalks shall be constructed where shown on the Drawings. They shall be a minimum of 5 inches thick and shall slope away from buildings or structures at a rate of 1/4 inch per foot. Concrete shall be as previously specified. Sidewalks shall be constructed on 3 inches of compacted granular fill. They shall have tooled joints of 1 inch minimum depth at approximately 5-foot centers with 1/2 inch preformed expansion joint filler at approximately 25-foot centers with one at all corners and located anywhere sidewalks abut structures and buildings.

### 3.18 CONCRETE REMOVAL AND PATCHING

- A. All areas disturbed as a result of concrete removal or repair shall be patched as specified in Bonding to Existing Concrete.

END OF SECTION



## SECTION 05 12 00

### STRUCTURAL STEEL

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Structural carbon steel framing members.
  - 2. Steel base plates and bearing plates.
  - 3. Structural steel bolted connections and anchor bolts.
  - 4. Welding of structural steel.
  - 5. Galvanizing of structural steel.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. AISC—Code of Standard Practice—Manual of Steel Construction—Allowable Stress Design (ASD).
- B. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
- C. ASTM A53—Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- D. ASTM A123—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- E. ASTM A143—Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- F. ASTM A153—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- G. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
- H. ASTM A325—Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- I. ASTM A384—Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- J. ASTM A385—Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- K. ASTM A500—Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

- L. ASTM A780—Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- M. ASTM A992/A992M—Standard Specification for Structural Steel.
- N. AWS A2.4—Symbols for Welding, Brazing, and Nondestructive Examination.
- O. AWS D1.1—Structural Welding Code.
- P. SSPC (Steel Structures Painting Council)—Painting Manual.

#### 1.03 SUBMITTALS FOR REVIEW

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Provide shop drawings with complete details and schedules for fabrication and shop assembly of members.
  - 1. Include details of cuts, connections, camber, holes, and other pertinent data.
  - 2. Indicate welds by AWS symbols, and show size, length, and type of weld.
  - 3. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages.
  - 4. Identify details by reference to sheet and detail number on the Drawings.
- C. Mill Test Reports: Submit indicating structural strength and composition.
- D. Unless shown otherwise, all connections shall be designed and detailed by the fabricator to support one-half of the total uniform load capacity shown in the tables for uniform load constants in the AISC Specifications.
- E. Except as shown otherwise, structural steel details shall conform to standard practice as illustrated in Structural Shop Drafting Textbook of the AISC.
- F. Indicate all temporary bracing or cabling required to stabilize the structural frame during erection.

#### 1.04 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC Code of Standard Practice.
- B. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

#### 1.05 QUALIFICATIONS

- A. Qualify welding processes and welding operators in accordance with AWS “Standard Qualifications Procedures.”
- B. CONTRACTOR shall design connections not detailed on the Drawings under direct supervision of a professional engineer experienced in design of this work and licensed in the State of Kentucky.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to allow uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.
- B. Store all members off the ground using pallets, platforms, or other supports.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.
- D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

## PART 2-PRODUCTS

### 2.01 MATERIALS

- A. Structural Steel Members:
  - 1. ASTM A36/A36M (channels, angles, plates).
  - 2. ASTM A992-50 (wide flange sections).
- B. Structural Tubing: ASTM A500, Grade B.
- C. Pipe: ASTM A53, Grade B.
- D. Bolts, Threaded Rods, Nuts, and Washers: ASTM A307 or ASTM A325, galvanized in accordance with ASTM A123 and A153.
- E. Anchor Bolts: ASTM F1554 Grade 36.
- F. Welding Electrodes: Comply with AWS D1.1; E70XX electrodes. For ASTM A992 steel and any other steel with 50 ksi or greater yield strength, use only E7018 or other E70XX electrodes specifically permitted by AWS D1.1.
- G. Galvanizing: ASTM A123 and A153 for structural steel plates, shapes and bars, and structural steel tubing. ASTM A53 for steel pipe.

### 2.02 FABRICATION

- A. Fabrication and Assembly:
  - 1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
  - 2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
  - 3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
  - 4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
  - 5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

- B. Connections:
  - 1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
  - 2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
  - 3. Assemble and weld built-up sections to produce true alignment of axes without warp.
  - 4. Welding shall be done by the shielded arc process.
  - 5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.
- C. Holes for Other Work:
  - 1. Provide holes for securing other work to structural steel framing and for the passage of other work through steel framing members as indicated.
  - 2. Provide threaded nuts welded to framing and other specialty items as shown to receive other work.
  - 3. Drill, cut, or punch holes perpendicular to metal surfaces.
  - 4. Do not flame cut holes or enlarge holes by burning.
  - 5. Drill holes in all bearing plates.

## 2.03 FINISHES

- A. Before shipping, prepare structural component surfaces in accordance with SSPC SP 10 as specified in Section 09 91 00–Painting.
- B. Immediately after surface preparation, shop prime structural steel members in accordance with Section 09 91 00–Painting. Do not prime surfaces that will be field-welded, galvanized, or high-strength bolted with friction-type connection.
- C. Surfaces which will be inaccessible after assembly or erection shall be field finish coated prior to assembly or erection.
- D. Do not prime surfaces where galvanizing or field welding is required.
- E. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.
- F. Galvanizing:
  - 1. All items designated to be galvanized, except piping, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
  - 2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in “Recommended Details for Galvanized Structures” as published by the American Hot Dip Galvanizer’s Association, Inc.
  - 3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
  - 4. Silicon content for steel to be hot-dipped galvanized shall be in the range of 0 to 0.04%.
  - 5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.

6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, "Welding Zinc Coated Steel." All uncoated weld areas shall be touched up.

### PART 3-EXECUTION

#### 3.01 EXAMINATION

- A. Correct conditions detrimental to proper and timely completion of the work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.02 ERECTION

- A. General: Comply with AISC Specifications and Code of Standard Practice and as specified herein.
- B. Surveys:
  1. Establish permanent bench marks necessary for the accurate erection of structural steel.
  2. Check elevations of concrete and masonry, bearing surfaces, and locations of anchor bolts and similar items before erection proceeds.
- C. Temporary Shoring and Bracing:
  1. Provide temporary shoring and bracing members with connection of sufficient strength to bear imposed loads.
  2. Provide temporary guidelines to achieve proper alignment of the structures as erection proceeds.
  3. Remove temporary connections and members when permanent members are in place and final connections are made.
- D. Anchor Bolts:
  1. Provide anchor bolts and other connectors for securing structural steel to foundations and other in-place work.
  2. Provide templates and other devices as needed for the presetting of bolts and other anchors to accurate locations.
- E. Setting Bases and Bearing Plates:
  1. Clean bearing surfaces free from bond-reducing materials and then roughen to improve bond to surface.
  2. Set loose and attached base plates and bearing plates for structural members using wedges, leveling nuts, or other adjusting devices.
  3. Tighten anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edges of the base or bearing plates prior to packing with grout.
  4. Pack grout solidly between bearing surfaces and bases so that no voids remain.
  5. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's instructions.
- F. Field Assembly:
  1. Set structural frames accurately to the lines and elevations indicated. Align and adjust

- the various members forming a part of a complete frame or structure before fastening permanently.
2. Clean the bearing surfaces and other surfaces which will be in permanent contact before assembly.
  3. Perform necessary adjustments to compensate for discrepancies in elevation and alignment.
  4. Level and plumb individual members of the structure within specified AISC tolerances.
  5. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- G. Gas Cutting:
1. Do not use gas cutting torches in the field for correcting fabricating errors in the structural framing.
  2. Cutting will be permitted only on secondary members which are not under stress as acceptable to ENGINEER.
  3. When gas cutting is permitted, finish the sections equal to the sheared appearance.
- H. After erection, prime welds, abrasions, and surfaces not shop-primed or galvanized, except surfaces to be in contact with concrete.
- I. Comply with AWS Code for procedures of manual shielded metal arc welding, appearance and quality of weld made, and methods in correcting welding work.

### 3.03 GALVANIZING REPAIR

- A. Areas damaged by welding, flame-cutting or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16 inches in width.
1. Cold Galvanizing Compound:
    - a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
    - b. Areas to be repaired shall be power disc-sanded to bright metal. So that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
    - c. Touchup paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
    - d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
    - e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
  2. Zinc-Based Solder:
    - a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
    - b. Areas to be repaired shall be wire brushed.
    - c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.
    - d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

### 3.04 FIELD QUALITY CONTROL

- A. CONTRACTOR shall inspect all field-bolted connections in accordance with the AISC Specifications.
- B. Field Welding:
  - 1. CONTRACTOR shall visually inspect all welds and test during erection of structural steel.
  - 2. CONTRACTOR shall certify welders and conduct inspections and tests as required by applicable standards.
  - 3. CONTRACTOR shall record types and locations of defects found and record the work required and performed to correct deficiencies.
- C. Correction:
  - 1. Correct deficiencies in structural steel work which inspections and test reports have indicated to be not in compliance with the specified requirements.
  - 2. CONTRACTOR shall perform all additional testing required to show compliance of corrected work.

END OF SECTION

## SECTION 05 50 00

### METAL FABRICATIONS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Shop-fabricated carbon steel, stainless steel, and aluminum items, including metal stairs, guard posts, ladders, and other items shown on the Drawings.
  - 2. Stair treads and nosings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A36—Carbon Structural Steel.
- B. ASTM A53—Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM A123—Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A143—Practice for Safeguarding Against Embrittlement of Hot-Dipped Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- E. ASTM A153—Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A240—Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- G. ASTM A276—Stainless Steel Bars and Shapes.
- H. ASTM A307—Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
- I. ASTM A384—Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- J. ASTM A385—Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- K. ASTM A500—Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- L. ASTM A780—Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- M. ASTM A992—Structural Steel Shapes.
- N. ASTM A1008—Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.



- O. ASTM A1011—Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- P. ASTM B209—Aluminum and Aluminum-Alloy Sheet and Plate.
- Q. ASTM B211—Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
- R. ASTM B221—Aluminum and-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
- S. AWS A2.0—Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- T. AWS A5.4—Stainless Steel Electrodes for Shielded Metal Arc Welding.
- U. AWS D1.1—Structural Welding Code—Steel.
- V. AWS D1.2—Structural Welding Code—Aluminum.
- W. AWS D1.6—Structural Welding Code—Stainless Steel.
- X. ASTM F593—Standard Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- Y. ASTM F594—Standard Specification for Stainless Steel Nuts.

#### 1.03 DESIGN REQUIREMENTS

- A. All fabrications shall meet applicable code requirements including OSHA.

#### 1.04 SUBMITTALS FOR REVIEW

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, sections, elevations, and details where applicable.
- C. Mill Test Reports: Submit indicating structural strength and composition.
- D. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

#### 1.05 QUALITY ASSURANCE

- A. Fabricate steel members in accordance with AISC Code of Standard Practice.
- B. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

#### 1.06 QUALIFICATIONS

- A. Qualify welding processes and welding operators in accordance with AWS *Standard Qualifications Procedures*.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to allow uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.
- B. Store all members off the ground using pallets, platforms, or other supports.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.
- D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

## PART 2-PRODUCTS

### 2.01 MATERIALS-CARBON STEEL

- A. Steel Sections:
  - 1. ASTM A36 (channels, angles, plates).
  - 2. ASTM A992 (wide flange sections).
  - 3. Pipe: ASTM A53, Grade B.
  - 4. Tubes: ASTM A500, Grade B.
  - 5. Silicon content of steel members to be hot-dipped galvanized shall be in the range of 0 to 0.04%. Submit mill test reports confirming compliance.
- B. Sheet Steel: ASTM A1011.
- C. Plain Washers: Round carbon steel complying with FS FF-W-92.
- D. Bolts, Threaded Rods, and Nuts: ASTM A307 Grade A, or galvanized to ASTM A153 for galvanized components for exterior use and where built into exterior walls.
- E. Lock Washers: Helical spring-type carbon steel complying with FS FF-W-84.
- F. Welding Electrodes: Comply with AWS D1.1. E70XX electrodes for carbon steel. For ASTM A992 steel and any other steel with 50 ksi or greater yield strength, use only E7018 or other E70XX electrodes specifically permitted by AWS D1.1.
- G. Select fasteners for the type, grade, and class required.

### 2.02 MATERIALS-STAINLESS STEEL

- A. Unless otherwise noted, all stainless steel bars and shapes shall meet the requirements of ASTM A276 and shall be Type 316L.
- B. Unless otherwise noted, all stainless steel bolts shall meet the requirements of ASTM F593 and shall be Type 316L.
- C. Unless otherwise noted, all stainless steel nuts shall meet the requirements of ASTM F594 and shall be Type 316L.

- D. If components are not available in Type 316L, other 300 Series type shall be used as approved by ENGINEER.
- E. Welding Electrodes:
  - 1. Comply with AWS D1.6.
  - 2. Use ER316L electrodes for 316L stainless steel.
  - 3. Use ER308L electrodes for 304L stainless steel.

## 2.03 MATERIALS–ALUMINUM

- A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.
- B. Sheet Aluminum: ASTM B209, Alloy 3005.
- C. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.
- D. Bolts, Nuts, and Washers: Stainless steel.
- E. Welding Materials: AWS D1.2; type required for materials being welded.

## 2.04 ACCESSORIES

- A. Stair Treads: Stair treads for aluminum stairs shall be constructed of nonslip grating and shall have an integral nosing. Treads shall be IKG Industries, or equal, serrated, aluminum swage-locked treads with 1 1/4-inch abrasive nosing.

## 2.05 FABRICATION

- A. Fabrication and Assembly:
  - 1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
  - 2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
  - 3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
  - 4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
  - 5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.
- B. Connections:
  - 1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
  - 2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
  - 3. Assemble and weld built-up sections to produce true alignment of axes without warp.
  - 4. Welding shall be done by the shielded arc process.
  - 5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.
- C. Workmanship:
  - 1. Use materials of size and thickness shown or, if not shown, of size and thickness to produce strength and durability in the finished product.

2. Work to dimensions shown or accepted on the shop drawings using proven details of fabrication and support.
3. Form exposed work true to line and level, with accurate angles and surfaces, and with straight sharp edges.
4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing works.
5. Cap all open ends of pipe and structural tubing.
6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
7. Provide for anchorage of the type shown. Coordinate with supporting structures. Fabricate and space the anchoring devices to provide adequate support for intended use.
8. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive hardware and similar items.

## 2.06 MISCELLANEOUS METAL FABRICATION

- A. Metal Stairs:
  1. Fit and shop-assemble components in largest practical sections for delivery to site.
  2. Fabricate components with joints tightly fitted and secured.
  3. Supply components for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
  4. Treads and risers for metal pan stairs shall be fabricated with 14-gauge sheet steel, closed risers, treads ready to receive concrete.
  5. Aluminum grating stair treads shall be bolted to stringers with aluminum or stainless steel bolts.
  6. Aluminum safety treads shall be screwed to aluminum carrier angles.
- B. Aluminum Ladder: Provide fixed aluminum ladder. Aluminum ladder shall have serrated surface on rungs.

## 2.07 FINISHES

- A. Carbon steel surfaces shall be prepared by abrasive blasting to SSPC-SP10 as specified in Section 09 91 00—Painting.
- B. Do not prime surfaces where galvanizing or field welding is required.
- C. Immediately after surface preparation, prime paint carbon steel items with one coat in accordance with manufacturer's instructions and Section 09 91 00—Painting.
- D. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.
- E. Surfaces that will be inaccessible after assembly or erection shall be finish painted prior to assembly or erection.
- F. Galvanizing:
  1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped

- galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in *Recommended Details for Galvanized Structures* as published by the American Hot Dip Galvanizer's Association, Inc.
  3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
  4. Silicon content for steel to be hot-dipped galvanized shall be in the range of 0 to 0.04%.
  5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
  6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, *Welding Zinc Coated Steel*. All uncoated weld areas shall be touched up.
- G. Aluminum shall have a mill finish unless otherwise specified. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

### PART 3-EXECUTION

#### 3.01 EXAMINATION

- A. Correct conditions detrimental to the proper and timely completion of the work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.02 PREPARATION

- A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete construction.
- B. Coordinate delivery of such items to project.
- C. Clean and strip primed steel items to bare metal where site welding is required.

#### 3.03 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement:
  1. Perform cutting, drilling, and fitting for installation of miscellaneous metal fabrications.
  2. Set work accurately in location, alignment, and elevation and make plumb, level, true, and free from rack measured from established lines and levels.
  3. Fit exposed connections accurately together to form tight hairline joints.

4. Weld connections that are not to be left as exposed joints, grind joints smooth, and touchup shop paint coat or galvanizing repair.

### 3.04 FIELD WELDING

- A. Comply with AWS Code for procedures of manual shielded metal arc welding (steel, stainless steel) and gas metal arc welding (aluminum), appearance and quality of weld made, and methods in correcting welding work.

### 3.05 TOUCH-UP PAINTING

- A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting in accordance with Section 09 91 00–Painting.

### 3.06 GALVANIZING REPAIR

- A. Areas damaged by welding, flame-cutting, or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16 inch in width.
  1. Cold Galvanizing Compound:
    - a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
    - b. Areas to be repaired shall be power disc-sanded to bright metal. So that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
    - c. Touch-up paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
    - d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
    - e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
  2. Zinc-Based Solder:
    - a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
    - b. Areas to be repaired shall be wire-brushed.
    - c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.
    - d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

### 3.07 SCHEDULE

- A. The following schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- B. Guard Posts: Steel pipe, concrete-filled, crowned cap, as detailed-galvanized and field finish paint in accordance with Division 09.

- C. Aluminum stairs, serrated aluminum treads. Mill finish.
- D. Aluminum ladder.

END OF SECTION

SECTION 05 52 00  
HANDRAILS AND RAILINGS

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes aluminum handrails, railings, and fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM B241–Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

1.03 DESIGN REQUIREMENTS

- A. Railings and handrails shall be designed in accordance with and meet the applicable requirements of the Occupational Safety and Health Act and the 2018 Kentucky Building Code.
- B. Submit engineering calculations for all rails, posts, and connections demonstrating compliance with the design requirements. Calculations shall be stamped by a Kentucky Professional Engineer.

PART 2–PRODUCTS

2.01 ALUMINUM RAILING SYSTEM

- A. Provide a mechanically joined pipe railing system, Tabco 2500 Railing System as manufactured by Tuttle Aluminum and Bronze Co. or equal.
- B. Rails shall be ASTM B241, Aluminum Alloy 6063-T6, 6005-T5, or 6105-T5, Schedule 40, 1 1/2-inch-diameter pipe extrusion.
- C. Posts shall be ASTM B241, Aluminum Alloy 6063-T6, 6005-T5, or 6105-T5. Schedule 40, 1 1/2-inch-diameter pipe.
- D. Furnish and install 4-inch by 1/4-inch toeboards where shown or noted on the Drawings, or where required by OSHA 1910.29(k).
- E. Provide expansion joints in railing and toeboards at expansion joints in structures and as necessary to prevent buckling or buildup of stresses. Expansion joints shall occur within 1 foot of posts.
- F. Finished joints shall be smooth.



- G. All rails, posts, toeboards, and connectors shall have a M10C22A41 clear anodized finish.
- H. Posts shall be anchored to the top of walls and decks with a flange base plate. Base plate shall reinforce the bottom end of the post as required to meet OSHA design criteria.
- I. Stainless steel adhesive or expansion bolt anchoring system, in accordance with manufacturer's recommendations, shall be used.
- J. All accessories and connections for aluminum rails and posts shall be aluminum or stainless steel.
- K. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Install all railing in accordance with approved shop drawings and manufacturer's instructions providing a complete installation.
- B. Install components plumb and level, accurately fitted, and free from distortion or defects.
- C. Clean all components as recommended by railing manufacturer.

END OF SECTION

## SECTION 05 53 00

### GRATING, FLOOR PLATES, AND FLOOR PLANK

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes floor and stair tread grating and aluminum floor plank.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NAAMM Metal Bar Grating Manual ANSI NAAMM MBG531 and MBG532.
- B. ASTM B221-Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Floor grating and plank shall be designed for a maximum deflection of 1/4 inch when supporting a 100 psf uniform load.

##### 1.04 FIELD MEASUREMENTS

- A. Take all field measurements prior to preparation of shop drawings. Verify that field measurements are as indicated on shop drawings.

#### PART 2–PRODUCTS

##### 2.01 ALUMINUM FLOOR GRATING

- A. All grating, unless otherwise specified, shall be rectangular bar style, swage-locked aluminum floor grating with serrated surface.
- B. Acceptable manufacturers include the following or equal: Harsco Industrial, IKG Type S-19-4-BS.
- C. All edges of the grating and all openings in the grating for pipe and miscellaneous equipment shall be banded by welding on minimum 1/8-inch-thick bars. The band shall have less depth than the bearing bars to permit drainage.
- D. Individual sections shall be of a size to permit ease in handling with a maximum length not in excess of 8 feet. Weight of individual sections shall not exceed 75 pounds.
- E. Where possible, provide a 12-inch-wide section of grating over each stop gate and over each valve operating nut.

- F. All aluminum grating support angles shall be aluminum. Support angles shall be provided at the bearing ends of all grating. This includes locations such as wall openings and corners. Support angles shall also be provided at the nonbearing ends of grating where shown on the Drawings.
- G. For aluminum grating stair treads, refer to Section 05 50 00—Metal Fabrications.
- H. Provide 4-inch by 1/4-inch toeboards anchored to edge of grating at all slide gates in grated areas.

## 2.02 ALUMINUM FLOOR PLANK

- A. Aluminum plank shall be unpunched heavy duty extruded aluminum plank as manufactured by Ohio Gratings, Inc., or equal.
- B. Plank shall have SlipNot® finish as specified below except where noted otherwise on the Drawings. Plank without SlipNot® finish shall have a striated top surface to increase slip-resistance.
- C. Planks shall be six inches wide with support bars spaced 1.2 inches on center, and shall be fabricated with banding into panels of standard width to fill areas shown on the Drawings. Plank depth shall be based on loading requirements and clear span.
- D. Fabricate cutouts in plank sections for penetrations indicated. Arrange cutouts to permit plank removal without disturbing items penetrating plank. Band ends and cuts in plank with 3/16-inch-thick bars of same depth as the plank.
- E. Materials: Plank and banding shall be aluminum type 6063-T6.
- F. Fabrication Tolerances shall be in accordance with ANSI/NAAMM MBG 531-09 Metal Bar Grating Manual.
- G. Finish: Gratings shall be Mill finish.
- H. Provide stainless steel ADA plank lug fasteners at each end of plank into supports.
- I. Individual sections of plank shall be of a size to permit ease in handling with a maximum length not in excess of 8 feet. Weight of individual sections shall not exceed 75 pounds.
- J. All aluminum plank support angles shall be aluminum. Support angles shall be provided at the bearing ends of all plank. This includes locations such as wall openings and corners. Support angles shall also be provided at the nonbearing ends of grating where shown on the Drawings.
- K. Provide 4-inch by 1/4-inch toeboards anchored to edge of plank at all slide gates in plank areas.
- L. Where possible, provide a 12-inch-wide section of planking over each stop gate.
- M. Provide one 1 1/4-inch finger hole centered along each bearing end of each plank panel. Locate hole 2 inches from end of panel. Provide PVC or rubber plugs for holes.

## 2.03 FINISHES

- A. Protection of Aluminum from Dissimilar Materials:
  - 1. Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with multiple coats of bituminous paint, minimum 10 mils dry, or other approved insulating material.
  - 2. Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry, or lime mortar, exposed aluminum surfaces shall be painted with multiple coats of bituminous paint, minimum 10 mils dry, or other approved insulating material.
- B. Provide anti-slip aluminum surface finish on top of aluminum plank. Surface finish shall be SlipNOT® by W. S. Molnar Company, or equal, with the following properties:
  - 1. Surface texture: Grade 2 medium.
  - 2. Bond strength (ASTM C633): 2,000 psi minimum.
  - 3. Coefficient of friction: 0.6 minimum.
  - 4. UL listed as slip-resistant.

## PART 3—EXECUTION

### 3.01 EXAMINATION

- A. Verify that opening sizes and dimensional tolerances are acceptable.
- B. Prior to installation, CONTRACTOR shall inspect supports for correct size, layout, and alignment. Any inconsistencies between Contract Drawings and supporting structure deemed detrimental to placement shall be reported in writing to ENGINEER prior to placement.

### 3.02 INSTALLATION

- A. Place embedded frames and supports in correct position, plumb and level. Provide blocking as required to maintain alignment of sections.
- B. Seal small gaps between embedded angles at face of wall with backer rod to prevent concrete entry.
- C. All aluminum floor grating and plank shall be secured to supporting members with aluminum or stainless steel saddle clips supplied by the grating manufacturers. Stud bolts and other hardware shall be supplied by CONTRACTOR.
- D. Install in accordance with shop drawings and standard installation clearances as recommended by the NAAMM Metal Bar Grating Manual.
- E. Cutting, Filling, and Placement:
  - 1. Perform all cutting and fitting required for installation.
  - 2. Cutouts for circular obstructions are to be at least 2 inches larger in diameter than the obstruction. Cutouts for all piping 4 inches or less shall be made in the field.
  - 3. All rectangular cutouts are to be made to the next bearing bar beyond the penetration with a clearance not to exceed bearing bar spacing.

4. Utilize standard panel widths wherever possible.

END OF SECTION

## SECTION 05 56 00

### ANCHOR BOLTS AND POST-INSTALLED ANCHORS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Anchor bolts, expansion bolts, adhesive anchors, and screw anchors.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
- B. ASTM F1554—Anchor Bolts, Steel, 36, 55, and 105-ksi yield strength.
- C. ICC-ES International Code Council—Evaluation Service.
- D. AC 193—Acceptance Criteria for Mechanical Anchors in Concrete Elements.
- E. AC 308—Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete.
- F. ACI 355.2—Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
- G. ACI 355.4—Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

#### PART 2—PRODUCTS

##### 2.01 GENERAL

- A. Unless indicated otherwise on the drawings or specified, use the following bolt material for the various installation situations:
  - 1. Stainless Steel: For all submerged locations, below final grade, and in contact with aluminum appurtenances and other items not to be painted. Also for anchoring equipment, unless otherwise specified.
  - 2. Steel: In other locations in contact with items to be painted or encased in concrete.

##### 2.02 ANCHOR BOLTS

- A. Anchor bolts complete with washers and nuts shall be fabricated as shown or as specified by the equipment manufacturer and unless otherwise indicated shall be hot-dip galvanized carbon steel or 316 stainless steel. Anchor bolts shall, as a minimum, conform to the requirements of ASTM F1554-Grade 36.
- B. Stainless steel anchor bolts shall be used in all submerged locations, below final grade, and in contact with aluminum and other items not to be painted. Galvanized anchor bolts shall be used elsewhere.

## 2.03 EXPANSION BOLTS

- A. Expansion bolts shall be KWIK Bolt TZ by Hilti, Inc., Power-Stud+ SD2, SD4, or SD6 by DeWalt, Strong-Bolt or Strong-Bolt 2 by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All expansion bolts shall comply with the Kentucky Building Code, AC 193, and ACI 355.2. They shall be ICC-ES approved for use in cracked and uncracked concrete.
- C. Expansion bolts will not be permitted as substitutes for embedded anchor bolts except with the prior written acceptance of ENGINEER or where otherwise specifically called for.

## 2.04 ADHESIVE ANCHORS

- A. Adhesive anchors shall be HIT HY 200 by Hilti, Inc., Red Head C6+ or Red Head A7+ by ITW, Pure 110+ or AC200+ by DeWalt, Set-XP by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All adhesive anchors shall comply with the Kentucky Building Code, AC 308, and ACI 355.4. They shall be ICC-ES approved for use in cracked and uncracked concrete.

## 2.05 SCREW ANCHORS

- A. Screw anchors shall be KWIK HUS-EZ by Hilti, Inc., Screw-Bolt by DeWalt, Titen-HD by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All screw anchors shall comply with the Kentucky Building Code. They shall be ICC-ES approved for use in cracked and uncracked concrete.

# PART 3-EXECUTION

## 3.01 ANCHOR BOLTS

- A. Anchor bolts for structural members shall be located as shown and specified.
- B. Anchor bolts for mechanical equipment shall have embedment length, edge distances, and spacing as required by the equipment manufacturer.
- C. All dirt or foreign materials shall be removed prior to embedding into concrete. After anchor bolts have been embedded, their threads shall be protected by grease and by installing the nuts or by other means until the time of installation of the equipment or metal work.

## 3.02 EXPANSION BOLTS

- A. Unless otherwise noted on the drawings, expansion bolt edge distance and spacing shall be in accordance with manufacturer's printed installation instructions.
- B. Bolt embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.

- D. Where location of bolts is adjustable, reinforcing steel shall be located prior to drilling holes and bolts shall be located to clear reinforcing steel.

### 3.03 ADHESIVE ANCHORS

- A. At locations shown on the drawings, reinforcing bars or threaded rod shall be provided in existing concrete by drilling holes, injecting epoxy adhesive, and inserting the reinforcing bar.
- B. All existing surfaces to receive adhesive anchors, including the entire area in contact with the new concrete, shall be cleaned and roughened to amplitude of 1/4 inch.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.
- E. CONTRACTOR shall arrange an anchor manufacturer's representative to provide on-site installation training for installation of their adhesive anchor system products. Submit documentation that all CONTRACTOR's personnel or subcontractors who install adhesive anchors have been trained prior to the announcement of anchor installation.
- F. Concrete receiving adhesive anchors shall be greater than 21 days of age per ACI requirements.
- G. Adhesive anchors in horizontal and upwardly inclined orientations to resist sustained tension loads are subject to the following requirements:
  - 1. They shall be installed by personnel certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchor Installer Certification program, or equivalent, as approved by ENGINEER.
  - 2. They require continuous special inspection during installation. CONTRACTOR shall notify ENGINEER and SPECIAL INSPECTOR of the schedule for these anchor installations to permit coordination of inspections.

### 3.04 SCREW ANCHORS

- A. Unless otherwise noted on the drawings, screw anchor edge distance and spacing shall be in accordance with manufacturer's recommendations.
- B. Anchor embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.

END OF SECTION



## SECTION 06 61 14

### FIBERGLASS WEIRS, BAFFLES, AND TROUGHS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Fiberglass weirs, baffles, and troughs as shown on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/AWWA F101—Contact-Molded, Fiberglass-Reinforced Plastic Wash Water Troughs and Launderers.
- B. ANSI/AWWA F102—Matched-Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles, and Mounting Brackets.
- C. ASTM D570—Standard Test Method for Water Absorption of Plastics.
- D. ASTM D638—Standard Test Method for Tensile Properties of Plastics.
- E. ASTM D790—Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- F. ASTM D2583—Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
- G. NSF/ANSI 61 Drinking Water System Components—Health Effects.

##### 1.03 DESIGN REQUIREMENTS

- A. Troughs:
  - 1. Loadings: The troughs shall be designed to support, within stress and deflection limitations, the following loadings:
    - a. Gravity load: Downward vertical loads shall include the weight of the trough and appurtenant attachments, such as weir plates and the spreader bars, together with the weight of water to fill the trough. Any additional loads, such as piping, etc., shall also be considered.
    - b. Buoyant load: The buoyant load shall act vertically upward, its magnitude equal to the weight of displaced water (trough weight neglected). The line of action passes through the centroid of the submerged cross-sectional area.
    - c. Lateral load: Loads acting against the trough side walls, specifically those included by differential water levels on either side of the trough walls. The maximum possible differential, existing when the trough is empty and the tank is full, or when the tank is empty shall be used when calculating deflection, fiber stress, etc.

2. Thermal stresses: The troughs shall be designed to accommodate temperature-induced stresses resulting from differences in coefficients of thermal expansion (contraction) between the trough and tank/support materials.
3. Torsional stability: The trough system shall be designed to resist torsional oscillations induced by the flow of water over trough edges. Any or all of the following trough stabilization techniques shall be considered.
  - a. Trough-to-trough stabilization.
  - b. Torsional stiffness.
  - c. Support spacing and rigidity.
  - d. Internal baffles and/or flow straighteners.
4. Deflection under load: Maximum vertical deflection under full buoyant or gravity load shall be less than or equal to  $L/1,000$  where  $L$  is defined as the unsupported trough length in inches. Under no circumstances shall the maximum vertical deflection, measured at mid-point between trough supports, exceed  $3/16$  inch.
5. Maximum trough side wall horizontal deflection under full lateral load shall be less than or equal to  $D/100$  where  $D$  is defined as the trough depth in inches. Under no circumstances shall the maximum side wall deflection exceed  $3/16$  inch.
6. Trough bottom deflection (oil canning) under full buoyant or gravity load shall be less than or equal to  $W/100$  where  $W$  is defined as the trough width in inches. Under no circumstances shall the maximum bottom deflection exceed  $3/16$  inch.
7. Fiber Stress Limitations: Supplemental to the deflection criteria, the troughs shall also be designed such that the maximum wall stress under the most severe loading conditions is less than or equal to 1,500 psi. This stress criterion is equivalent to 4:1 safety factor (approximate) as applied to the tensile and flexural properties of contact molded troughs and launders.
8. Thermal Expansion/Contraction: The trough shall be designed to accommodate a thermally induced expansion (contraction) of  $1/8$  inch per 20-foot length of trough over temperature range of  $10^{\circ}\text{F}$  to  $100^{\circ}\text{F}$  without exceeding the deflection or strain limitation set forth in the preceding sections.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer shall maintain a continuous quality control program and shall, upon request, furnish ENGINEER with certified test reports of physical properties.
- B. Weir plates, scum baffles, and mounting brackets shall be fabricated to ANSI/AWWA F102 Standards.

#### 1.05 PACKING AND STORAGE

- A. Should it be necessary to store product prior to installation, precautions should be taken to prevent warpage or distortion.
- B. Troughs should be stored on a flat place and adequately supported on wooden support members to evenly distribute weight of troughs. When stored more than one high, succeeding items should be stored level and evenly supported by blocks or spacers.

## PART 2-PRODUCTS

### 2.01 WEIRS AND BAFFLES

- A. Weirs and baffles shall be fiberglass.
- B. Fiberglass shall be as manufactured by Warminster Fiberglass Company, NEFCO Incorporated, or equal. All fasteners and anchors shall be type 304 stainless steel of size and type recommended by manufacturer of weirs and baffles.
- C. The weirs, scum baffles and supports shall be polyester plastic resin, reinforced with glass fiber. All weir plates, weir washers, weir splice plates, scum baffle panels, scum baffle splice plates and baffle support brackets shall be fiberglass reinforced plastic molded to produce uniform smooth surfaces. The surface shall be resin rich, free of voids and porosity, without dry spots, crazes or unreinforced areas and shall provide for increased corrosion resistance and UV protection. All edges shall be sealed in the mold. The weirs and scum baffles shall be green in color.
- D. Laminate will have Type "C" (chemical) glass surfacing mat, 10 to 20 mils thick, with a silane finish and a styrene soluble binder, on both sides. Required thickness will be achieved using the appropriate number of piles of Type "E" (electrical borosilicate) glass mat with chrome or silane finish and a styrene soluble binder. Glass content of laminate will be  $28 \pm 3\%$  by weight. Resin filters shall be  $40 \pm 2\%$  of the resin mixture. Final laminate thickness shall be within  $\pm 10\%$  of the nominal specified thickness.
- E. The fiberglass laminate shall have the following minimum physical properties:

		Test Method
Tensile Strength (min)	14,000 psi	ASTM D638
Flexural Strength (min)	25,000 psi	ASTM D790
Flexural Modulus (min)	$1.0 \times 10^6$	ASTM D790
Impact, Notched, Izod, foot pound per inch (min)	15.0	ASTM D256
Barcol Hardness (min avg)	40	ASTM D2583
Water Absorption, % 24 hours (max)	0.2%	ASTM D570
Average Coefficient of Thermal Expansion inch per inch per °F (max)	$10.5 \times 10^{-6}$	ASTM D696

- F. All machined or cut edges shall be sealed with Polyester Resin.

### 2.02 TROUGHS

- A. Manufacturer: Troughs shall be fiberglass as manufactured by Warminster Fiberglass Company, NEFCO Incorporated, or equal.
- B. Materials:
  - 1. Resin: The resin shall be a commercial grade general purpose polyester thermosetting resin which has either been evaluated in laminate or which has been determined by a previous documented service to be acceptable for the service conditions.
  - 2. The resin shall contain no fillers except as follows:
    - a. A thixotropic agent which does not interfere with laminate quality or with the required chemical resistance of the laminate may be added for viscosity control.

- b. Resin may contain pigments, dyes, or colorants which have been determined by at least 5 years previous service to be acceptable for the service condition without fading or chalking from original color standard.
3. Ultraviolet Resistance: Ultraviolet resistance is required in all laminates exposed to ultraviolet light whether it be in the form of pigmentation or ultraviolet absorbers.
4. Metal Reinforcement: When metal reinforcements are used, they shall be free of rust, oil, and any foreign matter. They shall be completely encapsulated with a minimum of 1/8-inch-thick laminate.
5. Glass reinforcement shall consist of chemically bonded surfacing mat and chopped strand or chopped strand mat as hereinafter described. Surfacing mat shall be Type C, 10 to 20 mil thick, with a silane finish and a styrene-soluble binder. The glass content of the finished laminate shall be adequate to produce mechanical and physical properties conforming to the following:

	ASTM Test Method	For 1/4-IN Wall Thickness
Ultimate Tensile Strength psi x 10 <sup>3</sup> (min)	D638	12
Flexural Strength psi x 10 <sup>3</sup> (min)	D790	19
Flexural Modulus of Elasticity psi x 10 <sup>3</sup> (min)	D790	0.9
Barcol Hardness (min)	D2583	35
Water Absorption-% (max)	D570	0.2

C. Manufacture:

1. The inner surface of the trough shall be smooth and resin rich. The outer surface shall be reasonably smooth, and no glass fibers shall be exposed. The size and number of air bubbles shall be held to a minimum. Lamination shall be dense and without voids, dry spots, cracks, or crazes.
2. The inner surface of the trough shall be reinforced with glass surfacing mat. This shall be followed with chopped strand glass laminate (maximum two ounces per square foot) in a minimum of two layers. Void content of the complete laminate shall not exceed 2 1/2% of laminate volume.
3. The top edges of the trough shall be level and parallel with a tolerance of plus or minus 1/8 inch (measured when the trough is not loaded). The length of a trough section shall have a tolerance of  $\pm 1/8$  inch per 10-foot length. The laminate thickness tolerance shall be  $\pm 1/8$  inch thick.
4. Thickness at locations of supports such as saddles shall be at least 1 1/2 times the nominal thickness of the trough and shall conform to the fiber stress limitations set forth in the design section of this specification.
5. End flanges and blind ends shall be a minimum of 1 1/2 times the nominal thickness of the trough and shall conform to the fiber stress limitations set forth in the design section of this specification.
6. An integrally molded waterstop shall be provided on the trough whenever the trough is grouted into and/or passes through a wall.
7. One-inch-diameter ABS spreaders shall be bolted between the trough walls on approximate 2-foot centers to enhance the structural rigidity of the trough system.

## 2.03 NEOPRENE GASKETS

- A. All splices and connections of weirs and troughs shall have a minimum 1/4 inch thick, or as noted on drawings, neoprene gasket in accordance with Section 10 00 20–Miscellaneous Specialties.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. All trough mounting brackets, hardware, and stabilizers shall be Type 316L stainless steel and shall be supplied by the trough manufacturer.
- B. Install weirs and baffles in accordance with details shown on the drawings using Type 316L stainless steel or fiberglass connection hardware.
- C. Troughs, weirs, and scum baffles shall be installed level to within  $\pm 1/8$  inch.
- D. Troughs shall be watertight.
- E. All weir and trough splices and connections shall be watertight. Provide neoprene gaskets between all splices and connections to provide complete watertight unit. Provide splice plates as required.

END OF SECTION

SECTION 07 61 00  
SHEET METAL ROOFING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Standing Seam Metal Roof System.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A653—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. SMACNA—Architectural Sheet Metal Manual.
- C. NRCA—Roofing and Weatherproofing Manual (including construction details) and Handbook of Accepted Roofing Knowledge.
- D. Manufacturer's Handbook of Construction Details.
- E. AISI "Specifications for the Design of Light-Gauge Cold Formed Steel Structural Member, latest edition."

1.03 SUBMITTALS

- A. See Section 01 33 00—Submittals for general submittal requirements.
- B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.
- C. Samples: Submit one sample of each type of prefinished and preformed panel showing color and profile match. Provide same for closures.
- D. Warranty from manufacturer: Submit sample of manufacturer's 20-year warranty on weather tightness, flashing, inclusive.

1.04 QUALITY ASSURANCES

- A. Perform work in accordance with manufacturer's instructions and these specifications.

1.05 QUALIFICATIONS

- A. Material Manufacturer: Five years documented experience with this type of construction.
- B. Installer: Five years of satisfactory documental experience in the installation of this type of work.

## 1.06 WARRANTIES

- A. Architectural finish coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.
- B. Warrant materials and workmanship for 20 years for weather tightness, flashing, inclusive.

## 1.07 SYSTEM DESIGN

- A. All components of the paneling system shall be designed in accordance with sound engineering methods and practices.
- B. The panels shall be designed in accordance with AISI "Specifications for the Design of Light Gauge Cold Form Steel Structural Members," latest edition.
- C. The paneling system and its attachments shall be designed to support live, snow, and wind loads.
- D. Panels shall be designed for 30 psf live load.
- E. The roof system shall carry UL wind-uplift Class 90 rating.

# PART 2—PRODUCTS

## 2.01 MATERIALS

- A. Metal Roof System:
  - 1. Roof panels shall be roll formed panels of uniform width 12 to 16 inches wide with two major corrugations, 2 inches high, 16 inches (equal to panel width) on center.
  - 2. Panel materials shall be 24 gauge, hot-dipped galvanized steel (50,000 psi yield), G-90 coating conforming to ASTM A653 specification.
- B. Fasteners:
  - 1. All connections of panels to structural members, except at eave, shall be made with clips with moveable tabs that are seamed into the standing seam side lap.
  - 2. Panel clips shall be fastened to structural members with fasteners as per manufacturer's erection drawings.
  - 3. Panel-to-panel connections shall be made with a positive, field-formed standing double-lock seam, formed by a special seaming device.

## 2.02 MANUFACTURERS AND PRODUCTS

- A. Roof panels shall be BattenLok HS panels as manufactured by MBCI, or equal.
- B. Sealants: Per Section 07 90 00—Caulking and Sealants.
- C. Flashing at eave, gable, ridge, and penetrations shall be in accordance with manufacturer's recommendations.

- D. Unless shown otherwise on the Drawings, provide continuous ridge venting using manufacturer's standard ridge/hip flashing and manufacturer's approved detail. Provide vent material to prevent entry of insects.

## 2.03 FINISHES

- A. Finishes on all exterior surfaces shall be a 1.0 mil DFT two-coat, factory-applied, 70% fluoropolymer coating over an epoxy prime coat.
- B. All exposed fasteners shall be provided with the same finish as the sheet material products.
- C. Colors shall be selected by OWNER.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. The panels shall be attached to the supporting structurals by means of a clip device. The clip shall occur at the panel major corrugation.
- B. Panel sidelaps shall be field-seamed by a seaming device; all sidelap sealant shall be factory-applied.
- C. Panel endlaps, when required, shall be at least 6 inches and sealed with field-applied sealant. One panel end shall be "swaged" to provide nestible, watertight endlaps.
- D. Provisions for thermal expansion/contraction movement of the panel shall be accomplished by the use of clips with a moveable tab. The tabs shall be factory-centered on the roof clip to provide full movement in either direction.
- E. The roof shall provide for thermal expansion/contraction without detrimental effect on the roof panel when there is a 100°F temperature differential between the interior structural framework of the building and the roof panels.

END OF SECTION



SECTION 07 71 23  
GUTTERS AND DOWNSPOUTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Aluminum gutters and downspouts.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM B209–Aluminum and Aluminum Alloy Sheet and Plate.
- B. SMACNA–Architectural Sheet Metal Manual.

1.03 DESIGN REQUIREMENTS

- A. Conform to SMACNA manual for sizing components for a 10-year storm event.

1.04 REGULATORY REQUIREMENTS

- A. Conform to the Kentucky Building Code or governing local building code for size and method of rainwater discharge.

PART 2–PRODUCTS

2.01 GUTTERS AND DOWNSPOUTS

- A. Gutters and downspouts shall be constructed of 0.032-inch-thick aluminum sheet conforming to ASTM B209.

2.02 ACCESSORIES

- A. Anchorage devices shall meet SMACNA or manufacturer's requirements.
- B. Gutter supports shall be straps and fasteners at maximum 3 feet 0 inch on center.
- C. Downspout supports shall be brackets of the appropriate size and spacing.
- D. Fasteners shall be aluminum or stainless steel.

2.03 FABRICATION

- A. Form gutters and downspouts to SMACNA requirements.
- B. Fabricate with required connection pieces.

- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion by providing expansion joints as required.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

#### 2.04 FINISHES

- A. Finish on gutters and downspouts shall match finish on fascia system. All components, including fasteners and supports, shall be prefinished to match gutters and downspouts.

### PART 3—EXECUTION

#### 3.01 INSTALLATION

- A. Install gutters, downspouts, and accessories with manufacturer's instructions.
- B. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Install gutters level.
- D. Seal metal joints watertight.

END OF SECTION

SECTION 07 90 00  
CAULKING AND SEALANTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Caulking and sealants on the project, including primers and backer rod material.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C920—Elastomeric Joint Sealants.

1.03 SUBMITTALS

- A. Submittals shall comply with provisions of Section 01 33 00—Submittals.
- B. Submit color chart for each sealant used on project. Colors will be selected by ENGINEER.
- C. Submit copies of warranty.

1.04 WARRANTY

- A. Caulked joints shall be weathertight and guaranteed watertight by installer for two years from Substantial Completion of the project. Deliver original guarantee to OWNER with copies to ENGINEER.

PART 2—PRODUCTS

2.01 CAULK—NONSUBMERGED AND SUBMERGED NON-POTABLE APPLICATIONS—GENERAL

- A. Caulk for nonsubmerged and submerged non-potable water contact applications in all locations except floor joints shall be a one-part or two-part polyurethane sealant.
- B. Acceptable products include the following, or equal:
  - 1. Masterseal NP1 by Master Builders Solutions.
  - 2. Vulkem 116 by Tremco, Inc. (exterior applications only).
  - 3. Dymonic 100 by Tremco, Inc.
  - 4. Sikaflex-2c NS EZ Mix by Sika Products.

2.02 CAULK—NONSUBMERGED AND SUBMERGED NON-POTABLE WATER APPLICATIONS—FLOOR JOINTS

- A. Caulk for floor joints in nonsubmerged and submerged non-potable water contact applications shall be a one-part, self-leveling, polyurethane sealant.

- B. Acceptable products include the following, or equal:
  - 1. MasterSeal SL1 by Master Builders Solutions.
  - 2. Vulkem 45 SSL by Tremco, Inc.
  - 3. Sikaflex-2c SL by Sika Products.

## 2.03 ACCESSORIES

- A. Backer rod shall be flexible, closed-cell polyethylene rod stock sized to be under at least 25% compression when positioned in the joint. In shallow joints and where backer rod is not used, polyethylene bond breaker tape shall be used. It is essential that the caulk bond to the side of the joint but not to the base of the joint.
- B. Primer(s) shall be used where required by the manufacturer for the specific product(s) used and the specific application(s) intended. Specific product(s) shall be as recommended by the manufacturer.
- C. Cleaning fluid shall be methyl ethyl ketone (MEK), methyl isopropyl ketone (MIK), or similar solvent material which will not etch or mar metal finishes and shall be the product of a nationally recognized manufacturer, of type expressly recommended for use with the caulking or sealant compound used.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Seal completely all joints around entire perimeter of all openings in all exterior walls (inside and outside faces), including joints at all exterior doors, windows, louvers, sills, and elsewhere as noted on the Drawings and as necessary to seal all open joints in the building in a complete manner. Joints in exterior walls shall be caulked in a completely weathertight manner. Joints between interior walls and concrete ceilings and other interior joints shall be caulked as indicated on the Drawings. Caulking not specified in other sections shall be performed under this heading.
- B. All caulking shall be done in accordance with manufacturer's specifications. Allow minimum 28-day curing period for concrete, grout, or mortar prior to caulking unless requested otherwise. Caulking work shall be done before the final coat of paint is applied except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting. All caulking shall occur only when the temperature is above 40°F.
- C. Joints shall be thoroughly cleaned and primed before caulking in accordance with manufacturer's instructions. Unless otherwise shown, joints shall be square in cross section 1/2-inch by 1/2-inch and shall comply with manufacturer's joint width/depth ratio limitations.
- D. Backer rod shall be used in all openings 3/4 inch or more in depth and shall be tightly packed to completely fill the space to 1/2 inch back of face. The 1/2 inch shall then be filled with caulking compound.
- E. Caulking shall be done by hand gun. Compound shall be driven into joint grooves with sufficient pressure to force out all air and fill joint grooves solidly. Caulking where exposed shall be free of wrinkles and shall be uniformly smooth.

- F. At completion of caulking, clean off all excess material from adjoining surfaces and material. Entire installation shall be left in a perfect appearing weathertight condition.

### 3.02 CAULKING EXISTING JOINTS

- A. All caulked joints in walls, ceilings, and floors requiring painting in the Room Finish Schedule (see Drawings) shall be recaulked. Existing caulk and backer shall be completely removed. Caulk joints as specified for new construction.
- B. Caulking of existing joints shall be coordinated with Section 09 91 00–Painting.

END OF SECTION

## SECTION 08 17 43

### FIBERGLASS DOORS AND ALUMINUM FRAMES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes thermally-insulated fiberglass doors and aluminum frames.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 WARRANTY

- A. Provide 10-year warranty on doors and frames signed by manufacturer, installer, and CONTRACTOR.

#### PART 2—PRODUCTS

##### 2.01 FIBERGLASS DOORS

- A. Thermally-insulated fiberglass doors shall be 1 3/4 inches total thickness with a 1 1/2-inch rigid polyurethane core.
- B. Acceptable products include the following, or equal: Special-Lite, Inc., SL-17. Doors shall be provided with concealed adjustable bottom brush, SL-301. Exterior doors shall be provided with concealed proximity card reader pockets, concealed conduit run from the pocket to the hinge side, and a pull string inside the conduit. Card readers to be provided and installed by others at a later date.

##### 2.02 DOOR FRAMES

- A. Frames shall have 4-inch head member at 7 feet 0 inch doors in masonry walls.
- B. Thermally Broken Aluminum frames shall be tube-type, minimum 0.125-inch-thick.
- C. Acceptable products include the following: Special-Lite, Inc., SL-450TB or SL-600TB.

##### 2.03 FABRICATION

- A. Face sheets shall be laminated to the polyurethane core. Face sheets shall be 0.120-inch-thick reinforced polyester. Face sheets shall be Spec Lite 3, Inc., as manufactured by Special-Lite, Inc.
- B. Stiles and rails shall be minimum 2 5/16 inches depth by 0.125-inch-thick aluminum, 6063-T5 aluminum alloy.
- C. All doors shall be mortised and reinforced to receive hardware.

- D. Frames shall be prepared for all door hardware.

## 2.04 FINISH

- A. Color of fiberglass door face sheets shall be chosen by OWNER.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. Set all doors and frames as supplied by manufacturer. Use masonry anchors to support frame.
- B. Hang all doors allowing for expansion and contraction at time of setting.
- C. Set all hardware in accordance with templates as supplied by hardware supplier.
- D. Cover all exposed hardware until completion of painting and finishing.
- E. Examine hardware at completion; test, oil, grease, and adjust as needed for smooth operation.

### 3.02 SCHEDULE

- A. See Door Schedule on the Drawings.

END OF SECTION

## SECTION 08 31 13

### ACCESS DOORS AND FRAMES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work included: Aluminum floor doors and frame units.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

#### PART 2—PRODUCTS

##### 2.01 ALUMINUM FLOOR DOORS AND FRAMES

- A. Acceptable products include the following, or equal: The Bilco Company, Types K.
- B. Type K doors shall be designed for minimum live load of 150 psf with a maximum deflection of 1/150 of span.
- C. Doors shall be constructed of stiffened 1/4-inch aluminum diamond-pattern plate.
- D. Hinges shall be through bolted to the door and frame with tamper-proof Type 316 stainless steel lock bolts.
- E. Type K doors shall have cast steel cam-action hinges that pivot on torsion bars. Doors shall have smooth controlled operation and not be affected by temperature.
- F. Provide hold-open arm that automatically locks in open position. Provide snap lock with fixed handle mounted to underside of cover. Provide removable exterior turn/lift handle with spring-loaded ball detent to open cover. All hardware shall be Type 316 stainless steel for corrosive environment.

##### 2.02 FINISH

- A. Aluminum floor doors and frames shall have mill finish. Apply bituminous coating to portions of frames in contact with concrete.

##### 2.03 ACCESSORIES

- A. All aluminum floor/door openings shall be fitted with a permanently installed, fall-through prevention grating system that is easily retractable for access to the opening below. Grating system shall be factory installed by access door manufacturer.
- B. Performance Characteristics:
  - 1. Grating panel(s) shall be high visibility safety yellow in color.
  - 2. Grating panel(s) shall lock automatically in the full open position.
  - 3. Grating system shall have a twenty-five year warranty.



- 4. Grating panel(s) shall have a provision for locking to prevent unauthorized opening.
- C. Grating: Panels shall be aluminum with a powder coat paint finish and designed to meet OSHA 1926.502(c) and 1910.29 requirements for fall protection.
- D. Hold Open Feature: A Type 316 stainless hold open device shall be provided to lock the cover in the fully open 90 degree position.
- E. Hardware: All hardware shall be Type 316 stainless steel.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.

#### 3.02 ADJUSTING AND CLEANING

- A. Clean exposed surfaces using methods acceptable to the manufacturer that will not damage finish.
- B. Test units for proper function and adjust until proper operation is achieved.
- C. Repair finishes damaged during installation.
- D. Restore finishes so no evidence remains of corrective work.

#### 3.03 SCHEDULE

- A. See Door Schedule on the Drawings.

END OF SECTION

## SECTION 08 51 13

### ALUMINUM WINDOWS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes exterior extruded aluminum window frames.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. AAMA 101—Specifications for Aluminum Prime Windows and Sliding Glass Doors.
- B. ASTM E283—Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
- C. ASTM E330—Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- D. ASTM E331—Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- E. ASTM B221—Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
- F. AAMA 611—Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand a minimum static air pressure difference of 90 psf for exterior windows and 60 psf for interior windows in accordance with ASTM E330.
- B. Limit member deflection to 1/175 with full recovery of glazing materials.
- C. System to accommodate, without damage to components or deterioration of seals, movement between window and perimeter framing, deflection of lintel.
- D. Limit air leakage through assembly to 0.10 cfm/min/sq ft of wall area measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E283.
- E. Water leakage: None when measured in accordance with ASTM E331 with a test pressure difference of 10 psf.

##### 1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.

## PART 2-PRODUCTS

### 2.01 EXTERIOR WINDOWS

- A. Exterior window frames shall be 2-inch-deep extruded aluminum, in accordance with ASTM B221, with thermobreak.
- B. Acceptable products include the following, or equal:
  - 1. Kawneer Sealair 8225T Isolock, Fixed Windows.
  - 2. Oldcastle Signature Series 12P Fixed Windows.

### 2.02 FABRICATION

- A. Aluminum extrusions shall be not less than 0.125 inch thick.
- B. All fabrication and erection fasteners shall be 18-8 stainless steel.
- C. Unless shown otherwise, provide 0.040-inch aluminum sill plates on exterior of window. Finish shall match window.
- D. Permit internal drainage weep holes and channels to migrate moisture to exterior. Provide internal drainage of glazing spaces to exterior through weep holes.
- E. Nominal window height and length for all windows shall be as shown in the schedule. CONTRACTOR shall measure all openings and coordinate sizes with window supplier.

### 2.03 FINISH

- A. Finish on all exposed aluminum shall be architectural class 1, anodic coating, confirming to AAMA 611. Color to be selected by OWNER.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Field verify wall opening sizes.
- B. Frames shall be securely attached to masonry as recommended by the window manufacturer.

### 3.02 SCHEDULE

- A. See Window Schedule on the Drawings.

END OF SECTION

## SECTION 08 71 00

### DOOR HARDWARE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Hardware to fully equip all doors.
  - 2. Thresholds and weatherstripping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NFPA 80—Fire Doors and Windows.

##### 1.03 REGULATORY REQUIREMENTS

- A. Hardware shall conform to the Kentucky Building Code for requirements applicable to fire-rated doors and frames. Hardware shall comply with NFPA 80 and shall be properly stamped or labeled for easy identification.
- B. Hardware shall comply with barrier-free requirements.

#### PART 2—PRODUCTS

##### 2.01 LOCKSETS AND LATCHSETS

- A. Lockset and latchset numbers listed in Paragraph 3.02 Schedule are PDQ.
- B. Provide removable core brass PDQ SF IC 7-pin cylinder(s) with construction cores.

##### 2.02 EXIT DEVICES

- A. Exit devices shall be PDQ 6300 Series, or equal, and shall be equipped with reinforced cross bars and functions as indicated on the hardware sets. Refer to the schedules in Section 3.02 for required exit devices for different areas and applications. The exit device shall be operated by a lockable lever from the exterior side, PDQ 6EW Series Heavy Duty Exit Device Trim.

##### 2.03 HINGES

- A. Continuous hinges shall be Special-Lite SL-11HD, or equal.

##### 2.04 DOOR CLOSERS

- A. Door closers shall be PDQ 7100 Series Extra Heavy Duty Closers with hold open arm, or

equal. Provide aluminum finish on closers. Provide full covers. Door closers for locations noted as (ss) shall have the SRI primer for corrosion resistance.

## 2.05 SURFACE BOLTS

- A. Surface bolts shall be 8-inch Ives 1630 series, or equal. At doors with (ss) hardware, bolts shall be 8-inch Ives 1640 Series, or equal. Top and Bottom surface bolts shall be provided.

## 2.06 KICKPLATES

- A. Kickplates shall be Rockwood, or equal, 10 inches high. Kickplate width shall be 2 inches less than door width.

## 2.07 DOOR STOPS

- A. Provide wall- or floor-mounted door stops at all interior doors. Stops shall be Glynn Johnson GJFB-13, GJ60C, or GJ60W for locations noted as (ss), or equal.

## 2.08 THRESHOLD AND WEATHERSTRIPPING

- A. All exterior doors shall be weatherstripped with NGP 5075CL Triple Fin Smoke Seal, or equal. Provide NGP 896N Aluminum Bumper Threshold, or equal, thresholds for exterior doors. Provide NGP 513 Aluminum Saddle Threshold, or equal, for interior doors.

## 2.09 PUSH/PULL BARS

- A. Push bar shall be PDQ 6EW Escutcheon Trim Wide Stile with Philadelphia lever.

## 2.10 PUSH PLATE AND PULL

- A. Push/pull plate shall be Rockwood No. 70C 4-inch by 16-inch with 111 x 70C pull manufactured by Rockwood.

## 2.11 KEYING

- A. Door keys shall be keyed to match existing plant key system. Provide two keys per lock. Doors shall have temporary construction cylinders. Provide permanent cylinders at project completion.

## 2.12 ROLLER LATCH

- A. Roller latch shall be Glynn Johnson GJ32, or equal.

## 2.13 LATCH PROTECTION PLATE

- A. Latch protection plate shall be 3 inches by 11 inches for use with cylindrical locksets with a 2 3/4-inch backset. Protection plate shall be steel with finish to match door hardware, Hager 341D, DonJo MLP211, or equal.

## 2.14 FINISH

- A. Finish for all hardware, except as noted below, shall be US 26D or US 32D where stainless steel (ss) hardware is specified.
- B. Finish for surface bolts shall be US 26D; finish for kickplates shall be 32D.
- C. Where stainless steel (ss) is specified, all hardware, including threshold and weatherstripping, shall be installed with stainless steel fasteners.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Provide finish hardware to fully equip all doors.
- B. Install hardware in accordance with manufacturer's instructions.

### 3.02 SCHEDULE

- A. Provide the following hardware groups in the amounts indicated on the door schedule or required for a complete and proper installation:

#### Group 1

SINGLE INTERIOR OR EXTERIOR  
DOOR (SS)

Exit Device—PDQ 6300RA 630 Rim Panic  
Exit Device Trim—PDQ GEW 08 PHL SF7L  
Door Closer—PDQ 7100 Series  
Continuous Hinges, Kickplate, and all other  
accessories, as specified

#### Group 2

EXTERIOR DOOR (SS) INACTIVE  
LEAF

Exit Device—PDQ 6300M 630 Mortise  
Panic Exit Device Trim—PDQ GEW 08 PHL  
SF7L  
Door Closer—PDQ 7100 Series  
Continuous Hinge, Kickplate, and all other  
accessories, as specified

#### Group 3

EXTERIOR DOOR (SS) ACTIVE  
LEAF

Levers—Rigid, each face, PDQ GEW style, no  
cylinders  
Surface Bolt—Top and bottom  
Door Closer—PDQ 7100 Series  
Continuous Hinge, Kickplate, and all other  
accessories, as specified

END OF SECTION

## SECTION 08 81 00

### GLAZING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes glass and glazing for windows and door lights.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. GANA–Glass Association of North America.
- B. NFPA 257–Standard on Fire Test for Window and Glass Block Accessories.
- C. NFPA 80–Standard for Fire Doors and Other Opening Protectives.
- D. UL 9–Standard for Safety Fire Tests of Window Assemblies.

##### 1.03 WARRANTY

- A. Exterior insulating glass shall be provided with a 10-year warranty against failure of the seal.
- B. Coated glass shall be provided with a 10-year warranty against peeling, cracking, or deterioration of the coating.

#### PART 2–PRODUCTS

##### 2.01 EXTERIOR GLASS

- A. Glass in exterior metal windows and exterior door lights shall be 1-inch-thick insulating glass consisting of two pieces of 1/4-inch float glass separated by a 1/2-inch air space.
- B. Acceptable manufacturers include the following, or equal: Oldcastle Glass Company, PPG Solarban 70XL.
- C. Glass shall be Low-E with clear tint outboard light and clear tint inboard light with the following maximum values, or equal.

	Shading Coefficient	U-Value		SHGC
		Winter	Summer	
Clear	.32	.28	.26	.27

- D. Exterior windows adjacent to doors and exterior door lights shall have tempered glass in compliance with the governing building code.

## 2.02 GLAZING COMPOUNDS AND ACCESSORIES

- A. Glazing system shall consist of a polyisobutylene-butyl tape, liquid polymer sealant, and vinyl roll-in strip.
- B. Acceptable products include the following, or equal:
  - 1. Tremco Vision Strip System.
  - 2. General Electric Silglaze.

## 2.03 FABRICATION

- A. Glazing of windows shall be from the interior.
- B. Accessories such as setting blocks, clips, etc., shall be provided to properly set glass.
- C. Obtain sizes from work at the site or from the manufacturer of work into which the materials will be set. Responsibility for the correctness of measurements shall be assumed by CONTRACTOR.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Comply with "Glazing Manual" by Glass Association of North America (GANA), except as specifically recommended otherwise by manufacturers of the glass and glazing materials.
- B. Completed installation shall be water- and airtight.

END OF SECTION



## SECTION 09 91 00

### PAINTING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Surface preparation and application of paints and coatings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
- B. ASTM D2247—Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity.
- C. ASTM D3363—Standard Test Method for Film Hardness by Pencil Test.
- D. ASTM D4060—Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- E. ASTM D4541—Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. ASTM D4585—Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- G. Federal Register—Code of Federal Regulations (CFR).
- H. Federal Register—Resource Conservation and Recovery Act (RCRA).
- I. Federal Register—Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
- J. ICRI—International Concrete Repair Institute.
- K. NACE—National Association of Corrosion Engineers.
- L. SSPC—The Society for Protective Coatings—Steel Structures Painting Manual.

##### 1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop primer proposed for use shall be submitted with all material and equipment submittals. All shop primers shall be of the same generic type and quality as those specified herein.

- C. Submit manufacturer's Safety Data Sheets (SDS) for each type of paint with each shop drawing submittal. SDS sheets shall be posted at the construction site at all times painting is in progress.
- D. Substitution submittals shall include performance test data, as certified by a qualified testing laboratory, for the ASTM tests specified in Paragraph 2.01.

#### 1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
- B. Prepainting Meeting:
  - 1. A prepainting meeting shall be held immediately following the project preconstruction conference. The prepainting meeting is to be held prior to any material and equipment that requires painting is delivered to the site.
  - 2. CONTRACTOR, the paint subcontractor, and the paint manufacturer's representative shall be present to review the specifications and project scope.
  - 3. The paint manufacturer's representative shall review progress at the site as requested by ENGINEER. These are generally expected to be prior to monthly progress meetings.

#### 1.05 FIELD QUALITY CONTROL

- A. Furnish testing apparatus as applicable for observing surface preparation, testing atmospheric conditions and testing coatings, prior to beginning surface preparation. Provide the following apparatus:
  - 1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.
  - 2. One wet-film thickness gauge.
  - 3. One dry-film thickness gauge, Mikrotest III, 0-40 mils with calibration standard approved by the Bureau of Standards.
  - 4. One Bacharach Sling Psychrometer, Model 12-7011.
  - 5. Tinker and Razor Model M-1 Holiday Detector and recommended wetting agent.
  - 6. One set of SSPC-VIS 1-89 Visual Standards for Abrasive Blast Cleaned Steel.
- B. Provide access via scaffolding or staging for inspection.
- C. Entire surface of coated submerged concrete shall be tested with holiday detector. Mark and repair all pinholes, then retest until no pinholes are found.
- D. CONTRACTOR shall provide documentation to ENGINEER of conditions before and during painting operations for each area and each day's work. Documented conditions shall include the following at a minimum: date, area of work, system used, preparation methods, environmental conditions, quantity and thickness of coating placed, noted conditions, and nonconforming items. ENGINEER can provide sample report form if CONTRACTOR does not have their own.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original containers with labels intact and seals unbroken.

- B. Drop cloths shall be used in all areas where painting is done to fully protect other surfaces.
- C. Oily rags and waste must be removed from the building each night or kept in an appropriate metal container.

#### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. CONTRACTOR shall dry-heat, dehumidify, and ventilate to obtain painting conditions recommended by the paint manufacturer during surface preparation, application, and cure.
- B. Relative humidity conditions as specified by the paint manufacturer's data sheet shall be adhered to. This includes times in which supplemental heat is used. Supplemental heat shall be indirect-fired hot air furnaces or electric heat. Open-flame heaters shall not be used.
- C. No unprotected, unheated exterior painting shall be undertaken when damp weather appears probable, nor when the temperature of the substrate is below 55°F, unless approval in writing is received from the paint manufacturer.

#### 1.08 COLOR SELECTIONS

- A. Provide color charts for all coatings being used on the project. After initial selection of colors by OWNER, provide draw down samples of selected colors for OWNER's final approval. For stained wood, provide specified wood species sample with selected color for final approval.
- B. CONTRACTOR shall provide a summary sheet at the completion of the project listing the finish paint products used and the manufacturer's color identification for each item painted. This summary sheet should be submitted to ENGINEER and OWNER for review.

### PART 2-PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. All materials required for painting shall be types and quality as manufactured by Tnemec Company, Inc., Sherwin-Williams Company, Carboline, PPG Protective and Marine Coatings, or equal, unless noted otherwise in the schedule.
- B. Where thinning is necessary, only the products of the manufacturer furnishing the paint will be allowed. All such thinning shall be done strictly in accordance with the manufacturer's instructions.
- C. Paint and paint products of Tnemec Company and Sherwin-Williams, listed in the following specifications, are set up as standard of quality. Carboline and PPG Protective and Marine Coatings have preapproved equivalent products that shall be used. Other manufacturer's products will be considered as a substitution if CONTRACTOR and paint manufacturer certify that the products offered are recommended for the service intended, are compatible with the shop primers used, are equal in solids content and composition, and are of the same type. Submittal shall include the following performance data as certified by a qualified testing laboratory. ASTM Specifications shall be the latest revision:
  - 1. Abrasion-ASTM D4060, CS-17 Wheel, 1,000 grams load.
  - 2. Adhesion-ASTM D4541.
  - 3. Hardness-ASTM D3363.
  - 4. Humidity-ASTM D2247 and D4585.

5. Salt (Fog) Spray–ASTM B117.

## PART 3–EXECUTION

### 3.01 SURFACE PREPARATION

#### A. General:

1. All surfaces to be painted shall be prepared as specified herein and by the manufacturer's published data sheet and label directions. The objective shall be to obtain a uniform, clean, and dry surface.
2. No field painting shall be done before the prepared surfaces are observed by ENGINEER. Surfaces painted without such observation shall be abrasive-blast-cleaned and repainted.
3. Prior to field-blasting, a sample of the blast abrasive shall be provided to ENGINEER for pH testing. Additional samples of subsequent deliveries or batches of blast abrasive shall be provided to ENGINEER for pH testing.
4. For on-site abrasive-blasting, low-dust, low-silica content material shall be used. Coal slag abrasive shall be used on pipe and ferrous materials. Staurolite abrasive shall be used on concrete and concrete block.
5. Quality of surface preparations listed below are considered a minimum. If paint manufacturer requires a better preparation for a particular application, it shall be considered a requirement of this specification.
6. All concrete surfaces shall be tested for moisture in accordance with ASTM D4263 and, if necessary, F1869. Surfaces shall also be verified that the pH of the cleaned concrete surface to be coated is within the range of 8 to 11.

#### B. Ferrous Metal:

1. All ferrous metal to be primed in the shop shall have all rust, dust, and mill scale, as well as all other foreign substances, removed by abrasive blasting. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
2. All ferrous metals not primed in the shop shall be abrasive-blasted in the field prior to application of the primer, pretreatment, or paint.
3. Abrasive blasting of metals in the shop shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for immersion service shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for nonimmersion service shall be in accordance with SSPC-SP6 Commercial Blast Cleaning.
4. Solvent cleaning in accordance with SSPC-SP1 shall precede all abrasive-blasting operations.
5. Ductile iron pipe shall be prepared by abrasive blasting per National Association of Pipe Fabricators NAPF 500-03-04 Abrasive Blast Cleaning.
6. Prior to finish coating, all primed areas that are damaged shall be cleaned and spot-primed.

#### C. Concrete:

1. All concrete surfaces, including precast concrete to be painted, shall be cleaned of all form oil, curing compound, and other foreign matter. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues.
2. All new concrete and precast concrete walls, floors, and ceilings shall be abrasive-blast cleaned in accordance with SSPC-SP13/NACE No. 6 in order to prepare the surfaces for adherence of the painting systems as specified. Abrasive blasting of concrete shall result in a surface profile in accordance with ICRI No. 03732 at CSP-3 to CSP-5.

3. Bug holes, pits, voids, and cracks shall be filled as specified in Section 03 30 00—Cast-In-Place Concrete without placing a friable sand-cement surface overall. The dried surface shall be stoned down.
  4. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
  5. After cleaning, the surface shall be washed and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.
- D. Existing Concrete and Concrete Block:
1. All previously coated walls and ceilings of concrete and concrete block of existing structures, except as noted, shall be pole-sanded and hand-sanded to remove all old peeling paints as well as roughen-up existing paints.
  2. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues and allowed to dry.
  3. All existing floors, unless otherwise specified, shall be power-sanded with a Clark HD floor scrubber, or equal, with a rubber pad and abrasive disc, followed by vacuuming and removing all oil and grease contamination and particulate matter.
  4. Bug holes, pits, voids, and cracks that are opened up shall be filled with an appropriate filler.
  5. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
  6. After cleaning, the surface shall be washed, and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.
- E. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with nonhydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC-SP1 and shall be abrasive-blasted in accordance with SSPC-SP16 Brush-Off Blast Cleaning.
- F. Copper: Where copper piping is not submerged or buried, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- G. PVC and CPVC: All PVC and CPVC to be painted shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- H. Aluminum: Where listed in the Schedule to be painted, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- I. Wood:
1. Wood surfaces shall be thoroughly cleaned and free of all foreign matter. Cracks and nail holes and other defects shall be properly filled and smoothed.
  2. Wood trim shall be sandpapered to a fine finish and wiped clean of dust.
- J. Dust Controls:
1. All motors, pumps, mechanical equipment, and electrical controls shall be wrapped in 6 mil opaque plastic sheeting and taped in place with 3-inch-wide tape where abrasive blasting or spray coating application is being performed.
  2. Plastic sheeting shall be provided with continuous filtered clean air supply to create a positive pressure relative to surrounding spaces.

### 3.02 APPLICATION

- A. All materials shall be used as specified by the manufacturer's published data sheets and label directions.
- B. No paint shall be applied on a wet or damp surface and in no case until the preceding coat is dry and hard. Each coat shall be allowed to dry in accordance with manufacturer's data sheets before the next coat is applied.
- C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, other drying times will be necessary.
- D. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry and cured.
- E. Steel that will be inaccessible in the completed work shall receive the final coat before enclosure.
- F. Paint shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Tops and bottoms of walls and areas that are "cut-in" by brush prior to rolling shall have a uniform appearance in comparison with adjoining surfaces.
- G. Concrete block walls shall be back-rolled to achieve a pinhole-free surface coat.
- H. Walls and ceiling surfaces shall receive a minimum of one coat of paint before surface-mounted items such as conduits, boxes, piping, etc., are installed on these surfaces.
- I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of the first field coat of primer or intermediate coat. This includes, but is not limited to, between pipe flanges, pipe flange/pipe barrel joints, equipment fittings, and other narrow openings.
- J. No paint shall be applied to new or existing surfaces until joints have been caulked according to Section 07 90 00—Caulking and Sealants requirements, except at moving joints which shall be finish-painted before caulking or caulking shall be protected during painting.
- K. For PVC and CPVC piping, unions and valves shall not be painted.

### 3.03 FIELD QUALITY CONTROL

- A. Examination of work on the site by the manufacturer's representative shall be performed when requested by ENGINEER.

### 3.04 CLEANING

- A. All stains and marks shall be removed from other surfaces upon completion of the work.

### 3.05 SCHEDULE

#### A. General:

1. At the completion of the project, all painted surfaces which have been damaged shall be repainted or touched-up.
2. See Finish Schedule on the Drawings for an additional reference for areas to be painted.
3. The painter shall use some discretion in what should and should not be painted. Do not paint over labels and other information, bronze, machined surfaces, moving parts where painting may impair movement, hot surfaces which may peel, etc. If in doubt whether a part should be painted, ask ENGINEER.
4. Products listed first are Tnemec and second are Sherwin-Williams.

#### B. New Work:

1. All new work done by all trades shall be painted by CONTRACTOR in accordance with the following schedule and in accordance with paint manufacturer's recommendation. It is the intent of these specifications that all non-galvanized ferrous metal items scheduled for painting be shop-primed. If items are not shop-coated, surfaces shall be prepared and painted in the field as specified. If any items of new construction are not listed, CONTRACTOR shall request paint system from ENGINEER, and the items shall be painted as part of this Contract without additional cost.
2. Interior concrete floors, including equipment bases: One prime coat of 201 Epoxoprime, ArmorSeal 1000 HS Epoxy (reduced), hand broadcast antiskid sand into the wet paint between finish coats in locations as requested by OWNER, and two finish coats of 280 Tneme-Glaze, ArmorSeal 1000 HS Epoxy.
3. Interior concrete block walls and concrete walls: One filler coat of Epoxoblock WB 1254, Kem Cati-Coat HS, and two coats Series N69 Hi-Build Epoxoline II, Macropoxy 646.

Note: Paint shall be roller- or brush-applied to concrete sound-absorptive block.

4. All exposed concrete ceilings (ceilings of water-containing tanks are not considered exposed): Two coats of Series N69 Hi-Build Epoxoline, Macropoxy 646.
5. Cast or ductile iron; not submerged or buried (including pipes to be insulated):
  - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
  - b. Touch-up prime coat prior to finish coating; and apply either:
    - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces, or
    - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
6. Cast or ductile iron, tar coated; buried: Not painted.
7. Cast or ductile iron, submerged:
  - a. One shop coat Series 1 Omnithane (20HS or N69-1255 Epoxoline), Dura-Plate 235 Beige as primer.
  - b. Touch-up prime coat prior to finish coating and one stripe coat on all edges of N69 Epoxoline, Dura-Plate 235.
  - c. Two coats of Series N69-Hi-Build Epoxoline II, (one coat) Sher-Glass FF.
8. Steel, machinery, and equipment; not submerged (including pipes to be insulated):
  - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer.
  - b. Touch-up primer prior to finish coat, and either:
    - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
    - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

9. Steel, machinery, and equipment, submerged:
    - a. One shop coat Series 1 Omnithane (20HS or N69-1255 Epoxoline), Dura-Plate 235 Beige as primer.
    - b. Touch-up prime coat prior to finish coating, and one stripe coat on all edges of N69 Hi-Build Epoxoline, Dura-Plate 235.
    - c. Two coats of N69 Hi-Build Epoxoline, (one coat) Sher-Glass FF.
  10. Galvanized, copper, CPVC, and PVC; submerged or buried: Not painted.
  11. Aluminum items:
    - a. Exposed areas of structural items such as railings and grating shall not be painted.
    - b. For structural items in contact with concrete, see Division 05.
  12. Stainless steel: Not painted.
- C. Existing Areas: Existing areas damaged by removal of existing work and/or installation of new work shall be repainted to match existing and in accordance with the schedule for new work. Existing equipment and structures shall be painted with the following schedule and as listed in the Finish Schedule, or as noted on the Drawings.
1. Precast Ceilings: Interior which remain exposed and are currently painted.
    - a. Prepare and overcoat as specified.
    - b. Coat in accordance with Item 4 of new work.
  2. Concrete floors which are currently finished:
    - a. Remove existing coating as specified.
    - b. Coat in accordance with Item 2 of new work.
  3. Interior concrete block walls which are currently painted and remain exposed:
    - a. Prepare and overcoat as specified.
    - b. Provide spot masonry filler coat as needed and two finish coats per Item 3 of new work.
- D. Coverage:
1. Dry mil thickness shall conform to those specified. Mil test measurement shall conform to SSPC Steel Structures Painting Manual. Dry Film Thickness (DFT) shall be verified in accordance with SSPC-PA2.
  2. The coatings listed will provide the mil thickness given when applied at the coverages listed. Upon the request of ENGINEER, such surfaces shall be checked by the painter with a calibrated mil thickness gauge and any deficiencies found in the film shall be remedied by additional coat(s) at the expense of CONTRACTOR.
  3. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative pinhole-free finish either by decreasing the coverage rate or by applying additional coats of paint.
  4. Coverages reflect manufacturer's recommendations using spray application techniques. Where brushing or rolling is specified or performed at the discretion of the painter, one additional coat, minimum, will be required to achieve total DFT as specified and recommended by the manufacturer.

	Sq. Ft.** Coverage	Dry Mil** Thickness Per Coat
<b>Products</b>		
N69 Hi-Build Epoxoline II, Macropoxy 646		
Steel or Impervious Substrate Primer Coat	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish Coat	---	5.0
1074 Endura-Shield II, Acrolon 218HS	---	2.5



	Sq. Ft.** Coverage	Dry Mil** Thickness Per Coat
201 Epoxoprime, ArmorSeal 1000 HS Epoxy	250	
280 Tneme-Glaze, ArmorSeal 1000 HS Epoxy	250	
Epoxoblock WB 1254, Kem Cati-Coat HS	80	
N69 Hi-Build Epoxoline, Macropoxy 646 (Masonry and Concrete)	250	
Series 1 Omnithane, DuraPlate 235 (Primer)		3.0, 5.0
N69 Hi-Build Epoxoline II (Submerged)		6.0
Sher-Glass FF (Submerged)		12.0

\*\* Roller or brush application requires two or more coats to obtain recommended film thickness. No allowance is made here for overspray, waste in handling, mixing, or application. Final total DFT shall be equal to that specified. Paint submittals shall note where roller or brush application is proposed and the paint manufacturer's recommendations of number of coats to achieve the required thickness shall be noted.

Primer, intermediate and/or final surface colors shall be of contrasting colors to promote coverage.

- E. Pipe Colors: Colors are to be selected by OWNER, with the following piping colors used where applicable. Pipe color shall be in accordance with the requirements of the Kentucky Administrative Code and Ten States Standards.

WATER PIPING COLORS	
Pipe Type	10 States Standards (2012 Water)
Chlorine (solution)	Yellow
Drain	---

Section 653.120 Piping Identification: Piping in a water treatment facility shall be identified clearly by legends and color coding as described in the Standards or American National Standards Institute (ANSI) Standard A-13.1. A consistent standard shall be used throughout the system.

- F. Shop Finish Painting: The following items shall have factory-applied finishes and will not require field painting. CONTRACTOR shall field touch-up any damaged areas with factory-provided touch-up coating.
1. Hoists, trolleys, and cranes.
  2. Chemical feed system pumps and accessories.
  3. Submersible pumps.
  4. Motor control centers.
  5. Supervisory control centers.
  6. Switchgear.
  7. Sump pumps.
  8. Aluminum windows.
  9. Fiberglass doors.

END OF SECTION

## SECTION 10 00 20

### MISCELLANEOUS SPECIALTIES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Neoprene gaskets.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

#### PART 2–PRODUCTS

##### 2.01 NEOPRENE GASKETS

- A. Furnish and install neoprene gaskets at weir plates and as called for on the Drawings.
- B. Neoprene shall be of the size and thickness shown on the Drawings. Minimum thickness shall be 1/8 inch. The material shall be 40-50 durometer premium-grade neoprene. Only virgin polymers shall be used to manufacture the neoprene. A certificate of material quality shall be furnished.
- C. Where splices are necessary, they shall be butt splices made with a two-part neoprene base-bonding cement. The vulcanizing cement shall be Black Cement by CPR Industries of Carteret, New Jersey, or equal.
- D. At splices in weir plates, provide an additional thickness of neoprene to match the plate material. Bond the additional neoprene to the continuous gasket using the cement specified for splices.
- E. All gaskets shall be watertight.

#### PART 3–EXECUTION

##### 3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.

END OF SECTION

SECTION 23 11 23  
FACILITY FUEL GAS PIPING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: All facility fuel gas pipe and fittings unless otherwise noted.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. NFPA 54–National Fuel Gas Code (Current Edition).
  - 2. ANSI B16.3–Malleable Iron Threaded Fittings.
  - 3. ASTM A53–Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - 4. ASTM A234–Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
  - 5. 2002 International Fuel Gas Code.

1.03 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept piping on-site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

- C. Protect piping systems from entry of foreign materials by installing temporary covers, completing sections of the work and isolating parts of completed system.
- D. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place.

#### 1.06 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings.
- D. Use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at CONTRACTOR's option. Where the grade or type is not specified, CONTRACTOR may choose from those commercially available.

#### 1.07 WELDER QUALIFICATIONS

- A. Before any metallic welding is performed, CONTRACTOR to submit their Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.
- B. Before any polyethylene fusion welding is performed, CONTRACTOR to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- C. ENGINEER and OWNER reserves the right to test the work of any welder employed on the project, at CONTRACTOR's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

### PART 2-PRODUCTS

#### 2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state, and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Buried natural gas shall be in accordance with Section 33 52 16-Fuel Gas Distribution Utilities.

## 2.02 NATURAL GAS

- A. 2-Inch and Smaller: ASTM A53, type E or S, standard weight (Schedule 40) black steel pipe with ASTM A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
- B. 2 1/2-Inch and Larger: ASTM A53, type E or S, standard weight black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
- C. Exposed piping shall be painted in accordance with Section 09 91 00–Painting. Where not labeled on manufacturer nameplate, regulator tags shall indicate inlet pressure, outlet pressure, and flow. Appliance regulators provided by equipment manufacturer as part of a manufacturer's gas train are not required to be tagged.

## 2.03 VENTS AND RELIEF VALVE DISCHARGE PIPING

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

## 2.04 UNIONS AND FLANGES

- A. 2-Inch and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.
- B. 2 1/2-Inch and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2 1/2-inch may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.
- C. Provide ASTM A 193 B7 grade bolts and A 194 2H grade nuts and hardened washers for connections (star washers for grounding).

## 2.05 GASKETS

- A. Fuel Oil and Natural Gas Systems: Branded, compressed, non-asbestos sheet gaskets. Klingsil C4401, Garlock 3000, or JM Clipper 978-C.

# PART 3–EXECUTION

## 3.01 PREPARATION

- A. Remove all foreign material from interior and exterior of pipe and fittings.

### 3.02 INSTALLATION

#### A. Support:

1. All interior or exposed pipelines shall be securely supported by adjustable metal saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile.
2. Strap hangers, tin clips, or U-hooks will not be acceptable.
3. In general, the maximum spacing of supports shall not exceed 10 feet on centers.
4. Insulation saddles shall be used. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the Drawings.
5. The weight of the piping shall be supported independently of connected equipment.
6. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so that stress will not be transferred to them.
7. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
8. The following maximum spacings shall be provided for supports:

MAXIMUM HORIZONTAL PIPE  
HANGER AND SUPPORT SPACING

Nominal Pipe or Tube Size	Black Steel (See Note 1) ft
3/4	8
1	8
1 1/4	8
1 1/2	8
2	10
2 1/2	10
3	10
4	10
5	10
6	10
8	10
10	10
12	10

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

9. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall

be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.

10. Provide saddles or shields under piping hanger and supports for all insulated piping to prevent crushing of insulation. Provide stainless steel pipe shields under stainless steel piping to prevent indentation of piping from the support or clamp.
11. Vertical piping shall be supported at each floor level and at intervals as specified for horizontal piping.

B. Penetrations:

1. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping.
2. The sleeve diameter shall not exceed the pipe O.D. (or flange O.D. where applicable) plus 2 inches, unless otherwise shown on Drawings.
3. If the concrete members are to be watertight, the annular space around the pipe shall be sealed with an approved mechanical seal.
4. Where pipes pass through a roof, they shall be run through an approved roof penetration with flashing and counter-flashing.
5. Where pipes pass through nonwatertight walls, the annular space shall be grouted full.
6. Where pipes pass through nonwatertight floors, the sleeve shall extend 1-inch above the finished floor elevation, and the annular space shall remain open.
7. Space between wall sleeve or wall pipe and concrete shall be filled with nonshrinking mortar.
8. The annular space between the wall sleeve and pipe shall be sealed with an approved mechanical seal.
9. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and grouted full (walls), remain open (floors).
10. Plug abandoned pipes and wall pipes, after pipe and fitting removal, flush to the concrete surface with nonshrinking mortar, or as otherwise acceptable, to achieve a watertight seal.
11. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the Drawings or Specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case, where such cutting or core drilling is necessary, shall reinforcing rods be cut or disturbed without prior consultation with ENGINEER.
12. All openings for pipe work shall be neatly patched in a workmanlike manner.

C. Layout:

1. Install all piping parallel to building walls and ceilings and at heights that do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult Drawings for location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
2. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings and floors, to permit access for covering of pipe and painting work.
3. Care shall be taken in laying out piping that there is no interference with the proper location of piping for other purposes or other equipment, and shall be run with regard to the requirements of each service.
4. Piping shall not interfere with headroom or clear floor space.

5. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings, constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.
6. An ample number of unions shall be provided in all threaded, soldered, and glued pipelines and at all equipment to facilitate removal and replacement. Install a shutoff valve at each appliance.
7. In joining two dissimilar types of pipe, standard fittings shall be used when available. The proposed joint shall be submitted by CONTRACTOR to ENGINEER for review prior to installation.

### 3.03 ERECTION

- A. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- B. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.
- C. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half the diameter of the main.
- D. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

### 3.04 WELDED PIPE JOINTS

- A. Welding of pipe in normally occupied buildings is prohibited. Off-site welding is acceptable.
- B. If welding is required in a normally occupied building for connecting to an existing welded system, written approval from OWNER shall be obtained and shall comply with building's fire and life safety, as well as hot work requirements.
- C. Piping and fittings shall be welded and fabricated in accordance with ASME/ANSI latest editions of B31 for all systems from the Code for Pressure Piping. Machine beveling in CONTRACTOR's shop is preferred. Field beveling may be done by flame cutting to recognized standards.
- D. Provide complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Maintain inside of fittings free from globules of weld metal.
- E. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipes shall have the ends beveled 37 1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction shall not be permitted.
- F. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.



- G. CONTRACTOR shall not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same procedure as the completed weld. Otherwise, remove tack weld during welding operation.
- H. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- I. Remove dirt, scale or other foreign matter from the inside of the piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
- J. Schedule 40 pipe shall in no case be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 shall be welded with no less than four passes, including one stringer/root, two filler and one lacer. In all cases, the weld must be filled before the cap weld is added.
- K. Weld Testing:
  - 1. All welds are subject to inspection, visual and/or x-ray, for compliance with Specifications. OWNER will at OWNER's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or x-ray testing. Initial visual and x-ray inspections will be provided by OWNER. CONTRACTOR shall be responsible for all labor, material and travel expenses involved in the reinspection and retesting of any welds found to be unacceptable. In addition, CONTRACTOR shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1 and B31.3 because of the discovery of poor, unacceptable or rejected welds.
  - 2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accordance with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

### 3.05 THREADED PIPE JOINTS

- A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

### 3.06 NATURAL GAS

- A. Pitch horizontal piping down 1-inch in 60 feet in the direction of flow. Install a 4-inch minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- B. Do not install gas pipe in a ventilation air plenum.
- C. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.
- D. Piping through a roof shall be run through an approved roof penetration with flashing and counter flashing.

- E. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- F. Clean all welded piping before all regulators and control valves. Test by placing target cloth over piping and blow with compressed air. Clean piping until target cloth is clean and free of debris.

### 3.07 VENTS AND RELIEF VALVE DISCHARGE PIPING

- A. Install vent and relief valve discharge lines as indicated on the Drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than 6 feet above a roof line. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- B. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminate with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least 7 feet above grade or pedestrian traffic and a minimum of 3 feet above or 10 feet horizontally from all air intakes or building openings. Provide stainless steel insect screens on vent outlets.

### 3.08 UNIONS AND FLANGES

- A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.
- B. Provide dielectric isolation device where nonferrous lines connect to ferrous lines or equipment, such as dielectric union, coupling, or dielectric flange fitting.

### 3.09 PIPING SYSTEM LEAK TESTS

- A. Piping system shall be tested as a complete unit or in sections. Under no circumstances shall a valve in a line be used as a bulkhead between gas in one section and test medium in an adjacent section, unless two valves in series are installed with a valved "telltale" located between these valves.
- B. Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- C. All natural gas systems shall be inspected, tested, purged and placed into operation in accordance with NFPA 54 and as required by local code. Tester shall submit pneumatic tests to ENGINEER.
- D. Conduct pressure test with air. Test time and pressure shall be as indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test

must be witnessed by ENGINEER. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

System	Pressure	Medium	Duration
Natural Gas	Test pressure shall be no less than 1.5 times the proposed maximum working pressure, but not less than 3 psi. Where the test pressure exceeds 125 psi, test pressure shall not exceed 50% minimum yield strength of pipe.	Air, carbon dioxide, nitrogen, or inert gas.	1/2 hour per 500 cubic feet pipe volume not to exceed 24 hours. Test duration shall be not less than 1/2 hour for each 500 cubic feet of pipe volume or fraction thereof. When testing a system having a volume less than 10 cubic feet the test duration shall be a minimum of 60 minutes. The duration of the test shall not be required to exceed 24 hours.

- E. Gradually increase the pressure to not more than one half of the test pressure; then increase pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. After testing is complete, slowly release the pressure in a safe manner.
- F. All necessary piping, fittings, blind flanges, and apparatus for conducting tests shall be furnished by CONTRACTOR and shall comply with the requirements of NFPA 54 and as required by local codes.
- G. All new rough-in distribution piping and affected portions of existing systems connected to, shall be subjected to a pneumatic test pressure utilizing clean, dry air and must be demonstrated to be absolutely tight when subjected to the pressures and time durations listed in table above. All equipment and components designed for operating pressures of less than the test pressure shall not be connected to the piping system during test.
- H. Test pressure shall be measured with a manometer or with a pressure-measuring device designed and calibrated to read, record or indicate a pressure loss caused by leakage during the pressure test period.
- I. Piping system shall withstand test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate a leak unless can be attributed to some other cause.
- J. Leakage shall then be located by means of a gas detector, a noncorrosive leak detection fluid, or other leak detection method. Matches, candles, open flames or other methods that provide a source of ignition shall not be used.
- K. When placing system into operation, appliances and equipment shall not be placed into operation until piping system has been checked for leakage with above requirements.

### 3.10 PAINTING

- A. All carbon steel parts shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation of all carbon steel parts shall

be performed at such time during the assembly process as to preclude damage to the equipment once installed and assembled. Cleaned surfaces shall then be shop-primed. Shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, Tnemec 140-1255 Beige Pota-Pox, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall review. It is the intent of this specification that all equipment, supports, and appurtenances be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation.

- B. Exterior steel natural gas piping shall be painted as follows:
1. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer.
  2. Touch-up primer prior to finish coat, and either:
    - a. Two coats of N69-Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
    - b. One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

END OF SECTION

## SECTION 23 74 17

### PACKAGED WALL MOUNTED AIR-CONDITIONING UNITS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Wall mounted units (WMU).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASHRAE 15—Safety Code for Mechanical Refrigeration.
  - 2. ASHRAE 62—Ventilation for Acceptable Indoor Air Quality.
  - 3. ASHRAE 84-87P—Method of Testing Air-to-Air Heat/Energy Exchangers.
  - 4. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - 5. ARI 210/240—Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - 6. ARI 410—Forced Circulation Air-Cooling and Air-Heating Coils.
  - 7. ARI 430—Central Station Air-Handling Units.
  - 8. ARI 1060—Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery.
  - 9. NFPA 70—National Electrical Code.
  - 10. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
  - 11. UL 181—Factory-Made Air Ducts and Air Connectors.
  - 12. UL 900—Test Performance for Air Filter Units.

##### 1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.
- E. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.
- F. Unit performance shall be certified in accordance with ARI 430 for Central Station Air-Handling Units.

- G. Direct expansion coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration, latest edition.

#### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Project specific wiring diagrams for power, signal and control.
- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements should follow the recommendations in the manufacturer's installation instructions.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

#### 1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year in accordance with GC 12.6.

## PART 2-PRODUCTS

### 2.01 WALL MOUNTED UNITS (WMU)

- A. Acceptable manufacturers are Bard, or equal.
- B. Units shall be furnished and installed as scheduled on Contract Documents and in these specifications. Cooling capacity ratings shall be based on ARI Standard 210/240. Units shall consist of enclosure with compressors, air-cooled condenser coil, condenser fans, evaporator coil, return air filters, supply motors and drives, and unit controls.
- C. Unit shall be factory prewired with all starters controls and control power transformer. Wiring and devices shall meet requirements of Division 26.
- D. Units shall be 100% factory-run tested and fully charged with R-410A.
- E. Condenser and evaporator coils shall be dipped in corrosion-resistant coating that resists corrosion from hydrogen sulfide and other corrosive atmospheres.
- F. Unit Casing:
  - 1. Cabinet: Painted steel, zinc coated, and finished with paint coating utilizing polyurethane primer and based on enzyme. Structural members shall be 16 gauge with access doors and removable panels of minimum 20 gauge.
  - 2. Insulation: Provide insulation on all exterior panels in contact with the return and conditioned air stream.
- G. Air Filters: Factory-installed filters shall be mounted on racks within the unit and shall be accessible through access panels. One-inch-thick glass fiber disposable media filters shall be provided with the provisions within the unit for 2-inch-thick filters to be field provided and installed.
- H. Fans and Motors: Provide evaporator fan section with self-aligning, grease-lubricated, ball or sleeve bearings with permanent lubrication fittings.
- I. Evaporator Coil:
  - 1. Provide configured aluminum fin surface mechanically bonded to copper tubing coil. Coil shall be provided with hydrophilic coating. The coil shall be dipped in protective coating.
  - 2. Provide drain pan for base of evaporator coil constructed of PVC or galvanized steel with external connections.
- J. Condenser Section:
  - 1. Condenser coil shall be copper hairpin with aluminum fin design. Coil shall be dipped in protective coating.
  - 2. Provide direct-drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be enclosed, permanently lubricated with integral thermal overload protection in a weathertight casing.
- K. Compressors: Provide scroll compressors. Provide motor with overtemperature and overcurrent protection.

- L. Fresh Air Vent: Provide barometric fresh air damper to provide up to 25% of unit airflow rating return and barometric relief air dampers.
- M. Operating Controls: Provide microprocessor unit-mounted control to control all air conditioner functions.

### PART 3-EXECUTION

#### 3.01 STAINLESS STEEL SUPPORT

- A. The WMU shall be supported by stainless steel frame mounted to existing brick or block wall. All fasteners shall be stainless steel.

#### 3.02 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Pipe and trap condensate as shown on Drawings.
- D. Provide flexible duct connections on all duct connections to unit in accordance with Section 23 33 00-Air Duct Accessories.
- E. Protect installed products until completion of project.
- F. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- G. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- H. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of Drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

#### 3.03 CLEANING

- A. Unit shall be cleaned and new filters shall be furnished and installed prior to final acceptance by OWNER. One spare set of filters shall remain for OWNER.

END OF SECTION



## SECTION 26 05 00

### GENERAL ELECTRICAL REQUIREMENTS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes general requirements for all electrical work.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

##### 1.02 REFERENCES

- A. ANSI/NFPA 70—National Electrical Code (NEC).
- B. ANSI/IEEE C2—National Electrical Safety Code.

##### 1.03 CONTRACT DOCUMENTS

- A. Any equipment roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to OWNER.
- B. The Drawings are generally diagrammatic, and CONTRACTOR shall coordinate the Work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.
- C. Hazardous or classified locations, where referenced in the Specifications or on the Drawings, shall be as defined in the NEC.

##### 1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to ANSI/IEEE C2.
- C. The rules and regulations of the federal, state, local, and civil authorities and utility companies in force at the time of execution of the Contract shall become a part of this specification.
- D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be paid by CONTRACTOR.

##### 1.05 CODES AND ORDINANCES

- A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and

interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.

- B. In preparing a Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the Drawings and Specifications. All cases of apparent conflicts between the Drawings, Specifications, and codes shall be brought to ENGINEER's attention, as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.
- C. When requested by ENGINEER, CONTRACTOR shall provide written calculations to show compliance with applicable codes or the Contract Documents. This shall include, but not be limited to, conduit and wire sizing, junction and pull box fill and sizing, manhole/handhole sizing, conductor derating, and voltage drop. CONTRACTOR shall indicate calculation method used as well as compliance with applicable code, drawing, or specification.

#### 1.06 EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

- A. Included in this Contract are electrical connections to equipment provided under other divisions. CONTRACTOR shall refer to final shop drawings for equipment being furnished under other divisions, for exact location of electrical equipment, and the various connections required.

#### 1.07 ELECTRICAL DISTRIBUTION SYSTEM

- A. Provide a complete electrical distribution system consisting of components indicated on the Drawings or specified herein including, but not limited to:
  - 1. Feeders, branch wiring, and electrical distribution equipment.
  - 2. All control wiring.
  - 3. Access panels and access doors for access to equipment installed by Division 26.
  - 4. Wiring between system components if equipment is not prewired.
  - 5. Lighting fixtures, lighting controls, and associated wiring.
  - 6. Support system design and supports for electrical raceways.
  - 7. Code-required disconnects.
- B. Provide a standby power system consisting of components indicated on the Drawings (see Section 26 32 13.1–Standby Power System West Hickman WWTP, Section 26 32 13.2–Standby Power System Town Branch WWTP, and Section 26 36 23–Automatic Transfer Switches).
- C. CONTRACTOR shall connect all equipment furnished by other Divisions consisting of components indicated on the Drawings or specified herein.
- D. Provide balancing and adjusting of electrical loads.
- E. CONTRACTOR shall instruct OWNER's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.
- F. Provide miscellaneous items for a complete and functioning system as indicated on the Drawings and specified herein.

- G. A partial list of work not included in Division 26 is as follows: Painting (except as otherwise specified herein).

#### 1.08 NOISE

- A. Eliminate any abnormal noises that are not considered by ENGINEER to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

#### 1.09 DRAWINGS

- A. The Drawings indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements in conformance with Contract Documents and cooperation with other trades.
- B. Prior to locating equipment, confer with ENGINEER as to desired location in the various areas. In no case should equipment locations be determined by scaling drawings. Relocate equipment and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.
- C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on the Drawings, and when CONTRACTOR is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at CONTRACTOR's expense.
- D. The Drawings are schematic in nature and are not intended to show exact locations of conduit, but rather to indicate distribution, circuitry, and control.
- E. Where locations of future structures are shown on the Drawings, CONTRACTOR shall not route any conduit or install any materials or equipment within 30 feet of the boundaries shown.

#### 1.10 EXISTING UNDERGROUND UTILITIES

- A. The Drawings show approximate location of existing underground utilities based on OWNER-provided record drawings. CONTRACTOR shall excavate and verify the location of all underground utilities prior to installing new electrical equipment and prior to making modifications to existing electrical. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground utilities to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

#### 1.11 SUBMITTALS

- A. CONTRACTOR shall submit to ENGINEER for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Section 01 33 00–Submittals for requirements.
- B. CONTRACTOR shall, in addition, submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract Drawings are contemplated

because of job conditions, interference or substitution of equipment, or when requested by ENGINEER for purposes of clarification of CONTRACTOR's intent. CONTRACTOR shall also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or equipment. Drawings and details under this section shall include, but not be limited to, the following, where applicable to this project:

1. Electrical interconnection wiring diagrams; see Section 26 09 00—Controls and Instrumentation and Section 26 24 19—Motor Control.
  2. Major feeder routing in plan and elevation, including service entrance raceways and cable.
  3. Equipment room layouts showing exact locations and arrangements of equipment, conduit, wiring, etc., and clearances.
- C. These drawings and diagrams shall show applicable electrical switch and breaker sizes as well as the manufacturer's name and catalog number for each piece of equipment used.
- D. Equipment and material submittals must show sufficient data to indicate complete compliance with Contract Documents as follows:
1. Proper sizes and capacities.
  2. That the item will fit in the available space in the manner that will allow proper service. Provide 1/4-inch scale plan view and elevations of all electrical equipment showing equipment layouts and clearances.
  3. Construction materials and finishes.
- E. When the manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. The shop drawings shall be clearly marked and noted accordingly.
- F. When equipment and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.
- G. See additional requirements of shop drawings under Division 01—General Requirements.

## PART 2—PRODUCTS

### 2.01 STANDARD PRODUCTS

- A. All equipment and products shall be of new manufacture per applicable specifications.
- B. All equipment shall be UL and NEMA approved.
- C. Unless specified otherwise, major distribution equipment such as panelboards, switchboards, switchgear, motor control centers, motor starters, VFDs, SPD, transformers, etc., shall each be by the same manufacturer.
- D. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, raintight, explosionproof, dustproof, or any other special type).

## 2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. While it is not the intention of OWNER to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. CONTRACTOR shall submit with each request for approval of substitute material or equipment sufficient data to show conclusively that it is equivalent to that specified in the following respects:
  - 1. Performance:
    - a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
    - b. Energy consumption at the point of rating shall not exceed that of the specified equipment.
    - c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
  - 2. Materials of construction.
  - 3. Gauges, weights, and sizes of all portions and component parts.
  - 4. Design arrangements, methods of construction, and workmanship.
  - 5. Coatings, finishes, and durability of wearing parts.
  - 6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
  - 7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.
- B. Requests for substitution shall include CONTRACTOR's reason for the request.
- C. If ENGINEER does not consider the items equivalent to those specified, CONTRACTOR shall provide those specified.
- D. See General Conditions for additional requirements.

## 2.03 LOW-VOLTAGE WIRING (LESS THAN 100 VOLTS)

- A. Low-voltage wiring specified in this section shall be applicable to all systems installed that utilize low-voltage wiring where such wiring is not specified in other technical sections.
- B. All wiring shall have copper conductors with 300-volt insulation rating and meet the requirements of NEC Article 725.
- C. All conductors must be suitable for the application intended. Conductors 16 AWG and larger shall be stranded. Conductors 18 AWG and smaller may be solid or stranded.
- D. Control Cable for Class 1 Remote Control and Signal Circuits: Individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the National Electrical Code.
- E. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the NEC Article 725.

## PART 3-EXECUTION

### 3.01 CONTINUITY OF SERVICE

- A. CONTRACTOR shall provide and maintain continuous services (power, controls, alarms, etc.) during the entire construction period.
- B. No service shall be interrupted or changed without permission from OWNER. Written permission shall be obtained before any work is started.
- C. When interruption of service is required, all persons concerned shall be notified and a prearranged time agreed upon. Notice shall be a minimum of 72 hours prior to the interruption.

### 3.02 CLEANUP AND REMOVAL OF RUBBISH

- A. All lighting and appliance panelboards, switchboards, MCCs, VFD enclosures, motor starter and disconnect switch enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cut off before installation of covers.
- B. Where louvers are provided in switchgear, MCCs, or transformer enclosures, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in equipment such as control panels, motor control centers and transformers, CONTRACTOR shall replace all filters with new at the time of final completion.
- C. All lighting fixture lenses and lamps (interior and exterior fixtures) shall be cleaned at the time of installation, and all lens exteriors shall be cleaned just prior to final inspection.
- D. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

### 3.03 CONCRETE WORK

- A. All cast-in-place concrete for new electrical equipment bases shown on the Drawings shall be provided by CONTRACTOR, except where specifically noted to be provided by others. All new equipment shall be set on 3 1/2-inch minimum leveling slabs including MCCs, free-standing enclosures, switchgear, etc. Pads shall be 3 inches larger than equipment being supported.
- B. Concrete shall comply with Section 03 30 00-Cast-In-Place Concrete.
- C. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

### 3.04 PAINTING

- A. All painting of electrical equipment shall be done by CONTRACTOR unless equipment is specified to be furnished with factory-applied finish coats.
- B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.

- C. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR.
- D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

### 3.05 CAULKING

- A. Caulk with a caulking sealant where indicated on the electrical drawings or hereinafter specified.
- B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.
- C. Caulking sealant shall contain no acid or ingredients that will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.

### 3.06 BUILDING ACCESS

- A. CONTRACTOR shall arrange for the necessary openings in the building to allow for admittance of all apparatus.
- B. When the installation requires openings and access through existing construction and the openings are not provided, CONTRACTOR shall provide the necessary openings.

### 3.07 COORDINATION

- A. Provide wiring for all motors and all electrically powered or electrically controlled equipment.
- B. All starters, VFDs, disconnects, relays, wire, conduit, push buttons, pilot lights, and other devices for the power and control of motors or electrical equipment shall be provided by CONTRACTOR except as specifically noted elsewhere in these specifications or on the Drawings.
- C. Where starters, VFDs, or other devices are provided by others, they shall be connected and wired by CONTRACTOR.
- D. CONTRACTOR's drawings and specifications shall show number and horsepower rating of all motors furnished, together with their actuating devices. Should any change in size, horsepower rating, or means of control be made to any motor or other electrical equipment after the Contract is awarded, any additional costs because of these changes shall be the responsibility of CONTRACTOR.
- E. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters or VFDs as specified herein or under the various trades' sections of these specifications.
- F. CONTRACTOR shall provide all line voltage power and control wiring (100 volts and above), including temperature control wiring for operation, control, and supervision of all motorized equipment, including wiring between motor starters, VFDs, and control devices as specified herein and as shown on the Drawings. Low-voltage control wiring (below 100 volts) shall be

provided by CONTRACTOR supplying the equipment that has low-voltage wiring, unless otherwise noted. CONTRACTOR shall provide raceways for all low-voltage wiring.

- G. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.
- H. Motors 1/2 hp and larger shall be NEMA rated 460 volts, three-phase, 60 Hz, unless otherwise shown. Motors 1/3 hp and below shall be 115 volts, single-phase, 60 Hz, unless otherwise shown.

### 3.08 EXCAVATION AND BACKFILL

- A. Backfilling of all trenches beneath concrete floor and stair slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Section 31 23 00–Excavation, Fill, Backfill, and Grading. Refer to Section 26 05 33–Conduit for additional requirements associated with PVC conduit installed in earth.
- B. Lines passing under foundation walls shall have a minimum of 1 1/2-inch clearance.
- C. Care shall be taken so that there is no disturbance of bearing soil under foundations.

### 3.09 EQUIPMENT ACCESS AND LOCATION

- A. CONTRACTOR shall coordinate work of this division with that of other divisions so that all systems, equipment, and other components of the building will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this division. Any components for the electrical systems that are installed without regard to the above shall be removed and relocated as required to provide adequate access at CONTRACTOR's expense.
- B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials that will fit properly the types of finishes actually installed.
- C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by CONTRACTOR at no additional cost.
- D. Electrical equipment, devices, instruments, hardware, etc., shall be installed with ample space allowed for removal, repair, calibration or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment that is to be installed or that is already in place.
- E. Locate electrical outlets and equipment to fit the details, panels, decorating, or finish of the space. ENGINEER shall reserve the right to make minor position changes of the outlets before the work has been installed. Verify door swings before installing room lighting switch boxes, and install boxes on the latch side of door unless noted otherwise.



### 3.10 WORKMANSHIP

- A. All work shall be performed in compliance with the NEC.
- B. Install work using procedures defined in NECA Standard of Installation.
- C. Location of process equipment as shown on the Drawings is approximate.
- D. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.
- E. Locations of utilization equipment and control devices as shown on the Drawings are within 10 feet of actual positions. Any mounting of this equipment within this 10-foot distance shall be performed at no additional cost to OWNER.
- F. Unless otherwise noted, conduit shall be fastened to building structure or equipment framework and not placed on the floor.
- G. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the Bid.
- H. Materials and equipment of the types for which there are National Board of Fire Underwriters Laboratories (UL) listings shall be so labeled and shall be used by CONTRACTOR.

### 3.11 AREA CLASSIFICATION

- A. As noted on the Drawings.
- B. Where referenced herein, damp and wet locations shall include, but not be limited to, all NEMA 4X areas, structures and areas below grade, and exterior locations.

### 3.12 MODIFICATIONS TO EXISTING CONSTRUCTION

- A. Alterations:
  - 1. Alter, extend, and reconnect conduits as necessary.
  - 2. Reconnect existing conduits that were reused, cut, or exposed because of construction as quickly as possible.
  - 3. Where wiring is involved, new wires shall be "pulled in" between the nearest available accessible reused outlets to the extent allowed by the governing code.
  - 4. Provide new conduits for wires if they cannot be "pulled in" to existing conduits.
  - 5. All new conduits, wiring, and electrical items shall be connected to the existing systems so as to function as a complete unit.
  - 6. Where existing electrical equipment, devices, fixtures, electrically operated items, etc., interfere with any remodeling work, they shall be removed and reinstalled in another location to avoid such interferences. All existing and relocated equipment shall be left in good operating condition.
- B. CONTRACTOR shall remove all electrical equipment, conduit, and wiring associated with the structures, equipment, and control systems specified herein and/or shown on the Drawings to be removed.

- C. Include in Bid removal of existing electrical material and equipment as specified hereinafter, as noted on the Drawings, or as needed by field conditions.
- D. Provide stainless steel cover plates for all existing recessed outlet and junction boxes not being reused. Seal or cap all existing conduit penetrations not being reused.

END OF SECTION

## SECTION 26 05 19

### WIRE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Wire.
  - 2. Wiring connections and terminations.
  - 3. Terminal blocks and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, which has been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01 33 00—Submittals.
- B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
- C. Submit manufacturer's instructions.

##### 1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-wrapped, waterproof, flexible-barrier material for covering wire on wood reels, where applicable, and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

- B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

## PART 2-PRODUCTS

### 2.01 WIRE

- A. All wire for permanent installation shall be new stranded copper delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted. The use of multiconductor cable is not allowed.
- B. Motor circuit branch wiring and associated control wiring:
  - 1. Insulation type shall be THHN (indoors, nonVFD application).
  - 2. Minimum size for motor control wiring shall be 14 AWG.
  - 3. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on Drawings.
- C. All power wiring to motors utilizing Variable Frequency Drives (VFDs) shall be type XHHW-2.
- D. All wiring within control panels, supervisory control centers, and motor control centers that does not extend outside of the enclosure or the motor control center bucket shall be insulation-type MTW, minimum size 16 AWG.
- E. Wiring in dry locations shall be THHN. Wiring in damp and wet locations shall be XHHW-2.
- F. Refer to Section 26 05 53-Electrical Identification for required wire insulation color coding and conductor labeling requirements. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.
- G. Branch circuit wiring for exit lights, emergency lights, and exterior lights in excess of 75 feet shall be minimum 10 AWG. Circuits 150 feet or over shall be sized for a maximum 2% voltage drop.

### 2.02 WIRING CONNECTIONS AND TERMINATIONS

- A. Provide crimp type UL or ETL listed terminations for 6 AWG and smaller stranded conductor connections to electrical devices and equipment such as receptacles, switches, and terminal strips. Crimp devices shall be Sta-kon, or equal.
- B. Provide insulated, silicone-filled spring wire connectors with plastic caps for 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Safety Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, or switch boxes. Spring wire connectors are not allowed for terminating motor conductors.
- C. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits. Motor connection kits shall consist of one-hole copper compression lugs for 6 AWG and larger, split-bolt connector for 8 AWG and smaller, and motor-lead pigtail splice kit. Individual components shall be as follows:
  - 1. Split-bolt connectors shall be for use with copper conductors only.

2. One-hole copper compression lugs shall be as manufactured by 3M, or equal, 30000 series. Lug size shall be selected based on motor and feeder wire sizes installed.
  3. Pigtail splice kit shall consist of one-hole lug cover, silicone grease, and mastic sealing strip. Pigtail splice kit shall have locking pins for conductors 2 AWG and larger. Kit shall be as manufactured by 3M, or equal, 5300 series, and be selected based on motor, feeder, and lug sizes installed.
- D. No splices will be allowed unless reviewed by ENGINEER. Where allowed, provide in-line splices for all conductor connections, 6 AWG and larger. Splice crimp component shall be Burndy UGSKIT2 or equal. Splice shall be made with crimp tool by manufacturer that allows expanded conductor ranges. Splice insulation component shall be Raychem heavy-wall, low-voltage tubing, type WCSM, or equal.

## 2.03 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed or UL recognized under UL 467, UL 486E, UL1059, and UL 1953 (power terminals only).
- B. Power Terminal Blocks: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts as manufactured by Allen-Bradley 1492-PDL, or equal.
- C. 600-Volt Fuse Holders: Fuse holders for circuit rated up to 30 amps and 600 volts AC shall be finger safe, UL Listed, DIN-rail mountable, and shall include blown-fuse indicating lights. Fuse holders shall be as manufactured by Allen-Bradley Bulletin 1492-FB, or equal.
- D. Signal and Control Terminal Blocks:
1. General-Purpose Terminal Blocks:
    - a. Terminal blocks shall be rated up to 600 volts AC/DC.
    - b. Terminal blocks shall accept center-mounted jumper bars without increasing the installed space.
    - c. Terminal blocks shall be Allen-Bradley Bulletin 1492-J, or equal.
    - d. Terminal block color shall be gray.
  2. Grounding Terminal Blocks:
    - a. Terminal blocks shall be Allen-Bradley Bulletin 1492-JG, or equal.
    - b. Terminal block color shall be green/yellow.
  3. Disconnect-type Terminal Blocks (300-Volt Class):
    - a. Terminal blocks shall be feed-through type with a knife-blade disconnect.
    - b. Terminal blocks shall be Allen-Bradley Bulletin 1492-JKD, or equal, depending on the application.
    - c. Terminal block color shall be gray.
  4. Fuse-type Terminal Blocks with Indicator (300-Volt Class):
    - a. Terminal blocks for applications from 100 to 300 volts AC shall be Allen-Bradley Bulletin 1492-H4, or equal, with neon blown-fuse indicator.
    - b. Terminal blocks for applications from 10 to 50 volts AC/DC shall be Allen-Bradley Bulletin 1492-H5, or equal, with LED blown-fuse indicator.
    - c. Terminal block color shall be black.
  5. Terminal Blocks for Power Meters and Current Transformers: Provide test-disconnect terminal blocks for disconnecting, shorting, and testing current transformers and for disconnecting and testing voltage sensing inputs. Provide test-disconnect terminals for individual current transformer or voltage sensing installations and provide a group of terminals for all current transformer and voltage sensing inputs for each power meter installation.

- a. Provide a pair of terminal blocks for each current transformer including one feed-through terminal block, one sliding disconnect terminal block with a cross-connection short-circuit slider. The pair of terminal blocks shall include the following:
    - (1) Feed-through terminal block shall be Weidmüller Model WTD 6/1 EN, or equal.
    - (2) Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
    - (3) Short-circuit slider shall be Weidmüller Model WKS 2/2, or equal. The short-circuit slider shall cover the terminal block conductor screws on the meter-side of the terminal blocks when in the non-shorting position and expose the terminal block conductor screws when slid into the shorting position.
    - (4) Provide two cross-connection sliders Weidmüller Model STB, or equal, with connecting sleeves Weidmüller Model VH, or equal. Provide one slider fixing screw Weidmüller Model BS, or equal. Connecting sleeves and fixing screws shall be color coded for each current transformer.
  - b. Provide disconnecting terminal blocks for each voltage sensing and neutral connection. The terminal blocks shall include the following:
    - (1) Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
    - (2) Provide one cross-connection slider Weidmüller Model STB, or equal, with connecting sleeve Weidmüller Model VH, or equal, for each voltage sensing and neutral connection terminal block. Provide one slider fixing screw Weidmüller Model BS, or equal. The neutral connecting sleeve shall be a different color than the voltage sensing connecting sleeves.
  - c. Terminal block colors shall be gray. Provide end plates and end brackets as required to complete the test-disconnect terminal block assembly.
6. Terminal blocks shall have self-locking screw compression clamps rated for the size of conductors being terminated and upstream overcurrent protection for each application.
  7. The same manufacturer and style of terminal block shall be used throughout the entire project for all applications.
  8. Terminal blocks shall have tin-plated copper current bars and tin-plated steel screws. Terminal housings shall be completely finger safe from all live circuits and be constructed of self-extinguishing material with minimum UL 94-V0 flammability rating.
  9. Terminal blocks shall accept pre-printed, snap-in labeling cards on both sides without increasing the installed space. Provide terminal block manufacturer's end barriers and screw-type retainers for all terminal block groupings.
  10. Terminal blocks shall mount on standard DIN rail and shall be able to be removed without removing adjacent terminal blocks.
  11. Multi-level terminal blocks and stacked, single-level terminal block installations are not acceptable.

E. Refer to Section 26 05 53—Electrical Identification for terminal block labeling requirements.

## PART 3—EXECUTION

### 3.01 GENERAL WIRING METHODS

- A. Install electrical wire and connectors in accordance with the manufacturer's written instructions, applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry

practices so that products serve the intended functions. Use appropriate wiring methods and materials for the equipment or environment.

- B. Stranded conductors shall be terminated using crimp-type devices specified herein. Conductors may not be wrapped around a terminal screw.
- C. Place an equal number of conductors for each phase of a circuit in the same raceway.
- D. Torque conductor connections and terminations with calibrated torque wrench to manufacturer's recommended values. Provide permanent marking on lug, bolt, nut, or connection for conductors larger than 4 AWG.
- E. Splice only in junction or outlet boxes. Splicing is not allowed in disconnects, manholes, motor control centers, panelboards, control panels, equipment, etc. Avoid splices between terminals of interconnecting power and control wiring.
- F. Spring wire connectors shall only be used in junction, outlet, or switch boxes. Equipment wireways (e.g., motor control centers, panelboards, disconnects, switchgear, etc.), and control panels shall not have any spring-wire connectors installed; all terminations shall be on terminal strips.
- G. Neatly train, lace, and tie wrap all wiring inside boxes, equipment, control panels, MCCs, and panelboards.
- H. Make conductor lengths for parallel circuits equal.
- I. The same color shall be used for each numbered wire throughout its entire length.
- J. Terminate all wiring on terminal blocks in control panels, VFD enclosures, starter cubicles, and similar equipment. This shall include all spare or unused wires.
- K. Provide a dedicated neutral for each branch circuit or feeder requiring a neutral. Ampacity of neutral conductor shall match that of the branch circuit or feeder.
- L. Do not use a pulling means that can damage the raceway.
- M. Signal wiring (below 100 volts) must be in a conduit separate from power and/or control wiring (over 100 volts). Signal wire shall include, but not be limited to, loop-powered devices, voice and data communications, and communication wiring (i.e., Ethernet, serial, etc.). Analog wiring shall be in a conduit separate from all other wiring.
- N. Control wiring (e.g., internal thermal overloads, lockout stops, etc.) to motors utilizing VFDs shall be in a conduit separate from motor power wiring.
- O. Provide junction or pull boxes to facilitate the "pulling in" of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.
- P. Thoroughly clean wires before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.

- R. Terminate spare conductors within equipment, MCCs, control panels, etc., on terminal strips and label as "SPARE." Spare wiring in pull or junction boxes may be terminated with electrical tape and labeled as "SPARE." All spare conductor labels shall indicate where the conductors terminate. Refer to Section 26 05 53—Electrical Identification, for additional requirements.
- S. Feeder connections to motors shall be installed within the motor junction box utilizing factory engineered kits as specified herein. Spring wire connectors are not allowed for connections to motors.

### 3.02 GENERAL LOW-VOLTAGE WIRING METHODS (LESS THAN 100 VOLTS)

- A. Low-voltage wiring installation requirements specified herein shall be applicable to all systems installed that utilize low-voltage wiring where such wiring installation is not specified in other technical sections.
- B. Low-voltage wiring shall be installed in conduit.
- C. Control wiring for HVAC and lighting equipment connected to emergency power shall be installed in conduit.
- D. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts. All sizes subject to NEC 725 requirements.
- E. Low-voltage cable splices shall only be allowed in junction boxes.

### 3.03 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL-listed wire-pulling lubricant for pulling 4 AWG and larger wires. Wax-based pulling lubricant is not allowed unless it includes a Teflon additive.
- B. Install wire in raceway after interior of building is enclosed, watertight, and dry, and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Conductors No. 6 AWG and larger shall be pulled into conduits by hand or by utilizing a tugger with built-in tension meter. Other motorized machines of any type are not allowed for any wire pulling. CONTRACTOR shall provide a report to ENGINEER for each pull indicating maximum tension reached during the pull along with manufacturer's maximum pulling tension.
- E. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes or outlet boxes.
- F. CONTRACTOR shall observe code limitation on the number and size of wires in an outlet box. CONTRACTOR shall either lay out work so that the wires do not exceed the particular box limitation or provide larger boxes approved for additional capacity.



- G. Panel riser feeder conductors shall be identified with colored tape at panel lugs. The same phase relation shall be maintained throughout.
- H. Circuiting is indicated diagrammatically on the Drawings.

#### 3.04 TERMINAL BLOCK INSTALLATION

- A. A maximum of one conductor shall be installed on the field-wired side of each terminal block. If rated to accept more than one conductor, a maximum of two conductors shall be installed on the enclosure-wired side of each terminal block. Provide additional terminal blocks and shorting jumpers as required.
- B. Provide a separate ground-type terminal block for each shielded-cable drain conductor.
- C. Provide ten percent spare terminal blocks for each type of connected terminal block, minimum five spare terminal blocks total. For each grouping of terminal blocks, provide 25% spare DIN rail space.
- D. Maintain a minimum of 1 1/2 inches between terminal blocks and adjacent devices and enclosure wireways.
- E. For current transformer shorting terminal blocks, the short-circuit slider shall cover the terminal block conductor screws on the meter-side of the terminal blocks when in the non-shorting position, and expose the terminal block conductor screws when slid into the shorting position.

#### 3.05 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.
- B. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.
- C. Subsequent to wire hookups, energize circuitry and demonstrate functionality in accordance with these specifications.
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- E. Perform field inspection and testing according to provisions of this section.

#### 3.06 ACCEPTANCE TESTS

- A. CONTRACTOR shall furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of OWNER or OWNER's representative and must be passed before final acceptance of the work.
- B. CONTRACTOR shall be responsible for powered tests of each field-installed device unless specifically noted otherwise. CONTRACTOR shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.

- C. Operation Test: By operational testing, OWNER will give final acceptance of the wiring system when all of the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the Drawings. All motors shall be properly connected to protective devices, and motor rotation shall be in the correct direction.
- D. At the request of OWNER's representative, demonstrate by test the compliance of the installation with these specifications and Drawings, the National Electrical Code, and the accepted standards of good workmanship. These tests shall include operation of equipment, continuity of the conduit system, grounding resistance and insulation resistance.
- E. Individually test 600-volt cables for insulation resistance between phases and from each phase to ground. Test with a Megger whose rating is suitable for the tested circuit after cables are installed and before they are put into service. Tests shall meet the applicable specifications of ICEA S-95-658 and NEMA WC70. Tests shall be witnessed by ENGINEER. The insulation resistance for any given conductor shall not be less than the value recommended by the ICEA, or a minimum of one megohm for 600-volt and less service, if not ICEA listed. Any cable not conforming to the recommended value or that fails when tested under full load conditions, shall be replaced with a new cable for the full length. The following cables shall be tested: Existing feeder conductors from Substation A 480-volt switchboard to MCC-B.
- F. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to OWNER. Such tests shall show compliance with governing codes.
- G. The transformer, feeder, and subfeeds to the lighting panels shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C as follows:
  - 1. Front-to-rear, top-to-bottom, or left-to-right when facing equipment.
  - 2. Phasing shall be accomplished by using distinctive colors for the various phases. The same color or variation of it shall be used for a particular phase throughout the building and project.

### 3.07 WIRE INSTALLATION SCHEDULE

- A. Install all wiring in raceways except as otherwise noted. This includes all low-voltage wiring such as temperature control, instruments, phone, network, fiber optic, etc.

END OF SECTION

## SECTION 26 05 23

### INSTRUMENT AND COMMUNICATION WIRE AND CABLE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This specification contains the requirements for instrument wire and cable as opposed to electrical power wire and cable.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this section as listed in Division 01.
- B. Qualifications of Installers: Workers who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

##### 1.03 PRODUCT HANDLING

- A. Instrument cable shall be furnished in lengths as necessary.
- B. Reels, coils, or package rolls of instrument cable shall be identified with the project name and other tagging identification as called for.

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Submit an electronic copy of the fiber optic cable testing report.
- C. Furnish three hard copies and one electronic copy of the final approved fiber optic cable test report to OWNER.

##### 1.05 QUALIFICATIONS

- A. CONTRACTOR shall have at least 10 years of experience in the installation of similar systems. CONTRACTOR shall provide documentation upon request to certify that all assigned staff have attended training courses corresponding to the type of cabling and equipment specified herein.
- B. CONTRACTOR shall currently be licensed to install low voltage electronic cabling systems in the state of the project.
- C. CONTRACTOR shall currently meet all manufacturer's requirements for the provision and installation of all equipment specified herein.

- D. CONTRACTOR shall utilize and have technicians trained in the utilization of fiber optic cable certification equipment.

## PART 2-PRODUCTS

### 2.01 SHIELDED PAIR CABLING FOR ELECTRONIC INSTRUMENTS

- A. Shielded pair cabling shall have stranded, tinned-copper conductors, No. 16 AWG, twisted with 2-inch lay.
- B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties.
- C. Color coding shall be manufacturer's standard or as stated.
- D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 35 mils thick, and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power-limited circuit cable.
- E. A 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A stranded, tinned-copper drain wire shall be furnished in continuous electrical contact with the shield.
- F. Single-pair shielded cables shall be Belden 9316, or equal.

### 2.02 INDUSTRIAL ETHERNET CABLE

- A. 600-Volt Rated Shielded Cable:
  - 1. For communication with plant SCADA Systems and equipment in supervisory control centers, motor control centers, switchgear, switchboards, control panels, etc., over 300 volts, and other areas or raceways with power wiring over 300 volts, provide 600-volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.
  - 2. Cable conductors shall be minimum 23 AWG with PVC jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.34 inch. Cable shall be CMR rated, UL listed, 600 V UL AWM rated, and be Belden 7953A or equal.
  - 3. Cable jacket color shall be red.
  - 4. Provide a shielded RJ45 connector on one end of each cable and an unshielded RJ45 connector on the other end of each cable.
- B. 300-Volt Rated Shielded Cable:
  - 1. For communication with plant SCADA Systems and equipment in supervisory control centers, motor control centers, switchgear, switchboards, control panels, etc., under 300 volts, and other areas or raceways with power wiring under 300 volts, provide 300 volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.

2. Cable conductors shall be minimum 23 AWG with PVC jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.29 inch. Cable shall be CMR rated, UL listed, and shall be Systimax Solutions 1271B, or equal.
  3. Cable jacket color shall be slate.
  4. Provide a shielded RJ45 connector on one end of each cable and an unshielded RJ45 connector on the other end of each cable.
- C. Below-Grade 300-Volt Rated Shielded Cable:
1. Communication cables routed in underground conduit and raceways with power wiring under 300 volts shall be 300 volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.
  2. Cable conductors shall be minimum 23 AWG with polyolefin jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be OSP-grade polyethylene. Cable shall be OSP-rated, UL-listed, and shall be Superior Essex Model 04-001-64, or equal.
  3. Cable jacket color shall be black.
  4. Provide a shielded RJ45 connector on one end of each cable and an unshielded RJ45 connector on the other end of each cable.
- D. 300-Volt Rated Unshielded Cable:
1. For communication with plant SCADA Systems and equipment in communication racks, supervisory control centers, and control panels without VFDs, etc., under 300 volts, and other areas or raceways with power wiring under 300 volts, provide 300-volt safety voltage rated, 80-volt operating voltage rated, 4-pair, unshielded (U/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.
  2. Industrial Ethernet cable shall be minimum 23 AWG with PVC jacket. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.24 inch. Cable shall be CMR rated, UL listed, and shall be Systimax Solutions 1071E, or equal.
  3. Cable jacket color shall be light blue.
  4. Provide unshielded RJ45 connectors on both ends of each cable.
- E. 600-Volt Rated, Shielded, Long-Range Cable:
1. For communication with devices requiring cable lengths up to 600 feet and under 600 volts, provide 600 volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard and shall support up to 2.5 Gbps data rates and up to 100 watts of PoE power for all PoE classes without the use of additional powered devices.
  2. Cable conductors shall be minimum 22 AWG with HDPE jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade LSZH FR Polyolefin with a maximum overall cable diameter of 0.380 inches. Cable shall be CM rated, UL listed, and shall be Paige Datacom Solutions GameChanger OSP Cable Model 258340804, or equal.
  3. Cable jacket color shall be black.
  4. Provide a shielded RJ45 connector on one end of each cable terminating in a patch panel or surge protector and an unshielded RJ45 connector on the other end of each cable.

- F. Patch cables shall be provided premanufactured by the cable manufacturer or connector manufacturer in sufficient length to connect the associated equipment to any port on the equipment, patch panel, or switch. Field-attached plugs shall be insulation displacement type and shall be by the same manufacturer as the cable.

## 2.03 FIBER OPTIC PATCH CABLES

- A. Fiber optic patch cables shall be multimode 50/125 microns or single-mode 9/125 microns, and shall meet UL 1666 (OFNR) or NFPA 262 (OFNP) flame ratings for standard compliant safety as required by the installation environment. All fiber patch cables shall be pre-terminated and tested for insertion loss. Cable performance shall meet or exceed requirements of the TIA/EIA-568.3-D standard for OM3 and OS2 fiber optic cables. Factory certification test information shall be provided with each cable.
- B. Fiber patch cable insulation color shall be aqua for OM3 cables and yellow for OS2 cables.
- C. Fiber connectors shall be LC-type, FOCIS compliant or compatible, and shall exceed the requirements of TIA/EIA-455-21A for 500 mating cycles. Field-coordinate connector types for cables interfacing with existing equipment and existing patch panels. The insertion loss for each connector shall not exceed 0.35 dB for multimode cables or 0.15 dB for single-mode cables.
- D. Fiber connector and strain-relief color shall be aqua for OM3 cables and blue for OS2 cables per the TIA/EIA-568.3-D standard. Strain-relief color shall match connector color.
- E. Fiber optic patch cables shall be provided in sufficient length to connect associated equipment to any port on the network equipment.

## 2.04 FIBER OPTIC CABLE

- A. Multimode Cables:
1. Provide indoor/outdoor fiber optic cables with fiber counts in each cable as shown on the Drawings. Cable shall be type OFNR and shall be suitable for use inside building and outside plant applications, including duct and conduit installation in accordance with ICEA S-104-696. Installation in building risers shall be in accordance with NEC 770. Cable shall be DX-Series Distribution Riser as manufactured by Optical Cable Corporation, FREEDM One Tight-Buffered Cable Riser as manufactured by Corning, or equal.
  2. Individual fibers shall be multimode, 50/125 microns, meeting TIA/EIA 492AAAC and ISO/IEC 11801 type OM3 standards for laser optimized fibers. Primary fiber coating diameter shall be 250  $\mu\text{m} \pm 15$  and the secondary tight buffer coating diameter shall be 900 microns (nominal). All coatings shall be mechanically strippable without damaging the optical fiber. Optical performance shall meet the following requirements:

Wavelength	850 nm	1310 nm
Gigabit Ethernet Distance	1000 m	600 m
10-Gigabit Ethernet Distance	300 m	300 m
Maximum Attenuation	3.0 dB/km	1.0 dB/km

3. Cable shall be all dielectric, tight-buffered, dry water blocking, gel-free, and shall meet UL 1666 and be RoHS compliant. The PVC outer sheath shall be flame-retardant and

marked with the manufacture's name, date of manufacture, fiber type, flame rating, and sequential length information. Outer jacket shall be black.

4. Connectors shall be provided on all fibers of each fiber optic cable.
5. All cables shall be installed in continuous lengths from endpoint to endpoint. Splices in fiber optic cables shall be allowed only where shown on the Drawings.

**B. Single-Mode Cables:**

1. Provide indoor/outdoor fiber optic cables with fiber counts in each cable as shown on the Drawings. Cable shall be type OFNR and shall be suitable for use inside building and outside plant applications, including duct and conduit installation in accordance with ICEA S-104-696. Installation in building risers shall be in accordance with NEC 770. Cable shall be DX-Series Distribution Riser as manufactured by Optical Cable Corporation, FREEDM One Tight-Buffered Cable Riser as manufactured by Corning, or equal.
2. Individual fibers shall be single-mode, 9/125 microns meeting TIA/EIA 492AAAC and ISO/IEC 11801 type OS2 standards for laser optimized fibers. Primary fiber coating diameter 250  $\mu\text{m} \pm 15$  and the secondary tight buffer coating diameter shall be 900 microns (nominal). All coatings shall be mechanically strippable without damaging the optical fiber. Optical performance shall meet the following requirements:

Wavelength	1310/1550 nm
Gigabit Ethernet Distance	5000 m
10-Gigabit Ethernet Distance	10000 m
Maximum Attenuation	0.5 dB/km

3. Cable shall be all dielectric, tight-buffered, dry water blocking, gel-free, and shall meet UL 1666 and RoHS compliance. The PVC outer sheath shall be flame-retardant and marked with the manufacture's name, date of manufacture, fiber type, flame rating, and sequential length information. Outer jacket shall be black.
4. Connectors shall be provided on all fibers of each fiber optic cable.
5. All cables shall be installed in continuous lengths from endpoint to endpoint. Splices in fiber optic cables shall be allowed only where shown on the Drawings.

**C. Subgrouped Multimode/Single-Mode Cables:**

1. Provide indoor/outdoor fiber optic cables with fiber counts in each cable as shown on the Drawings. Cable shall be type OFNR and shall be suitable for use inside building and outside plant applications, including duct and conduit installation in accordance with ICEA S-104-696. Installation in building risers shall be in accordance with NEC 770. Cable shall be G-Series Subgrouped Riser as manufactured by Optical Cable Corporation, or equal.
2. Individual fibers shall be multimode 50/125 microns and single-mode, 9/125 microns, meeting TIA/EIA 492AAAC and ISO/IEC 11801 type OM3 and OS2 standards for laser optimized fibers. Primary fiber coating diameter 250  $\mu\text{m} \pm 15$  and the secondary tight buffer coating diameter shall be 900 microns (nominal). All coatings shall be mechanically strippable without damaging the optical fiber. Optical performance shall meet the following requirements:

Fiber Type	Multimode		Single-Mode
Wavelength	850 nm	1310 nm	1310/1550 nm
Gigabit Ethernet Distance	1000 m	600 m	5000 m
10-Gigabit Ethernet Distance	300 m	300 m	10000 m

Fiber Type	Multimode		Single-Mode
Maximum Attenuation	3.0 dB/km	1.0 dB/km	0.5 dB/km

3. Cable shall be all dielectric, tight-buffered, dry water blocking, gel-free, and shall meet UL 1666 and RoHS compliance. The PVC outer sheath shall be flame-retardant and marked with the manufacture's name, date of manufacture, fiber type, flame rating, and sequential length information. Outer jacket shall be black.
4. Connectors shall be provided on all fibers of each fiber optic cable.
5. All cables shall be installed in continuous lengths from endpoint to endpoint. Splices in fiber optic cables shall be allowed only where shown on the Drawings.

## 2.05 FIBER OPTIC CABLE CONNECTORS

- A. Fiber connectors shall be FOCIS compliant or compatible, and shall exceed the requirements of TIA/EIA-455-21A for 500 mating cycles. Field-coordinate connector types for cables interfacing with existing equipment and existing patch panels. The insertion loss for each connector shall not exceed 0.35 dB for multimode cables or 0.15 dB for single-mode cables.
- B. Fiber connector and strain-relief color shall be aqua for OM3 cables and blue for OS2 cables per the TIA/EIA-568.3-D standard. Strain-relief color shall match connector color.
- C. Fiber patch panels or termination enclosures shall be provided as specified under Section 26 09 00—Controls and Instrumentation.

## PART 3—EXECUTION

### 3.01 INSTALLATION REQUIREMENTS AND SPECIAL CONSIDERATIONS

- A. Shielded pair, thermocouple, industrial Ethernet, and fiber optic cabling specified in this section shall be installed in conduit, and may not be run free-air or in nonmetallic tubing such as innerduct.
- B. Individual lead wires and/or multipair cables used in “emergency” or “critical” service shall normally be installed in underground electrical duct banks.
- C. Where circumstances prohibit underground installation of “emergency” or “critical” circuits, the lead wires and/or multipair cables shall conform to the appropriate sections of this specification, except they shall be armored and have an asbestos layer between the inner jacket and the armor to permit the wires to withstand an open-flame temperature of 1,700°F for a minimum of 20 minutes without interrupting the “critical” or “emergency” signals.

### 3.02 FIBER OPTIC CABLE INSTALLATION

- A. Provide minimum 30 feet of slack in all cables within the wall-mounted pull box in all electrical handholes. Manage slack on existing cable racks.
- B. Use cable tie tool to install cable ties to manage cable slack. Cable tie tool shall apply appropriate pressure to the cable bundles to prevent damaging cables and provide a smooth cut of excess cable tie. Cable ties shall be able to be turned freely around the bundle of cable. Cable bundles shall be limited to a 3-inch diameter.



- C. Use Velcro bands to secure cable bundles within interior pull boxes and fiber patch panels.
- D. Avoid excessive and sharp bends. Manufacturer's recommended bend radius and pulling tensions shall not be exceeded.
- E. Fittings or connections are allowed only at the input and output of devices. Splicing is not acceptable in any cable. The entire cable run shall be replaced in all such instances.
- F. All cables shall be installed in conduit. Underground installations shall include a 10 AWG, insulated-copper tracer wire. Wire insulation shall be orange and shall be XHHW-2. Wire shall terminate in handholes or junction boxes.
- G. A minimum of 15 feet of cable slack shall be provided at end of each fiber optic cable. This slack shall be exclusive of the length of fiber required to accommodate terminations and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored to prevent damage and secure cable in the patch panel or a separate enclosure designated for this purpose. Multiple cables may share a common enclosure. Exact cable termination locations shall be field verified with OWNER and ENGINEER.
- H. Fiber optic cables shall be pulled into conduits utilizing a tugger with built-in tension meter. CONTRACTOR shall provide a report to ENGINEER for each pull indicating maximum tension reached during the pull along with manufacturer's maximum pulling tension. Motorized machines of any type are not allowed for any fiber optic cable pulling.
- I. All spare fibers shall be terminated on spare fiber patch panel ports with protective plugs.

### 3.03 GROUNDING

- A. The shielded connection for shielded network cabling shall be connected at the network switch or patch panel and not at the field device connection. Ground patch panels and network switches accepting shielded network cables.
- B. Shielded cabling shall be installed in accordance with manufacturer's instructions and to minimize electrical noise and interference to associated instruments. Refer to instrument manufacturer's instructions for additional requirements.
- C. Ends of signal wires shall be sealed to prevent the migration of moisture into the cable and to prevent unintentional grounding of the shield at the open end. Seal signal wires using a minimum 1-inch piece of heat-shrink tubing installed over PVC jacket and individual wires, and heat-shrink to a watertight fit.
- D. All shields must be grounded.
- E. Shields shall be grounded at one point only. Shielded cabling shall be isolated and left open at the instrument. The single-pair electronic instrument cable shields shall be connected to the multipair electronic instrument cable overall shield in the field junction box. The multipair electronic cable overall shield shall be grounded to the control room instrument ground.
- F. Shielded pair thermocouple cable shields shall be connected to the individual pair shields of multipair thermocouple cables in the field junction boxes to maintain shield continuity for each individual shielded pair from the thermocouple to the input component in the control room. The multipair thermocouple cable overall shield shall be isolated and left open in the

field junction box. The individual thermocouple pair shields shall be grounded at the thermocouple connection head. The multipair thermocouple cable overall shield shall be grounded at the control room instrument ground. The other ends of the individual thermocouple pair shields and the multipair thermocouple cable overall shield shall be isolated and left open.

- G. When multipair electronic instrument cable is specified with individual shielded pairs to minimize crosstalk on flow meters or other pulsating signal applications, the shielding and grounding of the individual pair shields and the multipair overall shield shall be the same as for thermocouple applications.
- H. Cable shield grounds shall be isolated from control system signal grounds, except at instrument system grounding electrodes.
- I. The control room instrument ground shall be separate and isolated from the electrical power grounding system.
- J. See grounding riser diagram in the Drawings for additional requirements.

### 3.04 FIBER OPTIC TESTING

- A. Prior to installation, CONTRACTOR shall perform tests deemed necessary by CONTRACTOR to demonstrate integrity of all fiber optic cables.
- B. Upon completion of cable installation and termination, the fiber optic cabling shall be tested to include:
  - 1. Optical attenuation using Optical Loss Test Set (OLTS) testing.
  - 2. Verification of link integrity using Optical Time Domain Reflectometer (OTDR) testing.
- C. OLTS testing shall be performed on all fibers in both directions of transmission after being terminated in the associated permanent patch panels. Measurement shall be inclusive of the optical connectors and couplings installed at the system endpoints, including patch panel terminations. Access jumpers shall be used at both the transmit and receive ends so that an accurate measurement of connector losses is made. Fibers shall be tested in accordance with the IEC 61280-4-1 and IEC 61280-4-2 standards, utilizing 1, 2, or 3 reference cables, as needed.
- D. In addition to performing OLTS testing on each fiber, an OLTS test shall be performed on all fibers included in the device-to-device link for each network that is expected to experience the highest attenuation due to a combination of distance and the number of patch panel terminations and jumpers throughout the entire link. This worst case device-to-device link testing shall be performed for the highest expected attenuation path for each communication system, including, but not limited to, SCADA network switches, telecommunication network switches, fire alarm control panels, power distribution controllers, etc.
- E. The attenuation measured during OLTS testing shall not exceed the values calculated as follows:  $\text{Attenuation (max.)} = 2 \times \underline{C} + \underline{L} \times \underline{F} + \underline{S}$  dB, where  $\underline{C}$  is the maximum allowable connector loss (in dB),  $\underline{L}$  is the length of the run (in kilometers), and  $\underline{F}$  is the maximum allowable fiber loss (in dB/km).  $\underline{S}$  is the total splice loss (number of splices \* max. attenuation per splice). Values referenced herein shall be determined by manufacturer's specifications for approved products.

- F. OTDR testing shall be performed in one direction on all fibers after final terminations in permanently-installed patch panels, as well as any fibers planned to remain unterminated. Multimode fibers shall be tested at 850 nm (nominal). Single-mode fibers shall be tested at 1300 (nominal). The OTDR tests shall incorporate high-resolution optics optimized for viewing of short cable sections. Access jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive ends shall be used.
- G. OTDR traces revealing a point discontinuity in the fiber greater than 0.2 dB in a multimode fiber or 0.1 dB in a single-mode fiber, at any of the tested wavelengths, or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that fiber by OWNER. The installation of that cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that cable and the associated terminations shall be replaced at CONTRACTOR's expense.
- H. Upon completion of the installation, CONTRACTOR shall provide complete test reports to ENGINEER for review. Documentation shall include the following items:
  - 1. Test results submitted in the format specified for submissions under Section 01 33 00–Submittals. Where documentation provided in electronic form requires unique software for viewing test results, CONTRACTOR shall provide one licensed copy of the software along with the above documentation.
  - 2. Insertion loss test data, including a record of test wavelengths, cable type, fiber and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
  - 3. OTDR traces including individual optical fiber “signatures” obtained as specified above. Trace files shall be named to identify each individual fiber by its location in the cable system and fiber number or color. For OTDR traces, the vertical and horizontal scales shall be set so as to maximize the detail in each backscatter trace. The portion of the trace which depicts the fiber under test shall extend a minimum of 50% of the display area.

### 3.05 CURRENT TRANSFORMER INSTALLATION

- A. Minimize the length of current transformer cables to maintain current transformer burdens below the specified accuracy burden limits.
- B. Shielded-pair transformer lead extension cables wired to power meters with loop-through current sensors (i.e., no current input terminals at the metering device) shall be spliced with a short length of No. 14 AWG conductor as specified in Section 26 05 19–Wire for the final loop-through connection at the power meter. Limit the length of the conductor to maintain as much of the shielded-pair cable as possible. Splices shall use self-soldered butt splices as specified herein.

END OF SECTION

SECTION 26 05 26  
SECONDARY GROUNDING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Power system grounding.
  - 2. Electrical equipment and raceway grounding and bonding.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Ground Rods: Copper-bonded, 5/8-inch diameter; minimum length 10 feet.
- B. Ground Connections Below Grade: Exothermic type by Cadweld, compression type by ABB (Thomas & Betts), or equal. Compression connectors shall be prefilled with an oxide inhibitor.
- C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, GBL, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Compression-type connectors shall be installed with the manufacturer recommended tools. Compression dies shall emboss an index on the connector when installed correctly. An indenter crimp shall be made on ground rods prior to connection of grounding conductor.
- B. Provide a separate insulated equipment grounding conductor for each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.
- C. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and cold water plumbing systems.

- D. Connect grounding electrode conductors to metal water piping, metal frame of building or structure, structural reinforcing bars, and lightning protection system ground conductors using suitable ground clamps. Make connections to flanged piping at a point ahead of meter or service shutoff valve. Provide jumper connection across meter or service shutoff valve.
- E. Ground system, transformer neutrals, and equipment as required by code and local ordinances.
- F. All feeder neutrals shall be connected to neutral at only one point in the MCC or switchgear.
- G. All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.
- H. Water system grounds and a minimum of three ground rods at 15-foot separations near service or feeder entrance of each building shall be provided and ground wires must attach to point ahead of meter or service shutoff valve. These shall be connected to ground bus by conductors sized to code requirements. The above are minimum requirements.
- I. All grounding electrode conductors shall be installed in PVC conduit. All conduit bends shall be made using sweep elbows. Conduit bodies and 90-degree bends are not allowed.
- J. Include ground for grounded receptacles, light fixtures, telephone system, motors, and equipment items shown on the Drawings.
- K. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base, lighting fixture, or equipment frame to conduit system.
- L. Provide a separate grounding conductor system for the grounding of all lighting fixtures and devices installed in the same conduit as the branch circuit conductors. Ground conductors shall be individually connected at each fixture or device.
- M. All equipment in NEMA 4X areas that are fed from circuits in PVC conduit shall be provided with a separate green ground wire that is terminated at the metallic conduit system and the equipment.
- N. Separately derived systems as defined by the National Electrical Code shall be grounded as such. This shall include, but not be limited to, 4-wire transformers and 4-wire standby generators.
- O. Refer to Section 26 05 23—Instrument and Communication Wire and Cable for additional grounding requirements.

### 3.02 TESTING

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three-point “Fall-of-Potential” test. The test results shall include a graph of the results plus a diagram of the testing layout. The remote current probe (C2) shall be placed a minimum of 100 feet from the ground system

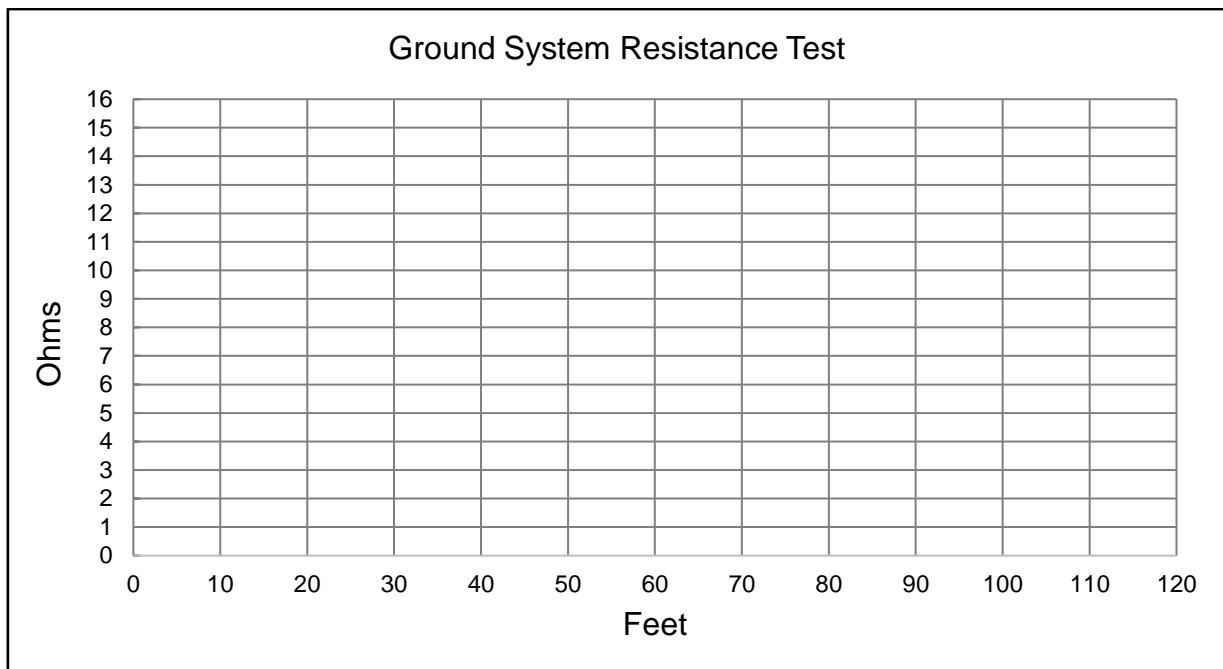
potential/current probe (P1/C1) or as required to provide sufficient spacing to demonstrate a resistance plateau on the graph. The ground resistance shall be tested with the potential probe (P2) between the P1/C1 probe and the C2 probe at 10% intervals starting at 0% and ending at 100% of the distance between P1/C1 and C2, 11 points total. A single point of measurement is not acceptable, and the two-point method of ground system testing shall only be used where there is no or insufficient "open earth" area to use the three-point Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms. All ground system tests shall be witnessed by ENGINEER or OWNER. ENGINEER shall be notified a minimum of 72 hours in advance of all ground system testing.

- C. The test meter shall be Associated Research Vibroground test set with null balance, or equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test equipment.
- D. Ground resistance testing shall be performed with all rods connected and shall be isolated from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.
- E. Multiple ground rod grids shall be isolated from all metallic connections such as from grid under test to other grounded structures and electrical system neutrals.
- F. Provide test report using the attached Form 26 05 26. Each ground grid, including service entrance transformers, switchgear, etc., shall have a form submitted.

END OF SECTION

## GROUND ROD RESISTANCE TO EARTH TEST RECORD

1. DATE \_\_\_\_\_
2. PROJECT NAME \_\_\_\_\_
3. LOCATION OF TEST \_\_\_\_\_
4. GROUND ROD TYPE \_\_\_\_\_  
DIAMETER \_\_\_\_\_ LENGTH \_\_\_\_\_
5. TEST METHOD \_\_\_\_\_  
INSTRUMENT TYPE \_\_\_\_\_  
SERIAL NO. \_\_\_\_\_
6. REQUIRED MAXIMUM RESISTANCE TO EARTH \_\_\_\_\_
7. MEASURED RESISTANCE TO EARTH \_\_\_\_\_  
GROUND ROD SYSTEM \_\_\_\_\_



TEST PERFORMED BY: \_\_\_\_\_  
Signature

TEST WITNESSED BY: \_\_\_\_\_  
Signature

SECTION 26 05 29  
SUPPORTING DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Conduit and equipment support members.
  - 2. Fastening hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MATERIAL

- A. Support Members:
  - 1. 316 stainless steel in exterior locations, NEMA 4X areas, and damp and wet locations.
  - 2. Fiberglass in NEMA 4X chemical rooms where noted on the Drawings.
  - 3. Hot-dipped galvanized steel in all other areas.
- B. Hardware:
  - 1. Stainless steel in exterior locations, NEMA 4X areas, and damp and wet locations.
  - 2. Fiberglass in NEMA 4X chemical rooms where noted on the Drawings.
  - 3. PVC-coated steel clamps and stainless steel hardware with stainless steel members where used to support PVC-coated rigid steel conduits.
  - 4. Hot-dipped galvanized steel in all other areas.
- C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. All supporting devices and support structures shall be constructed such that the structure adequately supports the load of the equipment installed on it including any wind and/or snow



loads. Provide additional support members to those shown on the Drawings to adequately support load.

- B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or support members. Do not use spring steel clips and clamps. Provide standoffs or suspended ceiling grid bridge supports as specified in other technical sections.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. The ends of all support members shall be ground smooth.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- F. Do not use powder-actuated anchors.
- G. Do not drill structural steel members.
- H. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring-lock washers under all nuts.
- I. In wet locations, install free-standing electrical equipment on concrete pads. Anchor all equipment to adjacent walls with standoffs and caulk.
- J. Install surface-mounted cabinets and panelboards with a minimum of four anchors.
- K. Do not use chain, wire rope, or perforated strap hangers.
- L. All welds shall be continuous and ground smooth.

END OF SECTION

## SECTION 26 05 33

### CONDUIT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Rigid metal conduit and fittings.
  - 2. Rigid aluminum conduit and fittings.
  - 3. PVC externally and internally coated galvanized rigid metal conduit and fittings.
  - 4. Polyvinyl chloride conduit and fittings.
  - 5. Liquidtight flexible metal conduit and fittings.
  - 6. Conduit seals and special fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI C80.1—Electrical Rigid Steel Conduit (ERSC).
- B. ANSI C80.5—Electrical Rigid Aluminum Conduit (ERAC).
- C. ANSI/NEMA FB 1—Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- D. NEMA RN 1—Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of Raceways: Firms regularly engaged in the manufacture of electrical raceways of the types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical materials, which have been listed and labeled by Underwriters Laboratories.
- E. Prior to shipment to the site, all conduit provided shall be new, unused material, and shall not have been stored outdoors or exposed to weather.

- F. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

#### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

#### 1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide color-coded thread protectors on the exposed threads of threaded rigid metal conduit.
- B. Handle conduit carefully to prevent end damage and to avoid scoring the finish.
- C. Store conduit inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, waterproof wrapping.

### PART 2–PRODUCTS

#### 2.01 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: ANSI C80.1 and UL6. Heavy wall seamless tubing with hot-dipped galvanized coating.
- B. Conduit bodies for rigid steel conduit shall be as manufactured by Appleton, Form 35, or equal, and be constructed of stamped steel for sizes 2 inches and under, and cast malleable iron for sizes over 2 inches. Conduit bodies shall have domed gasketed covers and stainless steel screws. Conduit bodies sizes 1 1/4-inch and larger shall have built-in pulling rollers. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- C. Rigid Aluminum Conduit: ANSI C80.5 and UL6A. Heavy wall.
- D. Conduit bodies for rigid aluminum conduit shall be as manufactured by Appleton, Form 85, or equal, and be constructed of pressure-cast, copper-free aluminum for sizes 2 inches and under, and sand-cast, copper-free aluminum for sizes over 2 inches. Conduit bodies shall have domed gasketed covers, and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size per application.
- E. PVC-coated conduit and fittings shall be internally and externally hot dipped galvanized rigid metal conduit with hot dipped galvanized threads and PVC coating. PVC coating shall be UL listed with rigid metal conduit as the primary means of corrosion protection for the conduit, and PVC coating shall have an external 40 mil thickness with an internal 2 mil urethane coating. Acceptable manufacturers shall be Plasti-bond RedH<sub>2</sub>OT by Robroy Industries, Ocal-Blue by ABB (Thomas & Betts), Calbond, or equal. All installers shall be field-certified from the factory for installation and shall provide proof of certification. PVC-coated conduit and fittings shall meet the following listings and manufacturing standards, without exception:

1. ANSI C80.1.
  2. UL6.
  3. NEMA RN1.
- F. Conduit bodies for PVC-coated rigid conduit shall be as manufactured by Plasti-bond RedH<sub>2</sub>O<sup>T</sup> by Robroy Industries, Ocal-Blue by ABB (Thomas & Betts), Calbond, or equal, and have a 40 mil PVC exterior coating and 2 mil red urethane interior coating. Conduit bodies shall be Form 8 style or pulling elbow and include domed, gasketed covers and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- G. Fittings and Conduit Bodies: ANSI/NEMA FB 1 and UL 514B; threaded-type material to match conduit. For hazardous locations, fittings and conduit bodies shall meet the requirements of UL 886. Split couplings are not allowed.
- H. Supports: One-hole straps with conduit clamps and backspacers shall be used for surface-mounted conduit. Where standoffs are required, provide conduit clamps and supporting devices as specified in Section 26 05 29—Supporting Devices. One-hole straps with conduit clamps and backspacers for PVC-coated rigid steel conduit shall be PVC-coated rigid steel material.

## 2.02 POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

- A. Conduit: Heavy wall rigid, Schedule 40, Schedule 80 where noted, UL listed for underground, encased, and aboveground applications. PVC conduit installed in exterior locations shall be UV resistant.
- B. Conduit bodies for PVC conduit shall be as manufactured by Carlon, or equal, and be suitable for use with Schedule 40 or Schedule 80 PVC conduit. Conduit bodies shall have smooth hubs, textured lids, and foam-in-place gaskets. CONTRACTOR shall select body style and size per application.
- C. Supports: Two-hole nonmetallic clamps shall be used for surface-mounted conduit. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 26 05 29—Supporting Devices. Support material shall match that of the conduit type being provided.

## 2.03 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Liquidtight Flexible Metal Conduit:
1. Conduit: Spiral-wound, electrogalvanized, single-strip steel with integral grounding conductor continuously enclosed within the entire length of the convolutions. The flexible PVC jacket shall be sunlight-resistant, flame-retardant, and resistant to damage from mild acids. Conduit shall be UL Listed and be rated for installation in Class I, Division 2, Groups C and D locations. Conduit shall be Liqueflex Type LA, or equal.
  2. Fittings: UL listed with thermoplastic elastomer sealing gasket. Provide stainless-steel fittings in all locations.
- B. Liquidtight Flexible Non-Metallic Conduit:
1. Conduit: Helically-wound, Type B, PVC construction with a continuous spiral of rigid PVC embedded within the PVC wall. The flexible PVC wall shall be sunlight-resistant,

flame-retardant, and resistant to damage from mild acids. Conduit shall be UL Listed and be rated for installation in Class I, Division 2, Groups C and D locations. Conduit shall be Liquatite Type NM, or equal.

2. Fittings: UL listed with thermoplastic elastomer sealing gasket. Fittings shall be non-metallic nylon and rated for use with Type B liquidtight non-metallic conduit.

#### 2.04 CONDUIT SEALS AND SPECIAL FITTINGS

- A. Conduit Seals: Duct sealing compound, OZ Gedney Type DUX, or equal.
- B. Expansion Fittings: Crouse Hinds or Robroy Type XJG (non-hazardous location) or Type UNY/UNF (hazardous location), or equal, for rigid, IMC, or PVC-coated rigid conduit. Carlon E945 Series, or equal for PVC conduit.
- C. Expansion Deflection Fittings: O-Z type "DX," Crouse Hinds, type XD (PVC conduit only), or Appleton.
- D. Ground Bushings: Crouse Hinds Model GLL, or equal.
- E. Mechanical Seals: 316 stainless steel, Link Seal, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners.
- F. Watertight Hubs: Diecast, insulated and gasketed, rated for wet or dry locations indoors or outdoors. Watertight hubs shall be Appleton HUBXXDN, Crouse-Hinds Myers Hubs, or equal.
- G. Conduit Plugs: Kwik N Sure pipe plug as manufactured by Cherne Industries, or equal. Plug shall include natural rubber O-ring with galvanized wing nut and hex nut.
- H. Conduit Threads Joint Compound: Kopr-shield conductive, anti-corrosion joint compound as manufactured by Thomas & Betts, or equal.

### PART 3-EXECUTION

#### 3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Size conduits for branch circuit conductors, control wires, and instrumentation cables so as to have not less than 25% spare capacity after installation; 3/4 inch minimum size. Minimum size for flexible metal conduit is 1/2 inch except 3/8 inch for lighting fixtures. Minimum size for liquidtight flexible metal conduit is 1/2 inch.
- B. Maintain at least 1 inch of separation between conduit sizes to 1 1/2 inches and 2 inches between conduits 1 1/2 inches or larger. Maintain 1 foot of separation between signal conduits (below 100 volts) and power conduits (100 volts and above).
- C. All conduit shall be supported in accordance with the NEC and as specified herein. This shall apply to all conduit types, including flexible conduit.
- D. Provide for the proper application, installation, and location of inserts, supports, and anchor bolts for a satisfactory raceway system. Where any component of the raceway system is damaged, replace or provide new raceway system.

- E. Maintain a minimum clearance of 6 inches from all hot water pipes, flues, or any high-temperature piping or ductwork.
- F. Conduits shall be attached to building surfaces and not suspended unless installed in a Unistrut-type conduit rack as specified herein. Individual conduits shall not be suspended. Clevis hangers are not allowed.
- G. Center conduit in structural slabs (other than topping), clear of reinforcing steel and spaced on centers equal to or exceeding three times the conduit diameter. Outside diameter of conduit shall not exceed one-third the slab thickness for each run of conduit 1 1/4 inches or larger. Provide shop drawings when conduit will be installed in structural slabs. Conduits shall not be run in slabs-on-grade or structural topping slabs.
- H. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice. Conduits through roofs shall be rigid metal conduit and be equipped with pitch pockets.
- I. Conduit attached to building surfaces that may be damp or wet shall be spaced out to avoid rust and/or corrosion using fittings approved for the use. Use back straps on all conduit in damp and wet locations, or mount conduit with Unistrut straps, or equal. Watertight hubs shall be used in all damp and wet locations.
- J. Conduits shall be securely fastened to building structure at intervals not exceeding 8 feet or closer, if necessary. Where hangers are necessary, 3/8-inch rod/eyelets/rings/or trapeze type in Unistrut channel and pipe clamps shall be used. Wire or perforated strap iron is not acceptable. PVC conduit shall be securely fastened to building structure at intervals not exceeding 3 feet.
- K. Vertical conduit runs 1 1/4 inches and larger passing through floors shall be supported at each floor with conduit riser grips.

### 3.02 GENERAL CONDUIT INSTALLATION REQUIREMENTS

- A. Conduit may be surface mounted on interior of existing structures.
- B. Conduit may be run exposed on the underside of precast or poured concrete floor slabs or in basements. Run exposed conduit grouped and parallel or perpendicular to construction. Do not route exposed conduits over boilers or other high-temperature machinery nor in contact with such equipment. All conduit shall be run exposed in structures below grade.
- C. All conduit installed below grade shall be buried a minimum of 2 feet 0 inch. All conduit installed below floor slabs shall be buried a minimum of 1 foot below slab.
- D. PVC-coated rigid steel conduit and PVC conduit installed in earth (interior and exterior) shall be bedded in compacted sand with a minimum of 6-inch cover on all sides.
- E. In all PVC conduit runs below grade 200 feet and longer, PVC coated rigid steel conduit shall be used for all 90 degree bends.
- F. Ream conduit smooth at ends, cap upon installation, rigidly attach to structural parts of the building, and securely fasten to all outlet boxes, panel cabinets, junction boxes, pull boxes, splicing chambers, disconnect switches, and all other components of the raceway system.

- G. Where conduits installed through roofs serve heating, ventilating, and air-conditioning equipment, conduits shall not be routed through ductwork or chases; conduits shall penetrate the roof and be equipped with pitch pockets.
- H. Conduits installed for future equipment or electrical work shall be cut off and capped flush with finished floor. Conduit ends shall have threaded fittings to accommodate future conduit installation.
- I. Provide all empty raceways 2 1/2 inches and over with No. 10 galvanized fishwire, and nylon cord for conduits smaller than 2 1/2 inches. Empty raceways and fishwire/nylon cord shall be identified with permanent label, and label shall include conduit termination point. All empty conduits shall be threaded, capped and flush with finished floor or wall. Exposed conduits shall be threaded and capped.
- J. Provide conduit raceway for exposed cables that are not UV resistant. This shall include, but not be limited to, instrument wiring, motor terminators, pump cables, float cables, etc.
- K. Conduit seals shall be provided for intrinsically safe circuits, where conduits pass from the interior to exterior of the building, where conduits enter a room which at any time is a low or high temperature room, where conduits enter a room which at any time is subject to internal air pressures above or below normal, any conduit entering a wet location, and any conduit entering a NEMA 4X area.
- L. Liquidtight flexible conduit shall be installed in such a manner that liquids tend to run off the surfaces and not drain toward the fittings.
- M. All runs of flexible conduit and flexible conduit couplings to equipment and devices shall be as short as practicable, of the same size as the conduit it extends, and with enough slack to reduce the effects of vibration to a minimum. A minimum of 18 inches of flexible conduit shall be installed for each motor.
- N. Provide conduit expansion-deflection fittings as specified herein in all conduit runs where movement perpendicular to axis of conduit may be encountered.
- O. Conduits shall be pitched so that drainage is towards handholes and away from all structures.
- P. Conduit bends for PVC conduit shall be made using a hot box, heat blanket, or glycol bender. Open flame or point heat sources of any type are not allowed.
- Q. The PVC-coated rigid conduit manufacturer's touch-up compound shall be used on all conduit interior and exterior bare steel exposed because of nicks, cuts, abrasions, thread cutting, and reaming; minimum six coats.
- R. Where below-grade PVC conduit is connected to rigid metal conduit, the length of PVC conduit shall be a minimum of 10 feet. For short, below-grade conduit runs where required lengths of rigid metal conduit limit the length of PVC conduit to less than 10 feet, rigid metal conduit shall be used for the entire run.
- S. Conduit bodies shall not be used for fiber optic cable routing. Provide pull boxes sized as required for fiber optic cable bending radius.

- T. Routing of conduits on exterior of buildings shall be avoided to the extent possible and shall not cover or interfere with lighting, signage, windows, louvers, or other openings. All conduit routing on exterior walls shall be reviewed with ENGINEER for approval prior to installation.
- U. Conduits installed in damp and wet locations shall have all threads coated with conduit threads joint compound.

### 3.03 CONDUIT PENETRATIONS AND TERMINATIONS

- A. Where fittings are brought into an enclosure with a knockout, a gasket assembly consisting of an O-ring and retainer shall be installed on the outside. Fittings shall be insulated throat type.
- B. Conduit penetrations for control panels or enclosures containing electronic equipment shall utilize watertight hubs and, if entering the top of the enclosure, shall be located at the front of the enclosure and not over any electronic equipment (e.g., PLC, power supplies, etc.).
- C. Conduit penetrations for all exterior enclosures (e.g., disconnects, junction boxes, control panels) shall utilize watertight hubs and enter the sides or bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.
- D. Provide conduit expansion fittings as specified herein in all conduit runs that cross a structural expansion joint, for conduits protruding from duct banks that are routed above grade and into structures, and for conduits protruding from earth.
- E. All conduits that protrude from poured concrete shall be PVC-coated rigid conduit. Conduit shall extend continuously (i.e., no joints) a minimum of 4 feet beyond the poured concrete (both sides). Where an underground conduit joint or coupling is located within 4 feet of the face of the penetration, the conduit shall be provided with reinforced concrete encasement doweled into the structure wall and continuing a minimum of 1 foot past the connection. The encasement construction shall conform with the encasements indicated for duct banks. PVC-coated rigid conduit 4-foot minimum projection requirement shall begin at, and extend from, the end of the encasement. The intent of this paragraph is to permit CONTRACTOR to use couplings at the inside face of the formwork.
- F. Conduits passing through masonry, concrete, or similar construction shall be cast in place using PVC-coated rigid conduit extending completely through the construction.
- G. Where above-grade conduits pass through cores in existing structures or through masonry walls, grout openings between conduit and walls or floors with sand cement mortar.
- H. Where wall penetrations through existing walls are below grade, cored openings shall be sealed with waterproof mechanical seals. Cores shall be pitched slightly such that conduit slopes away from building. Sleeve diameter shall be provided and mechanical seals installed as recommended by the manufacturer. Conduit shall extend continuously (i.e., no joints) a minimum of 4 feet beyond the wall (exterior).
- I. All spare conduits that terminate in a building or structure below grade shall be plugged with conduit plugs as specified herein.



### 3.04 CONDUIT INSTALLATION IN HAZARDOUS LOCATIONS

- A. All conduits installed in or passing through “hazardous locations” as defined by the NEC, NFPA, or as noted on the Drawings, shall be installed with seal-offs as specified herein.
- B. All conduits in hazardous locations shall be installed in accordance with the NEC.

### 3.05 CONDUIT INSTALLATION FOR EMERGENCY LIGHTING AND POWER CIRCUITS

- A. All emergency egress lighting and power circuits shall be installed in dedicated conduits.
- B. Conduits for emergency egress lighting and power circuits shall be installed and permanently marked in accordance with the NEC.

### 3.06 CONDUIT INSTALLATION SCHEDULE

- A. The following schedule lists specific conduit types allowed in designated areas. Those areas not listed under a specific conduit type shall not have that type of conduit installed:
  - 1. Rigid steel:
    - a. Structural slabs.
    - b. Interior locations requiring mechanical protection.
    - c. All exposed interior locations.
    - d. All concealed interior locations.
  - 2. Rigid aluminum:
    - a. All exposed interior locations.
    - b. Interior locations requiring mechanical protection.
    - c. Exterior locations (except in earth and at chemical feed locations utilizing chlorine liquids) and locations exposed to weather.
    - d. Above suspended ceilings.
    - e. All locations where attached to aluminum railings or aluminum structural members.
    - f. Where noted on the Drawings.
  - 3. PVC-coated rigid steel:
    - a. Conduits protruding from concrete.
    - b. Interior and exterior locations requiring mechanical protection.
    - c. Earth.
    - d. Exterior locations and locations exposed to weather.
    - e. Within 4 feet of building or structure footing, wall, or manhole/handhole.
    - f. Conduits within manholes.
  - 4. PVC:
    - a. Earth, except within 4 feet of a building or structure footing, wall, or manhole/handhole. PVC conduit under pavement or roadways shall be Schedule 80.
    - b. NEMA 4X areas (indoors only).
    - c. Grounding electrode conductors.
    - d. Buried below slabs on grade.
    - e. Concrete encased duct banks (Schedule 40 or Schedule 80).
  - 5. Liquidtight flexible metal conduit not over 3 feet in length for final connections to:
    - a. Equipment with sliding bases or flexible positioning.
    - b. Equipment with vibration isolation mounting.
    - c. Equipment housing ferromagnetic cores or with integral moving components capable of generating noise or vibrations, including transformers and motors.
    - d. All pumps and associated equipment.

6. Liquidtight flexible non-metallic conduit not over 3 feet in length for final connections to equipment in chemical storage locations.

END OF SECTION

## SECTION 26 05 35

### BOXES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Switch, outlet, and small junction boxes.
  - 2. Pull and junction boxes.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

##### 1.02 REFERENCES

- A. ANSI/NEMA OS 1—Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. ANSI/NEMA OS 2—Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. NEMA 250—Enclosures for Electrical Equipment (1000 Volts Maximum).

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation Work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, boxes, raceways, wire, connectors, outlets, switches, etc. that have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

## PART 2–PRODUCTS

### 2.01 SWITCH, OUTLET, AND SMALL JUNCTION BOXES

- A. Cast Boxes: Aluminum or cast feraloy, deep-type, gasketed cover, threaded hubs, Eaton FD Series, or equal.
- B. PVC-Coated Cast Boxes: Boxes shall be deep type and be by the same manufacturer as the conduit.
- C. NEMA 4X Boxes:
  - 1. Switch and Outlet Boxes: PVC or FRP, Carlon FD Series, or equal with proper cover and gasket. 316 stainless steel, Calbrite FDC Series, or equal where specified herein.
  - 2. Small Junction Boxes: PVC or FRP, Carlon HS Series, or equal with proper cover and gasket.
- D. Covers for switch and outlet boxes used as junction boxes shall have covers that match box type.

### 2.02 PULL AND JUNCTION BOXES

- A. Cast Boxes: NEMA 250; Type 4, surface-mounted junction box, UL-listed as watertight. Cast aluminum or feraloy box and cover with ground flange, neoprene gasket, and stainless steel cover screws, Crouse-Hinds WCB Series, or equal. Boxes larger than 12 inches in any dimension shall have hinged cover.
- B. PVC-Coated Cast Boxes: Provide PVC-coated cast boxes in areas where PVC-coated conduit is used. Boxes shall be by the same manufacturer as the conduit. Boxes larger than 12 inches in any dimension shall have hinged cover.
- C. NEMA 4X Boxes: PVC or FRP, Carlon HS Series, or equal with hinged cover and gasket. 316 stainless steel with hinged cover, recessed quarter-turn latches, and gasket, Saginaw Control and Engineering Enviroline Series, or equal, where specified herein.
- D. NEMA 12 Boxes: Painted steel with hinged cover, recessed quarter-turn latches, and gasket. Boxes shall be Hoffman CSD, or equal.
- E. Where terminal blocks or other devices are mounted in a pull or junction box, provide a 14-gauge steel back panel with a white enamel finish for mounting.
- F. All enclosures with double doors or that are free-standing shall have a three-point latch.
- G. Boxes specified in this section are not allowed to have knockouts and are not allowed to be used as enclosures for control panels.

## PART 3–EXECUTION

### 3.01 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the Drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.

- B. Electrical box locations shown on the Drawings are approximate. Verify location and size of outlet boxes in all work areas prior to rough-in.
- C. Where dedicated raceways are provided for different voltage systems or wiring, (e.g., motor power wiring and motor space heaters), separate boxes shall also be provided unless acceptable to ENGINEER. Where acceptable to ENGINEER, combined boxes shall be physically divided to separate the wiring.
- D. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of access doors.
- E. Locate and install to maintain headroom and to present a neat appearance.
- F. All boxes attached to building surfaces that may be damp or wet shall be spaced to avoid rust and/or corrosion. All boxes in damp and wet locations shall be on 1/2-inch standoffs.

### 3.02 SWITCH, OUTLET, AND SMALL JUNCTION BOX INSTALLATION

- A. Provide knockout closures for unused openings.
- B. Support boxes independently of conduit.
- C. Use multiple gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- D. Install boxes in walls without damaging wall insulation.
- E. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- F. Position outlets to locate luminaires.
- G. Switch and outlet boxes provided for branch circuits and feeders shall not contain control wiring. Control wiring, wiring for emergency egress lighting, shall have dedicated pull and junction boxes provided. Wiring for different voltage systems (e.g., 24 V, 120 V, 480 V) shall have dedicated pull and junction boxes for each voltage.
- H. Flush ceiling outlet boxes.
- I. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- J. In unplastered brick or block walls, use masonry boxes.
- K. In metal door frames, use partition boxes.
- L. For weatherproof switches, devices, and exterior fixtures, use cast boxes with proper cover and gasket.
- M. All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted.
- N. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.

- O. Boxes shall be of a depth to accommodate wires and splices and shall be equipped with both fixture hanging studs and tapped fixture ears. Boxes shall be installed so that they will support the weight of the fixture. Conduit will not be considered as adequate supports.
- P. Cast boxes with 3/4-inch hubs and aluminum fittings and enclosures may be used with all conduit types.
- Q. Sheet metal boxes installed in suspended ceilings for free-air splices or devices installed through the suspended ceiling shall be supported by the suspended ceiling grid system using grid support bridges. Provide mounting hardware, accessories, extensions, etc., based on ceiling grid installed for this project.
- R. Provide PVC-coated cast boxes in all areas where PVC-coated conduit is used. Boxes shall be by the same manufacturer as the PVC-coated conduit.

### 3.03 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable, except when used in conjunction with EMT conduit in areas where allowed.
- D. Refer to Section 26 05 53—Electrical Identification for junction box labeling requirements.
- E. All interior exposed junction and pull boxes shall be NEMA 12, unless noted otherwise.
- F. All exterior junction and pull boxes shall be NEMA 4X. Boxes in areas subject to damage shall be stainless steel.
- G. In inaccessible ceiling areas, position boxes within 6 inches of recessed luminaire to be accessible through luminaire ceiling opening.
- H. Boxes shall be by the same manufacturer as the PVC-coated conduit.

END OF SECTION

## SECTION 26 05 44

### HANDHOLES

#### PART 1–GENERAL

##### 1.01 DESCRIPTION

- A. Work Included: Precast polymer concrete handholes.
- B. Related Sections: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/SCTE 77–Specification for Underground Enclosure Integrity.
- B. ASTM D4101–Specification for Polypropylene Injection and Extrusion Materials.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Shop drawing submittals shall include the following:
  - 1. Interior elevations of each wall of all handholes provided under this Contract. Each conduit shall be identified as to what it serves.
  - 2. Product data (handholes): Manufacturer's technical information for handholes and accessories proposed for use.

#### PART 2–PRODUCTS

##### 2.01 PRECAST POLYMER CONCRETE HANDHOLES

- A. Material and Construction:
  - 1. Precast polymer concrete.
  - 2. Duct entrances sized and located to suit duct banks.
  - 3. Enclosures, boxes and covers are required to conform to test provisions of ANSI/SCTE 77 for Tier 22 applications.
  - 4. Handholes shall be a minimum of 30 inches deep. Handholes shall be sized in accordance with the NEC.
  - 5. Covers shall have the following stamped logo:  
  
“ELECTRICAL”
  - 6. Handholes shall be Hubbel, Quazite, PG-Style, or equal.
  - 7. Handholes for loop detector lead-in cables only shall be Quazite Model PC1212BA12 with Tier 15-rated, gasketed cover Model PC1212GA00, or equal.

## PART 3-EXECUTION

### 3.01 INSPECTION AND COORDINATION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

### 3.02 HANDHOLE INSTALLATION

- A. Coordinate handhole installation with piping, sheeting, and other underground systems and structures, and locate clear of interferences.
- B. Install handholes where shown and verify locations in field. Perform excavation and backfilling required for installation. Excavation and backfilling shall be in accordance with Section 26 05 00-General Electrical Requirements.
- C. Install handholes on a 3/4-inch crushed stone foundation 1 foot under all handholes, and within 2 feet of handholes. Handhole bases shall be set at the proper grade and carefully leveled and aligned.
- D. All conduits must enter the sides of handholes. Conduits entering the bottom will not be permitted. Conduits shall enter handholes a minimum of 6 inches above bottom of handhole. Provide handhole depth as required. Conduit burial depth shall be 24 inches as specified.
- E. Handholes shall be considered wet locations for purposes of equipment selection.
- F. All conduits shall be pitched so that drainage is towards handholes and away from all structures.

### 3.03 GRADING AT HANDHOLES

- A. Handholes in unpaved areas shall be built as shown to a rim elevation higher than the original ground. The ground surface shall be graded to drain away from the handhole. Fill shall be placed around handholes to the level of the upper rim of the handhole frame, and the surface evenly graded on a one (vertical) to five (horizontal) slope to surrounding ground, unless otherwise shown.
- B. CONTRACTOR shall be solely responsible for proper height of handholes necessary to reach final grade. ENGINEER's review of shop drawings for handhole components is general in nature, and CONTRACTOR shall provide random length handhole riser sections to adjust handholes to meet field conditions for final grading.

END OF SECTION



## SECTION 26 05 53

### ELECTRICAL IDENTIFICATION

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Nameplates.
  - 2. Labeling tags.
  - 3. Wire and cable markers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Provide schedule for nameplates and labeling tags with shop drawings. Reference Drawings for type used.

#### PART 2—PRODUCTS

##### 2.01 NAMEPLATES

- A. Nameplate material shall be multi-color, two-layer, nonconductive engraving plastic suitable for permanent installations in indoor and outdoor locations. The material shall be UV-resistant and suitable for installation in direct sunlight.
- B. Type "A":
  - 1. Use:
    - a. Motor starters.
    - b. Each separately mounted circuit breaker or disconnect switch.
    - c. Each device in main distribution panels.
    - d. Each device in switchboards and switchgear.
    - e. Each device in motor control centers.
    - f. SPD.
    - g. Each device on Supervisory Control Center exterior.
    - h. Cabinets, enclosures, pull, and junction boxes.
    - i. Field devices (flowmeter transmitters, level transmitters, etc.).
    - j. Panelboards.
  - 2. Size: 2 inches by 4 inches.
  - 3. Background Color: Black.
  - 4. Character Color: White.
  - 5. Character Size: 1/2-inch.
  - 6. Engraving: See MCC schedule, one-line, and I/O list for labels, or as requested by ENGINEER. Label shall include equipment number and description (i.e., SCAL-60-01, Fluoride Scale).

7. Mounting Location: Front exterior.
- C. Type "B":
1. Use:
    - a. Standby power systems.
    - b. Automatic Transfer Switches.
  2. Size: 2 inches by 4 inches.
  3. Background Color: Red.
  4. Character Color: White.
  5. Character Size: 1/4-inch.
  6. Engraving: See MCC schedule and one-line for labels, or as requested by ENGINEER.
  7. Mounting Location: As requested by ENGINEER.
- D. Type "C":
1. Use:
    - a. Motor Control Centers.
    - b. Switchboards.
    - c. Supervisory Control Centers.
    - d. Switchgear.
    - e. Integrated Power Centers.
    - f. Transformers.
    - g. Power Cable Tray (Emergency-type label required).
  2. Size: 4 inches by 4 inches.
  3. Background Color: Black.
  4. Character Color: White.
  5. Character Size: 2 1/4 inches.
  6. Engraving: Equipment label, Emergency shall be red with white letters. Label shall include equipment number and description (i.e., LP-10-01, First Floor Power Panel).
  7. Mounting Location: Equipment: Top wire way.
- E. Type "D":
1. Use: Control stations, thermostats, conduit fittings, etc.
  2. Size: 1/2-inch by 4 inches.
  3. Background Color: Black.
  4. Character Color: White.
  5. Character Size: 1/4-inch.
  6. Engraving: Control station number and equipment description (e.g., T-15-01, Chlorine Room).
  7. Mounting Location: Device front at top.
- F. Type "E":
1. Use: Electrical Distribution System Equipment not previously specified.
  2. Size: As necessary.
  3. Background Color: Yellow.
  4. Character Color: Black.
  5. Character Size: 1/4-inch.
  6. Engraving and Mounting Location: As requested by ENGINEER.

## 2.02 WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be permanently-attached, heat-shrink type labels.
1. Sleeve: Permanent, PVC, white, with legible machine-printed black markings.
  2. Acceptable Manufacturers: Raychem Model D-SCE or ZH-SCE, Brady Model 3PS, or equal.

- 3. Grounding Conductor: Provide green wire marker; minimum 2 inches wide.
- B. Wire or cable numbering preprinted on the conductor or cable insulation, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

### PART 3—EXECUTION

#### 3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Affix nameplates with weatherproof, UV-resistant adhesive in outdoor locations and sticky back adhesive in indoor locations.
- D. Affix labeling tags with stainless steel leaders; vinyl locking wire ties are not acceptable. Provide 3/8-inch hole to accommodate wire tie.
- E. Prepare and install neatly-typed circuit directories and schedules in all panels, including, but not limited to, panelboards, fiber optic patch panels, and existing panels where Work is done under this Contract.
- F. Labeling tags shall only be used for equipment enclosures without surfaces suitable for mounting fixed nameplates.

#### 3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor, including neutral and spare conductors, in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Neutral conductor labels shall include the associated branch circuit number. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Spare conductors shall have control wire number or shall indicate termination point of wire.
- B. Conductors in pull boxes, motor control centers, supervisory control panels, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system. All wiring labels shall be able to be read without removing wire management (i.e., wiring trough covers, spiral windings, etc.) or twisting the wire/cable.
- C. Where terminal blocks are factory provided with non-project-specific labels by equipment manufacturers in MCC buckets, combination starters, VFDs, motor control panels, control panels, and similar equipment and are wired to terminal blocks in control panels with project-specific labels, the interconnecting wiring shall be labeled at both ends to match the project-specific terminal blocks in the control panel. Provide an additional label on the end of each wire that is connected to a terminal block with a non-project-specific label to indicate the associated terminal block.

D. Power Conductor Insulation Color Code:

1. 6 AWG and Larger: Provide general-purpose, flame-retardant, permanent tape at each termination and at accessible locations such as manholes, handholes, junction and pull boxes, panelboards, motor control centers, switchboards, switchgear, etc. Apply tape with at least six full, overlapping wraps; minimum 2 inches wide.
2. 8 AWG and Smaller: Provide conductors with color-coded insulation.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
120/240 Volts Single-Phase, Three-Wire	Grounded Neutral	White*
	One Hot Leg	Black
	Other Hot Leg	Red
120/208 Volts Three-Phase, Four-Wire	Grounded Neutral	White*
	Phase A	Black
	Phase B	Red
	Phase C	Blue
277/480 Volts Three-Phase, Four-Wire	Grounded Neutral	White*
	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		
* When installed as part of a 120-volt or 277-volt branch circuit, provide a color-coded stripe on the white neutral conductor insulation matching the branch circuit insulation.		

E. Control Panel and Field-Installed Control Conductor Insulation Color Code:

1. All conductors shall have color-coded insulation.
2. Colors:

System	Conductor	Color
Supply Voltage	Ungrounded Circuit Conductors	Black
	Neutral	White
Discrete 120-volt AC Input/Output	Control Circuit Conductor	Red
	Neutral	White
Discrete 12/24-volt DC Input/Output	Control Circuit Conductor	Blue
	Common	White with Blue Stripe
Conductors energized when the main disconnect is in the "off" position (e.g., foreign supply voltages)	Control Circuit Conductor	Orange
	AC Neutral	White
	DC Common	White with Blue Stripe
	Ground	Green
Intrinsically Safe	Control Circuit Conductor	Light Blue
	DC Common	White with Two Light Blue Stripes

F. Circuit Identification:

1. Identify power, instrumentation, and control conductors at each termination and at accessible locations such as manholes, handholes, junction and pull boxes, panelboards, motor control centers, switchboards, switchgear, etc.
2. Conductors for panelboard circuits shall identify circuit matching the circuit directory designations, including the neutral conductor.
3. Control conductor identification shall match the associated terminal block label.
4. Circuits Not Listed in Circuit Directories:
  - a. Assign circuit name based on unique device or equipment at load end of circuit.

- b. Where unique device or equipment names are not available or apparent, add a unique number or letter modifier to each otherwise identical circuit name.

### 3.03 DATA CABLE AND COMMUNICATION EQUIPMENT IDENTIFICATION

- A. Individual labels shall be placed on all information outlets, patch panels, racks and communications cabinets, and both ends of all cables.
- B. Each component shall be clearly labeled using a code identifying each device's location throughout the facility along with a unique identifier. The Record Drawings shall identify the numbering at each rack, communication cabinet, and jack location. Each media type shall be uniquely labeled as follows:
  - 1. Floor-standing Racks and Wall-Mounted Communications Cabinets:
    - a. Mounting structure type (R=floor-standing rack, CC=communications cabinet), structure number, rack/cabinet number.
    - b. For example: "R-80-01" represents Rack No. 1 in Structure 80. "CC-10-01" represents Communications Cabinet No. 1 in Structure 10.
    - c. Racks shall be labeled on the top and bottom, both front and back of rack.
    - d. Nameplates are not required in structures with a total of one rack or cabinet installed.
  - 2. Patch Panels:
    - a. Rack/cabinet number, patch panel type (C=copper, F=fiber) and top position of patch panel in rack units from bottom of rack/cabinet.
    - b. For example: "R-80-01:C07" represents a copper patch panel mounted in top RU space 7 of Rack No. 1, which is located in Structure 80.
    - c. For structures with a total of one rack or cabinet installed, the patch panel labels shall not include a preceding rack number.
  - 3. Cables:
    - a. Patch panel number, cable type (D=data, V=voice)-jack number.
    - b. For example: "R-80-01:C07.D-001" represents the first data jack served from a copper patch panel mounted in top RU space 7 of Rack No. 1, which is located in Structure 80.
    - c. For structures with a total of one rack or cabinet installed, the cable labels shall not include a preceding rack number.
  - 4. Jacks:
    - a. Provide a label on the top or bottom of the faceplate identifying the patch panel serving the associated jacks, as specified herein.
    - b. Label each jack with the cable type (D=data, V=voice): jack number.
    - c. For example: "D-001" represents the first data jack served from the associated patch panel.
- C. Refer to Section 26 05 23—Instrument and Communication Wire and Cable for cable insulation and jack color requirements.

### 3.04 JUNCTION BOX IDENTIFICATION

- A. All junction boxes shall be labeled with permanent nameplates. Nameplates shall indicate circuit or load served, as well as the power source and highest voltage present on any conductor.

### 3.05 CONDUIT FITTINGS IDENTIFICATION

- A. All conduit fittings that contain splices of any kind shall be labeled with permanent nameplates indicating "splice within." Nameplates shall be clearly visible at location installed. Nameplates shall be fastened to each conduit fitting with heavy duty, UV-resistant, cold weather cable ties.

### 3.06 TERMINAL BLOCK IDENTIFICATION

- A. Terminal blocks shall be labeled on both sides of each terminal block. Terminal block numbering shall match the numbers shown on the project-specific wiring diagrams.
- B. Fused terminal blocks labels shall be located on top of the terminal blocks and include the fuse voltage and ampere rating.

### 3.07 COMPONENT IDENTIFICATION

- A. All components (e.g., relays, timers, power supplies, transformers, etc.) within enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed marking labels. Labels shall be installed on the enclosure back panel and not on the device itself, wireway covers, or any other removable devices. Labels shall be included on the as-built drawings.

### 3.08 LABELING FONT REQUIREMENTS

- A. The font for all conductor, cable, and device labels shall be Arial with black characters on white background, and minimum font size 12.
- B. The text for all conductor, cable, and device labels shall be machine printed. Handwritten labels are not acceptable.

END OF SECTION

## SECTION 26 05 73

### POWER SYSTEM STUDY

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work included: A Short-Circuit, Coordination, and Arc Flash Assessment, as specified herein shall be performed by e-Hazard of Louisville, Kentucky. CONTRACTOR shall include an allowance of \$6,000 for studies and report re-quired by this specification The studies shall be submitted to ENGINEER prior to receiving final approval of the equipment shop drawings and prior to release of equipment for manufacture. See Section 1.04 Submittals for additional requirements.
- B. The analysis, testing, and inspection shall include all portions of the new and existing electrical distribution system. This shall include, but not be limited to, the following items. Equipment not specifically noted below that is part of the distribution shall also be included.
  - 1. Utility service entrance including primary switching and fusing.
  - 2. Medium voltage service entrance switchgear.
  - 3. Medium voltage pad-mounted switches.
  - 4. Pad-mounted exterior transformers.
  - 5. Automatic transfer switches.
  - 6. Standby generators.
  - 7. Switchboards.
  - 8. Medium voltage motor control centers.
  - 9. Low voltage motor control centers.
  - 10. OEM-provided control panels with electrical supply over 100 amperes at 480 volts.
  - 11. Motor control panels.
  - 12. Power panels.
  - 13. Lighting panels.
  - 14. Safety switches.
  - 15. 480 V junction boxes and enclosures where terminations and splices are being made.
- C. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the power system study. Alternative scenarios shall be included to illustrate normal and standby power sources and the relative effects on the distribution system. This shall include scenarios where dual source contributions may be present, such as with closed-transition transfer switches or paralleling switchgear.
- D. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/IEEE Standards C37, 242, and 399.
- B. IEEE Standard 1584—IEEE Guide for Performing Arc Flash Hazard Calculations.
- C. NFPA70—National Electrical Code.

- D. NFPA70E–Standard for Electrical Safety in the Workplace, Latest Edition.
- E. OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S.
- F. UL 489-Underwriters Laboratories.

### 1.03 QUALITY ASSURANCE

- A. The power system study shall be performed, stamped, and signed by a registered professional engineer (electrical) in the State where the project is located. Credentials of the individual(s) performing the study and background of the firm shall be submitted to ENGINEER for review prior to start of the work. A minimum of 5 years of experience in power system analysis shall be required for the project manager.

### 1.04 SUBMITTALS

- A. The following submittal process shall be followed and be coordinated with the suppliers of equipment specified in other Divisions, along with other Division 26 sections. The report specified below shall be completed prior to equipment shop drawings being approved and prior to equipment being released for manufacture, such that equipment changes may be made during shop drawing review if changes are recommended by the report. If completion of the report may cause delay in equipment manufacture, partial approval from ENGINEER may be obtained if the preliminary submittal includes data sufficient to determine that the selection of device ratings, settings, and characteristics will be satisfactory.
- B. The following submittals shall be provided for review.
  - 1. Initial Power System Study Report: At the time of, or prior to equipment shop drawings being submitted, the finalized report shall be submitted for review. The report shall include all new equipment being provided based on shop drawing submittals, existing equipment based on information collected during site visits, and estimated cable lengths. The report shall also include a written document from the utility company indicating single-phase and three-phase short circuit contributions and X/R ratios for each utility service. This submittal shall be a completed, finalized report that will be updated with actual cable lengths once installed.
  - 2. Final Power System Study Report: Once all equipment is operating based on its design intent, the recommended overcurrent protective device setting adjustments shall be completed. The third-party firm shall visit the site to confirm that the new equipment matches the shop drawings. Additionally, the initial power system study report shall be updated with actual installed cable lengths and changes made during construction. This shall be completed prior to substantial completion.
- C. The final power system study report shall meet the following requirements:
  - 1. Submit two bound copies of the final report. Provide two USB flash drives with the final report in PDF format. The two USB flash drives shall also include all report files in Word format, one-line diagrams in PDF and CAD formats, and all power analysis software files and associated libraries.
  - 2. Organize and submit the report with the following sections. Below are minimum requirements:
    - a. Part I: Overview.
    - b. Part II: Short-Circuit Assessment:
      - (1) Purpose.
      - (2) Explanation of data.



- (3) Assumptions.
- (4) General and specific procedures followed.
- (5) Analysis of results.
- (6) Recommendations.
- (7) Fault Analysis Input Report.
- c. Part III—Coordination Assessment:
  - (1) Purpose.
  - (2) Explanation of data.
  - (3) Assumptions.
  - (4) General and specific procedures followed.
  - (5) Analysis of results.
  - (6) Recommendations, including trip curves and device settings for project-specific equipment.
  - (7) Spreadsheet or report showing the range of all device settings and recommended settings.
- d. Part IV—Arc Flash Hazard Assessment:
  - (1) Purpose.
  - (2) Explanation of data.
  - (3) Assumptions.
  - (4) General and specific procedures followed.
  - (5) Analysis of results, including arcing fault currents, device clearing times, incident energy levels, working distances, flash protection boundary, and recommended personal protective equipment (PPE).
  - (6) Recommendations, including system modifications that may reduce arc flash hazard based on analysis of results.
  - (7) Arc flash evaluation report including sample labels for major distribution equipment.
- e. Appendices:
  - (1) One-line diagrams of the system in similar format as the Contract Documents from the power analysis software showing project-specific equipment, wire and cable types and lengths, fault currents, and recommended device settings.
  - (2) Protective device summaries generated by the power analysis software.
  - (3) Reference data.
  - (4) Paper copy of warning labels to be provided for the project.

D. Refer to Part 3—Execution for additional requirements and specific analyses to be performed.

## PART 2—PRODUCTS

### 2.01 POWER SYSTEM STUDY SOFTWARE

- A. The power system study shall be performed using the latest version of SKM Power Tools software utilizing all required evaluation modules to perform the assessments specified herein.

### 2.02 ARC FLASH HAZARD LABELS

- A. Labels shall be provided for new and existing equipment shown on the one-line diagrams on the Drawings, all existing equipment as specified herein, and as specified in all Division 26 sections, as well as for equipment provided in other Divisions where an arc flash

hazard may exist. This shall include junction boxes and disconnect switches for motors 50 hp and larger. A separate label shall be installed on each panelboard, generator, automatic transfer switch, etc. For switchgear, switchboards, and MCCs with a main circuit breaker, a minimum of two labels shall be provided (one for main circuit breaker section and one for remaining sections in the equipment lineup). Provide labels as manufactured by Brady, or equal, and meet the following minimum requirements:

1. Self-adhesive, vinyl, 6 inches by 4 inches minimum.
2. Equipment identification corresponding to the Contract Documents.
3. Study date.
4. Arc-flash boundary.
5. Incident Energy Working Distance.
6. Nominal system voltage.
7. Shock-hazard boundaries (limited approach and restricted approach).
8. Site specific PPE level (Coordinate to match OWNER's existing PPE categories).
9. Available incident energy.
10. Bolted fault current.
11. Labeling shall match existing LFUCG standard in place at the two wastewater treatment facilities.

- B. New arc flash hazard labels shall be provided for all existing equipment included in the existing power system study software files. All existing arc flash hazard labels for existing equipment at the site shall be replaced with new, updated arc flash hazard labels.

### PART 3-EXECUTION

#### 3.01 DATA COLLECTION

- A. Third-party firm shall gather the required data from shop drawings and existing equipment for preparation of the power system study. The firm performing the power system study shall visit the site as needed to properly carry out the work and meet the requirements of these specifications.
- B. Third-party firm shall expedite collection of the data to complete the power system study within the deadlines specified herein. The following minimum information shall be collected and used:
1. Available fault current from the electric utility company serving the facility.
  2. If applicable, existing equipment ratings including bus bracing, interrupting device ratings, and age/condition.
  3. Installed cable or busway lengths, along with the specific rating, type and manufacturer.

#### 3.02 SHORT-CIRCUIT AND COORDINATION ASSESSMENTS

- A. Include in the appropriate report sections noted above, calculation methods and assumptions, base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and recommendations. Calculations shall be provided for multiple distribution system scenarios when source equipment can provide multiple power feeds to downstream equipment (i.e., Main-Tie-Main equipment, Kirk-key interlocked breakers, standby generators, etc.).
- B. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each new and existing bus (each change of impedance),

switchgear, transformer primary and secondary terminals, switchboard, motor control center, as well as other significant locations throughout the system, including all three phase motors 50 hp and larger. Provide a ground fault current assessment for the same system areas, including the associated zero sequence impedance data. Include in tabulations, fault impedance, X to R ratios, asymmetry factors, motor contribution, short-circuit kVA, and symmetrical and asymmetrical fault currents.

- C. In the Coordination Assessment, provide time-current curves for new and existing distribution equipment, indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time-delay settings.
- D. Include on the curve sheets power company relay and fuse characteristics, medium-voltage relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, and characteristics of other system load protective devices such as protective relaying equipment and multifunction relays. Include at least all devices down to the largest three-branch or feeder circuit breakers in each new and existing piece of distribution equipment. Also include the main circuit breaker (if applicable) and upstream overcurrent protective device.
- E. Include all adjustable settings for new and existing ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400, or 600% currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.
- F. Select each primary protective device required for a Delta-Wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58% of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16% current margin to provide proper coordination and protection in the event of secondary line-to-line faults.
- G. Include complete fault calculations as specified herein for each source combination for both new and existing equipment.
- H. Utilize equipment load data for the assessment obtained by third-party firm from Contract Documents.
- I. Include fault contribution of all motors and generators in the assessment, including scenarios where the generators and utility sources are both supplying electricity concurrently, such as with a closed transition transfer or paralleling power generation scheme. Motors rated 50 hp and larger shall be modeled individually and not grouped as a single load. Notify ENGINEER in writing of circuit protective devices not properly rated for fault conditions. Provide recommended settings for motor starters and note any system inadequacies or potentially hazardous conditions. Show each MCC full-load current plus symmetrical and asymmetrical

of the largest motor-starting current so that protective devices will not trip major or group operation.

- J. When a generator is provided, include phase and ground coordination of the generator paralleling equipment and generator protective devices to meet NEC requirements. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants, and current boost data in the study. Do not use typical values for the generator.
- K. Evaluate proper operation of ground fault relays in four-wire distribution systems with more than one main service circuit breaker or when generators are provided, and discuss the neutral grounds and ground-fault current flows during a neutral-to-ground fault.

### 3.03 ARC FLASH HAZARD ASSESSMENT

- A. Include in the appropriate report sections noted above, the following minimum requirements:
  - 1. Determine and document all possible utility and generator sources and scenarios that are capable of being connected to each piece of electrical gear. Calculations shall be based on the highest possible source connection.
  - 2. Arc flash values for two normal cases to define the highest values (low short-circuit and high short-circuit).
  - 3. Arc flash values for two maintenance cases which define the arc flash values available at the equipment, which would be available if the instantaneous trip of the upstream circuit breaker is set at a minimum value. This is recommended for personnel working on live equipment.
  - 4. Recommendations to reduce the arc flash incident energy in all areas that require 8 cal/cm<sup>2</sup> and higher PPE.
  - 5. Calculations shall conform to the latest version of the National Fire Protection Association (NFPA) 70E calculation standards. All incident energy units shall be calculated in calories per square centimeter.
- B. Provide labeling as specified herein based upon the results of the assessment.

### 3.04 FIELD SETTINGS

- A. CONTRACTOR shall perform field adjustments of the new and existing protective devices as required to place the equipment in final operating condition. The adjustments shall be in accordance with the recommended settings described in the final power system study report.
- B. Following energizing and placement into operation of all equipment, CONTRACTOR shall include a minimum of two additional trips to the site to make modifications to the settings for proper operation of the system.

END OF SECTION

## SECTION 26 09 00

### CONTROLS AND INSTRUMENTATION

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Allowances: None.
- B. Related Sections and Divisions:
  - 1. Applicable provisions of Division 01 shall govern work in this section.
  - 2. Section 26 09 10–Controls and Instrumentation Drawings.
  - 3. All other sections of Division 26.

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##### 1.02 SYSTEM DESCRIPTION

- A. The work includes furnishing, delivering, installing all items furnished, and placing in operation modifications to the Supervisory Control and Data Acquisition (SCADA) System

for the Town Branch Wastewater Treatment Plant and the West Hickman Wastewater Treatment Plant.

- B. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all PLC cabinets and required interface hardware and internal wiring, hardware, system drawings, and system software at the wastewater treatment plant.
- C. System Supplier shall be responsible for development of the SCADA System computer HMI graphics as specified herein. System supplier shall be responsible for all OIP graphics programming.
- D. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in, or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.
- E. CONTRACTOR shall be responsible for the placing of circuits and making of electrical connections in accordance with System Supplier-furnished drawings, instructions, and field supervision to provide proper connection. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise the making of connections to power supplies, motor leads, communication circuits, existing control equipment, and any other connections external to the new control equipment; adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in an acceptable manner. This shall include on-site review of software/hardware controls from the central control point.
- F. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by System Supplier.

### 1.03 QUALITY ASSURANCE

- A. System Suppliers: Firms regularly engaged in the design and manufacture of SCADA systems of the size and complexity specified herein, and whose systems have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: A firm with at least 10 years of successful installation experience on projects with SCADA System design and installation work similar to that required for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide control panels, power supplies, controllers, relays, wire, and connectors that have been listed and labeled by Underwriters Laboratories.
- E. NECA Standards: Comply with applicable portions of National Electrical Contractor's Association's Standard of Installation.

#### 1.04 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- C. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.
- D. Shop drawing submittals shall be assembled in phases.
  - 1. The first submittal shall include the following:
    - a. Detailed catalog information, descriptive literature, and specifications of hardware and software. All items being provided must be specifically noted on this literature, including all field devices and instruments.
    - b. Project implementation plan, including information on project organization, project management, engineering, programming, configuration, training, startup, and maintenance services. Plan shall include key personnel on project, point of contact, and communication protocol.
    - c. Overall network schematic showing all controllers, network switches, fiber optic patch panels, fiber optic patch cables, and hardware addresses applicable to the system.
    - d. Wiring diagrams for all control panels and MCCs, including modification drawings for existing equipment. Modification drawings shall be completed using electronic CAD software. Handwritten or PDF markups of any kind will not be allowed.
    - e. Database with PLC addresses.
  - 2. Subsequent submittals shall include the following:
    - a. Control narratives.
    - b. HMI graphic displays.
    - c. Database with PLC addresses.

#### 1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provision of Section 01 33 00–Submittals.
- B. Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.
- C. Submit Operation and Maintenance Manuals in accordance with Division 01. The following additional information shall apply:
  - 1. Manuals shall contain, but not be limited to, the following:
    - a. System Hardware.
    - b. System Software.
  - 2. Hardware section shall include:
    - a. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.
    - b. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.
    - c. Listing of all hardware timers installed in MCCs and SCCs, as well as the ranges set on each timer. Listing shall also include actual timer setting after completion of startup.
  - 3. Software section shall include:

- a. Software manual shall describe system techniques, general philosophies, list, and description of all standard software.
- b. Program documentation (i.e., PLCs, OIPs) shall include programs, documentation files, database and configuration as installed. Provide two USB flash drives with this information. Usernames and passwords for all programmable devices (i.e., PLCs, OIPs) shall be turned over to OWNER at the time of final completion.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle equipment carefully to avoid damage to SCC components, enclosure, and finish.

#### 1.07 SYSTEM ENGINEERING

- A. System Supplier shall provide all engineering necessary to accomplish and document the requirements of this specification and be in accordance with the system configuration. The engineering to be performed by System Supplier on this project shall include, but not be limited to, the following categories:
  1. PLC system layouts.
  2. Panel layouts.
  3. I/O configuration and wiring diagrams.
  4. PLC programming.
  5. Network configuration.
  6. OIP programming.
  7. HMI computer programming.
- B. Installation: CONTRACTOR shall install all system equipment, including PLCs and interconnecting cabling, as required. This work shall include all interconnection wiring from new and existing equipment as required for the completion of the system.
- C. It shall be the responsibility of System Supplier to ascertain that all field devices are compatible and consistent with the new system design. This includes reviewing drawings and data to ascertain the compatibility and consistency of the system with the field devices on such considerations as:
  1. Equipment size and available space.
  2. Power levels.
  3. Power sources.
  4. Logic schemes.
  5. Signal types and levels.
  6. Interface devices where required.
  7. All other aspects of field devices impacting the design of the system.
- D. The system shall be programmed to implement the control sequences and to provide monitoring according to this specification. It shall be the responsibility of System Supplier to include all inputs and outputs required to meet all aspects of this specification, regardless of whether they are specifically included in the I/O listing in this specification.
- E. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for 3 years from startup.



## 1.08 DESCRIPTION OF THE TOWN BRANCH AND WEST HICKMAN SCADA SYSTEMS

- A. System Supplier shall be responsible for the development of all required process control functions based on the algorithms described in this specification. A listing of major process areas and control panels that will need software development for operation is as follows.
  - 1. Town Branch WWTP Non-Potable Water System.
  - 2. Town Branch UV Disinfection System.
  - 3. West Hickman WWTP UV Disinfection System.
- B. System Supplier will be able to obtain a copy of shop drawings for the existing control system wiring diagrams for development of the required loop drawings, interface requirements, and wiring requirements.

## 1.09 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS

- A. This specification, along with the Contract Drawings, defines the requirements of a PLC-based process monitoring and control system. System Supplier shall construct a process monitoring and control system specifically for the demanding requirements of a real-time municipal wastewater treatment system.
- B. It is the intent of this specification to define modifications to an existing fully integrated open-type process monitoring and control system, factory tested, delivered to the site, and ready to function upon connection of a power source and field instrument wiring. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be responsible for reviewing the wiring diagrams and control sequences for equipment provided under other divisions of these specifications and coordinating all interface requirements. CONTRACTOR shall submit to ENGINEER, in writing, any deficiencies noted during this review. Any changes required by CONTRACTOR because of a failure to complete this review shall be the responsibility of CONTRACTOR, at no increase in cost to OWNER.
- C. CONTRACTOR shall be responsible for complete coordination in providing all equipment, sensors, and meters supplied with input and output signals, and contacts that are compatible with the systems as specified herein and existing systems. CONTRACTOR shall also be responsible for complete coordination with manufacturers of other systems specified in other divisions of these specifications with which an interface is required. The Contract Drawings and I/O Listing are symbolic representatives of the required work. It is not intended that the Drawings show all appurtenances. CONTRACTOR shall provide a complete and working system according to the true intent and meaning of the Drawings, Specifications, and standard industry practices.
- D. To provide a complete and totally integrated system, a single manufacturer who has experience in furnishing similar networked PLC-based monitoring and control systems of the same complexity and size for municipal wastewater treatment systems shall provide the specified equipment and services. The system proposed to meet this specification shall be of field-proven design incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the process monitoring and control system.
- E. Design and specification of devices and the completed system shall conform to the applicable portions of the latest edition of the National Electrical Code (NEC).

- F. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels that have individual components that are UL labeled, but do not have UL approval as an assembled unit are not acceptable.
- G. Training Program:
  - 1. Submit a training plan including course syllabus, personnel who will be conducting the training, and schedule.
  - 2. Provide materials, instructors, and workbooks to complete the training.
  - 3. Training courses shall include: Operator Training: The course shall consist of one 4-hour sessions at each WWTP. Training shall utilize equipment specified herein following installation and field testing.
  - 4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than the process itself.
  - 5. Refer to Section 01 91 00–Starting of Systems for additional training requirements.
- H. System Supplier shall meet the following minimum requirements:
  - 1. System Supplier shall have a full-time staff of qualified programmers who are knowledgeable in the configuration of networked computer systems and the PLCs being provided.
  - 2. System Supplier shall have a minimum of one Microsoft-certified engineer.
  - 3. System Supplier shall have training capabilities and shall have conducted training courses in programming and maintenance.
  - 4. System Supplier shall have an adequate inventory of spare parts.
  - 5. System Supplier shall have a full-time staff of qualified service technicians.
  - 6. System Supplier shall be responsible for the programming and documentation of the system.
  - 7. System Supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.
  - 8. System Supplier shall be responsible for all coordination between the system and the field devices, instrumentation equipment, motor control centers, and equipment furnished with other divisions of this specification. This shall include interface with existing equipment.
  - 9. System Supplier shall have a UL panel shop located inside the System Supplier's own facilities.
  - 10. System Supplier shall have experience with the specified HMI, historian, and reporting software on past projects of similar size and complexity.
- I. All components shall be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The Base Bid System Supplier shall be Rawden Myers, LOVO, or AES. See General Conditions and Supplementary Conditions regarding substitutions to the Base Bid system suppliers.

#### 1.10 ACCEPTANCE TESTING, SYSTEM STARTUP, AND SUPPORT SERVICES

- A. System Supplier shall be responsible for development of a formal address listing associated with each PLC and shall provide ENGINEER with an organized spreadsheet of all addresses to be used for programming of the HMI software specified herein. Point listing shall be provided in Microsoft Excel format, grouped individually for each PLC, and neatly organized into groups such as discrete I/O, analog I/O, setpoints, alarms, historical data, and dialer configuration. Points not used with the HMI software or for internal PLC logic shall be removed or hidden from the listing. Any revisions made to the original spreadsheet shall be clearly identified by highlighting, colored text, or notes within the documents. CONTRACTOR

shall provide OWNER an as-built version of the spreadsheet prior to Substantial Completion. Electronic files shall be named with the date and revision number.

- B. Permit ENGINEER and OWNER to observe vendor's staging records or other quality assurance records relating to system(s) supplied. System Supplier shall assemble the system components as a complete process monitoring and control system and demonstrate that the system is operational before shipment from System Supplier factory to the job site. This testing shall be as an integrated assembly by simulating each of the specified I/O points and all specified algorithms.
- C. On-Site Functional Acceptance Testing:
  - 1. After all equipment has been installed and is placed in full-time operation or after all equipment associated with the group of equipment scheduled for on-site functional acceptance testing has been installed and placed in full-time operation, CONTRACTOR and System Supplier shall demonstrate that all equipment and controls operate in compliance with the Contract Documents. For each piece of equipment being tested, all systems associated with the operation of the equipment (e.g., controls, supply/discharge piping, etc.) shall be installed and be in full operating condition so that all equipment functions are able to be completely tested without delay using real-time process I/O.
  - 2. All control wiring, hardwired interlocks, HMI screens, control programming, etc., shall be checked out and functionally tested by System Supplier prior to ENGINEER's on-site functional acceptance testing. All functional errors shall be corrected prior to ENGINEER's on-site functional acceptance testing.
  - 3. CONTRACTOR shall submit updated versions of all HMI screens developed by this System Supplier and HMI screens provided by Divisions 43 and 46 to ENGINEER for review at least 1 month prior to the functional acceptance testing of equipment controlled through the associated HMI screens.
  - 4. Coordination Videoconferences:
    - a. CONTRACTOR shall schedule and conduct an initial functional acceptance testing coordination videoconference at least two months prior to the anticipated functional acceptance testing. The videoconference shall include CONTRACTOR, System Supplier, Division 26 contractor, OWNER, and ENGINEER, and all other parties responsible for the equipment and controls scheduled for functional acceptance testing.
    - b. CONTRACTOR shall schedule and conduct additional functional acceptance testing coordination videoconferences one month prior to the date for functional acceptance testing of each group of equipment to confirm status of equipment installation and System Supplier checkouts, and updates to the functional acceptance testing schedule, after which ENGINEER will finalize reservations for travel and accommodations. All parties shall agree on a date for functional acceptance testing of the next group of equipment at this videoconference, or schedule an additional videoconference to establish a testing date one month prior to the delayed testing date. If the functional acceptance testing is rescheduled within one month of the agreed upon date, there will be deducted from payments due to CONTRACTOR the amount of penalties paid by ENGINEER for travel and accommodation cancellations. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.
    - c. CONTRACTOR shall provide the following information in written form at each videoconference. All information shall be updated prior to each videoconference.
      - (1) Equipment installation and manufacturer's startup schedule.
      - (2) Status of all power and control system wiring for the equipment scheduled for functional acceptance testing.

- (3) Schedule and status of System Supplier's on-site checkout and functional testing.
    - (4) Anticipated delays and the cause of each delay.
    - (5) Conflicts with OWNER's operation of the facility.
    - (6) Proposed dates for acceptance testing of all equipment and controls.
    - (7) Proposed dates for future acceptance testing coordination videoconferences.
  5. CONTRACTOR and System Supplier shall be on-site during testing to adjust equipment, correct erroneous wiring, and make modifications to control system, OIP, and HMI programming, as necessary. The equipment and controls do not operate according to the Contract Documents.
  6. System Supplier shall provide functional acceptance testing support through one or more on-site field service engineers and the project control system programmer. Time for the on-site field service engineers and programmer scheduled for functional acceptance testing shall be dedicated to the functional acceptance testing process and shall not be interrupted for other construction-related activities.
- D. Final acceptance and payment will not be made until the system has operated satisfactorily for a minimum of 30 consecutive days. CONTRACTOR shall include in the Bid field follow-up to provide proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:
1. Satisfactory operation of I/O control loops.
  2. Satisfactory operation of software.
  3. Satisfactory operation of control program.
  4. Satisfactory operation of peripheral equipment.
  5. The necessary debugging programs have been performed.
  6. Data output is reliable.
  7. Control loops are operational.
  8. Checking and calibrating of systems have been completed.
  9. Communication systems are reliable.
- E. CONTRACTOR, through System Supplier, shall provide the following support services:
1. Field Service Engineer: Field service engineer shall be responsible for programming of system PLCs, HMI computers, and OIPs in the factory and at the site. Field service engineer shall be present for startup of all systems and available throughout the entire construction process until final completion. Service technicians sent for system startup will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
    - a. Commissioning, installation, startup, and testing of equipment.
    - b. Revising or rewriting manuals to incorporate an installed and accepted system.
    - c. On-site training.
    - d. Software modifications.
  2. In-factory support shall include consultation following the acceptance testing and shipment. Services shall include, but not be limited to:
    - a. Researching and answering questions related to the system operation, documentation, and system use and functions.
    - b. Program modifications.
    - c. Revising or rewriting manuals.
- F. CONTRACTOR shall not install any hardware or software to enable remote access or control without written permission from OWNER and ENGINEER.

## 1.11 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.
- B. All indicating and control devices mounted on control panel, enclosure doors (e.g., meters, gauges, electronic indicators, pilot lights, selector switches, HIMs, OIPs, etc.) shall be located at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device.
- C. All motor control power shall be 120 volts with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- D. Devices powered at 120 volts from supervisory control panels shall be fused. This shall include, but not be limited to flowmeters and transmitters.
- E. Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. 120-volt power shall be available at all control points. Lightning protection shall be completely solid-state and self-healing and shall not require the use of fuses. Provide a single switch with an indicating light to deenergize the control power for each location. Each panel shall have a GFI, duplex, 15 ampere, 120-volt receptacle.
- F. Where equipment is necessary to perform a function as called for in one part of this specification, it shall be provided, even though the detailed enumeration at various control points may omit listing that equipment.
- G. Where a certain accuracy of sensing and transmitting levels, flows, or other process conditions and controlling operations are called for, means shall be provided to read or determine that the process conditions are within the limits or accuracy specified for the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of process conditions is necessary to set operating points, provide accuracy consistent with the requirements for operation of the system.
- H. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.
- I. Status signals for motors powered from VFDs or Ethernet-equipped starter overload relays, and associated equipment, noted in the Section 26 09 90—SCADA System I/O Listing to be communicated to the associated PLC via Ethernet shall be wired to inputs on the VFD or starter overload relay and communicated to/from the PLC via the SCADA System EtherNet/IP network.
- J. Hardwired Motor Controls:
  - 1. Equipment and wiring specified to be hardwired shall be physically wired independent of controllers, programmable relays, and communication systems to allow manual operation in the event of an emergency.
  - 2. Motor control wiring and logic shall be set up such that in the event of a power failure, equipment shall automatically restart if previously running, or remain off if previously off. A manual reset shall not be required to restart equipment following a power failure.

## 1.12 GENERAL CONTROL ALGORITHMS

- A. In general, the following is a definition of I/O at each MCC:

1. Run from auxiliary starter or VFD contact (dry contact or Ethernet).
  2. Fail from starter overload or VFD auxiliary contact (dry contact or Ethernet).
  3. Start/Stop maintained signal to starter or VFD, or as required (dry contact or Ethernet).
  4. In Auto/In Remote from selector switch on motor controller (dry contact or Ethernet).
  5. Any command to operate shall be acted upon within 5 seconds, and any status feedback signals shall be received within 5 seconds.
- B. Remove all existing PLC programming associated with the items being removed as shown on the Drawings and specified herein.
- C. Programming algorithms described herein and in Part 3–Execution shall reside within the PLC associated with that equipment and not in the Main PLC.
- D. All alarm contacts or system changes following a command must exist or not change for 0 to 5 seconds to activate an alarm at the SCADA System.
- E. All analog and digital inputs shall be monitored in the PLC. This shall include, but not be limited to, flows (air, water, etc.), weights, pressures, electrical values, and levels. The following analog signals shall have minimum, maximum, and running average calculated values: all flows (except aeration air), kilowatts, levels, temperatures, pressures, chlorine residuals, dissolved oxygen, and turbidity. Instantaneous values, totals, maximum, minimum, and average values shall be read by the HMI software and be reset on a daily basis as described below. Minimum, maximum, and average values shall be stored in the PLC for the current day and previous day.
- F. PLCs shall calculate equipment runtimes and number of starts for all equipment where run signals are monitored. Runtimes and number of starts shall be read by the HMI software and be reset on a daily basis as described below.
- G. Totalized flow values, chemical usage, electrical values (kilowatt-hours), and equipment runtimes as described above shall be stored in the PLC for a period of 7 days. This data shall be available for use by the HMI software for importing into a reporting software package for purposes of daily, weekly, and monthly reporting. The PLC shall indicate the specific date for each of the 7 previous days.
- H. Daily flow totals, runtimes, number of starts, electrical values (kilowatt-hours), and number of cycles as described above shall be reset on a daily basis. This reset shall occur based on a time (hour and minute) setpoint stored in the Main PLC through the HMI software and shall be automatically communicated to all Networked and Remote Telemetry-Connected PLCs so that each PLC will reset daily totals for its associated equipment even if there is a loss of communication with the Main PLC. The operator shall set the time when the daily reset will occur. Once this time setpoint matches the current time of the processor clock, each PLC shall clear any totals that have accumulated locally.
- I. In addition to the totalizers described above, the PLC shall also calculate cumulative totals for all runtimes, number of starts, flows, electrical values (kilowatt-hours), and chemical (weight) usage. Maximum, minimum, and running average for all analog inputs shall also be included as part of the cumulative total algorithm. Cumulative totals shall totalize until manually reset by the operator. The reset tag within the PLC shall be set by the operator at the HMI software and reset by the PLC. There shall be a manual reset for each signal. The PLC shall display the date of the last cumulative totalizer reset for each signal.

- J. Indication of time remaining for all timers (hardcoded and operator adjustable) within PLCs shall be made available for indication at the SCADA System.
- K. All analog signals shall be scaled to engineering units in the PLC with real or floating-point data types to prevent scaling values in the HMI. System Supplier shall provide all analog ranges and PLC register/tag addresses to ENGINEER for use with the HMI software. This shall include upper and lower limits for the associated device (i.e., 0 to 150 psi).
- L. For all analog input signals to the PLC I/O cards, provide a Transmitter Fail alarm at the SCADA System for each transmitter. Transmitter fail shall be defined as the signal from the transmitter being out of range or not changing for an operator-adjustable time period (0 to 120 minutes). An out-of-range signal shall initiate a transmitter fail alarm regardless of the alarm delay setpoint for an unchanging value. When the alarm delay setpoint for an unchanging value is set to zero minutes, an unchanging value shall be disabled from initiating a transmitter fail alarm.
- M. The following analog signals shall have associated high and low setpoints and alarms: all levels, pressures, pH, weights dissolved oxygen, process analyzers (e.g., chlorine residual, ORP, etc.), and amps (high only). Provide a "Reorder Chemical" level setpoint for all bulk chemical storage tank level analog signals.
- N. PLCs shall be set up so that the ranges of all analog input signals to the PLC I/O cards can be configured from the HMI software. Provide two operator-adjustable setpoints for each analog input, one corresponding to 4 mA and the other corresponding to 20 mA. These setpoints are applicable to devices attached to the Networked PLCs. This feature is intended to be used for startup and calibration purposes.
- O. All equipment controlled automatically from the SCADA System shall have "Call-to-Run" signals generated from their associated PLCs. These signals shall be displayed at the SCADA System through the HMI software. Each associated PLC shall also generate a Call-to-Run Fail alarm if the equipment is called-to-run but does not start within a specific time period. The Call-to-Run Fail alarm shall be generated within the PLC software and may not be combined with other fail signals such as hardwired motor fails, and overtemperature. Call-to-Run Fail alarms shall only be active when the selector switch on the motor controller is in the "Auto" position.
- P. All valves/gates controlled automatically from the SCADA System that have position feedback shall have "Call-to-Open/Close" signals generated from their associated PLCs. These signals shall be displayed at the SCADA System through the HMI software. Each associated PLC shall also generate a Call-to-Open/Close Fail if the valve/gate is called-to-open/close, but does not open/close within a specific time period. Call-to-open/close signals may be generated by the Main PLC, associated Networked PLC at the plant, as determined by System Supplier. The Call-to-Open/Close Fail signal shall be generated within the PLC software and may not be combined with other fail signals such as hardwired actuator faults. For valves/gates with analog 0 to 100% position feedback, provide an operator-adjustable deadband on the position feedback signal such that when the valve/gate position feedback is within the deadband of the position setpoint, the valve/gate shall be considered "in position."
- Q. In cases where the automatic alternation of equipment is provided by the PLC, indication of the lead, lag, and lag-lag pumps (where applicable) shall be made available for display at the SCADA System.

- R. All controlled equipment as described herein shall have the capability of manual control from the HMI software through the manipulation of analog or digital variables. This shall be through the use of a “SCADA H-O-A” switch or by forcing a single I/O point as a manual start command. All analog and digital outputs shall be capable of being manually set from the HMI software.
- S. Where a manual reset is required at the SCADA System (i.e., level lockout, pressure lockout), the HMI software shall be configured to set a discrete reset bit. Once the PLC receives the bit and the alarm condition has cleared, the PLC shall clear the alarm and place the associated equipment back in service.
- T. Provide an analog PLC tag for each piece of equipment controlled or monitored from a SCADA System PLC that shall be used for the color animation associated with that equipment’s HMI graphic object. The analog tag value shall be as follows: 0 = Off/Out of Service, 1 = In Auto at motor controller (e.g., starter in MCC), 2 = PLC Call-to-Run, 3 = Running Forward, 4 = Running Reverse, 5 = Failed (Call-to-Run, Starter Overload, etc.). Provide “Out of Service” indication for each piece of equipment when that equipment’s MCC or SCADA H-O-A is not in the Auto position. Precedence shall be given to the higher number conditions; for example, if a pump is In Auto but has failed, the tag value shall be 5. Provide similar analog PLC tags for each electrically-actuated valve and gate or manually-operated valves and gates with position feedback. For each electrically-actuated valve or gate, provide a dedicated tag for the valve or gate and a dedicated tag for the electrical actuator. PLC tags for valves shall be as follows: 0 = Closed, 1 = Opened, 2 = Not Opened and Not Closed, and 3 = Opened and Closed. PLC tags for valve actuators shall be as follows: 0 = Out of Service, 1 = In Remote, 2 = Call-to-Open, 3 = Call-to-Close, 4 = In Position, 5 = Failed (Actuator Fault or Out of Position).
- U. The SCADA System shall allow the operator to change all setpoints and operating parameters within the PLCs as described herein. All control algorithms and alarms for equipment shall be programmed in the associated PLC and not in the Main PLC. There shall be no control algorithms or alarms in the SCADA computers. Control of each piece of equipment shall be accomplished as described herein and in Part 3–Execution of this section.
- V. Each Networked PLC shall be set up so that the Main PLC monitors the scan cycle of each Networked PLC to detect a communication failure. This shall be accomplished by the Main PLC setting and resetting a bit internal to the Main PLC program every 60 seconds. This bit shall then be sent to each PLC. Once this bit is received by each Networked PLC, the PLC shall copy the value of this bit to a second bit internal to its PLC program. This second bit shall be read by the Main PLC. If the Main PLC does not see a change in status of the second bit, a PLC communication fail alarm shall be activated at the SCADA System. The Main PLC shall provide indication of which Networked PLC is in alarm.
- W. Each alarm shall have a discrete PLC tag that is able to be toggled at the SCADA System HMI to enable or disable the associated alarm from being activated.
- X. Wiring diagrams for all panels shall be included as part of the SCADA HMI. All wiring diagrams shall be incorporated with the SCADA HMI in a read-only format so that through the HMI, the operator will have the ability to view panel wiring diagrams from the SCADA computer. Acceptable electronic formats include .pdf, .jpg, and .gif.
- Y. Alarm functions shall be capable of being printed out listing both time and date of their occurrence, as well as acknowledgment, the operator that acknowledged the alarm, and the



current state of the alarm. Any change in alarm state shall also be capable of being printed. These alarms shall list both station and type of alarm that has occurred. Again, based on demand, a log or record of 24-hour/30-day records shall be kept and stored both by hard copy as well as hard disk or USB drive. All alarm points shown on the I/O list, as well as those developed in PLC software, shall each be indicated individually at the SCADA System (i.e., no common alarms).

- Z. In the event of a power failure, when power is restored, the PLC shall automatically stagger the restart of any controlled equipment that is being called to run by the PLC. The stagger shall be operator-adjustable from 0 to 300 seconds through the HMI graphics software on the SCADA computers.
- AA. Provide a hardcoded minimum speed within the associated PLC for each pump operating on a VFD. The minimum speed shall be the minimum speed at which the pump will still produce flow. Coordinate the minimum speed with the pump manufacturer during startup.

### 1.13 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from in accordance with GC12.6.

## PART 2-PRODUCTS

### 2.01 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 14 gauge steel, with continuously-hinged doors. Enclosures equal to or smaller than 24 inches wide by 24 inches high shall be equipped with at least two quarter turn latches. Enclosures larger than 24 inches in any dimension shall be equipped with 3-point latch with top and bottom bolts actuated by one rotating, lockable handle on each door. Provide a door stop kit for each door, data pocket for wiring diagrams, and minimum 12-inch, bolt-on, LED light and door switch. Panels over 48 inches wide shall have two lights. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, and white interior. All doors and panels shall be gasketed. All louvers shall be filtered and forced-air cooling shall be provided as necessary for conditions where installed. Provide enclosure dimensions as specified herein. Enclosures shall be as manufactured by Hoffman or Saginaw. MCC structures are not acceptable. Where installed next to motor control centers, enclosure color shall match that of the MCC.
- B. Each PLC enclosure shall include, but not be limited to, the following equipment:
  - 1. PLC, I/O modules, and communication modules.
  - 2. Power supplies.
  - 3. Surge protective devices.
  - 4. DIN-rail mounted terminal blocks for field wiring terminations.
  - 5. Plastic wiring ducts.
  - 6. General purpose 15-amp, 120-volt AC duplex GFCI receptacle.
  - 7. 20-amp, 120-volt AC main circuit breaker and branch circuit breakers as required to feed the PLC and the I/O controlled field devices.
  - 8. Other accessories required to provide a complete and working PLC system.
  - 9. UPS backup for the SCC.
  - 10. Fiber-optic patch panel.

11. Network switch.
  12. Front panel-mounted programming port with RJ-45 jack and 120-volt receptacle.
- C. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations.
- D. Refer to Section 26 05 53—Electrical Identification for the control panel and field wiring color code.
- E. 24 VDC power supplies shall be provided in the enclosures to power all 24 VDC devices and loop-powered analog input signals, where required.
- F. NEMA ratings of enclosures shall be as required for the area where installed, unless specified otherwise.
- G. Manufacturer of Accessories:
1. Plastic wiring duct shall be Panduit Panduct, or equal.
  2. Terminal blocks shall meet the requirements of Section 26 05 19—Wire.
  3. Wire markers shall meet the requirements of Section 26 05 53—Electrical Identification.
  4. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be rail-mounted type, Square D, Class 9080, Type GCB-150, or equal.
  5. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.
  6. Power supplies shall be Allen-Bradley Model 1606-XLS, or equal, and shall meet the following requirements:
    - a. Sized for the connected load plus inrush with capacity for a 50% power boost for up to 5 seconds.
    - b. Integral, dry-contact relay for monitoring "DC OK" status at the SCADA System.
    - c. UL Listed.
    - d. Conformal coated.
    - e. Temperature Range: -25°C to 60°C.
    - f. Protection Features:
      - (1) Over-voltage protection.
      - (2) Protection against no-load and short circuit conditions.
      - (3) Over-temperature protection.
      - (4) Internal input fuse.
      - (5) MOV-type input transient protection.
- H. All wiring within the enclosure shall be through plastic wiring troughs. Plastic wiring troughs shall have removable covers. Maximum fill for wiring troughs shall be 60%. All wiring in supervisory enclosures and control panels not in wiring troughs shall be bound with continuous-type spiral windings. Terminal strips located adjacent to wiring troughs shall have a minimum of 1 1/2 inches between terminal strip and wiring trough. All wiring labels shall be able to be read without removing wiring trough covers. Wiring troughs shall be provided for all field wiring.
- I. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal strips shall be located either at the bottom or on the side of the enclosure, depending on where the I/O conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. The field wiring terminals shall be clearly identified as to which I/O terminals they are wired. Jumpers between adjacent terminal

blocks shall be copper jumper bars supplied by the terminal block manufacturer. All wiring shall be labeled at each end with corresponding numbers matching the associated terminal block. This numbering shall be shown on the shop and Record Drawings.

- J. All door-mounted devices shall be furnished flush-mounted, and an exterior-engraved phenolic nameplate worded by OWNER (upon receipt of shop drawings) shall be provided for each component, device, and light. All components within the enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed marking labels with white background and black text; minimum size 12 font. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.
- K. All panels with DIN rail-mounted equipment shall include a minimum of 25% spare DIN rail space.
- L. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminals wired to terminal strips. Spares shall be provided for all voltage sources within the panel (e.g., 120 V, 24 V).

## 2.02 COMPACTLOGIX PROGRAMMABLE LOGIC CONTROLLERS

- A. Construction:
  - 1. The PLC shall include a CPU, memory, embedded dual Ethernet ports, and embedded energy storage.
  - 2. The PLC and all system modules shall be DIN rail mounted.
  - 3. All system modules shall be able to operate in an industrial environment with an ambient temperature of 32°F to 140°F.
  - 4. All system modules shall be able to operate in a free airflow environment.
  - 5. All system modules shall be able to operate in high electrical noise environments.
- B. The system shall support a minimum of eight local I/O expansion modules in up to three chassis.
  - 1. Local expansion modules shall be installed in the local chassis or in chassis adjacent to the local chassis.
  - 2. The manufacturer shall have available a variety of I/O modules, including, but not limited to, AC or DC discrete input, AC or DC relay contact output, 4-20 mA analog input and output, and RTD.
  - 3. Each chassis in multiple-chassis installations shall be interconnected via Ethernet.
  - 4. Discrete I/O cards shall be 120 VAC 16 point maximum, unless otherwise noted.
  - 5. Isolated discrete I/O cards shall be 8 point maximum. Isolated discrete cards shall be used if there are multiple or external power sources associated with the signals, if wiring leaves the building, or if the card is driving a load (i.e., solenoids, etc.).
  - 6. Analog input cards shall be 8 point.
  - 7. Analog output cards shall be 4 point isolated type.
- C. CPU:
  - 1. The CPU shall be a self-contained unit, and shall be capable of providing control program execution, supporting remote and local programming, controlling all I/O scanning and inter-controller and peripheral communication and diagnostic functions as follows:
    - a. 32 tasks (1,000 programs per task):
      - (1) Continuous—one allowed.

- (2) Periodic—Run via an interrupt at a user-defined interval in 1  $\mu$ s increments from 1 ms to 2000 s.
      - (3) Event—Triggered by consumed tag or EVENT instruction.
    - b. 256 controller connections.
    - c. Network connections:
      - (1) Up to 256 EtherNet/IP.
      - (2) Up to 120 TCP/IP.
  - 2. The PLC shall organize user applications as tasks, which can be specified as continuous, periodic, or event based. Tasks shall be triggered by input point or instruction.
  - 3. The CPU shall have a real-time clock.
  - 4. When the main power supply is removed, the CPU shall have the ability to back up user program and all data, or a nonenergy storage option.
  - 5. The front of the CPU shall have a USB port.
  - 6. The front of the CPU shall have an integrated latching mechanism for securing the secure digital (SD) memory card. The PLC shall operate with the memory card removed.
  - 7. The processor module shall have LED indicators to indicate CPU status.
  - 8. The processor module shall have a mode switch.
- D. Memory:
- 1. The PLC shall have a minimum of 3 MB of standard user memory. Provide processor configurations with additional memory as required.
  - 2. The program storage medium shall be solid-state, nonvolatile type.
  - 3. The PLC shall include a 2 GB SD memory card to store the user program and the firmware of all modules residing in the same chassis to protect against memory loss.
- E. Programming Environment:
- 1. Programming shall be through the USB 2.0 port or through the EtherNet/IP network.
  - 2. The programming software shall run on the latest version of Windows and the programming methods shall be:
    - a. IEC 61131-3 compliant ladder diagram.
    - b. Structured text.
    - c. Function block diagram.
    - d. Sequential function chart.
- F. Communication:
- 1. USB 2.0 port to support upload and download, online edits, firmware updates, and bridging to other modules.
  - 2. EtherNet/IP switch and dual 10/100/1000 Mbps EtherNet/IP ports with unique IP addresses or a single IP address when connected as part of a device level ring. The interface shall support:
    - a. IEEE 802.3 Physical and Data Link Standard.
    - b. Common Industrial Protocol (CIP), the protocol that provides real-time I/O messaging and information/peer-to-peer messaging.
    - c. Standard TCP/IP and UDP/IP communication.
    - d. 10/100/1000 Mbps auto sensing and auto switching.
    - e. Standard Ethernet media.
    - f. Subnet masking.
    - g. BOOTP and DHCP support.
    - h. Manual configuration using specified software.
    - i. Programmable Logic Controller messaging to peer controllers and workstations.
    - j. I/O data, real-time interlocking and information.
    - k. Full or half-duplex communication.

- l. Built-in web access to diagnostics.
  - m. I/O control.
  - n. Device level ring (DLR) network resilience.
  - o. Precision Time Protocol (CIP Sync, IEEE 1588).
- G. Power Supply:
- 1. The PLC shall be provided with separate, dedicated, field-side power supplies, quantity as needed, for sensor/actuator (SA) power, and a separate, dedicated, system-side power supply for power to the PLC and I/O modules (MOD) power.
  - 2. Provide field-potential-distributor modules as needed to transition SA power from AC to DC or from DC to AC input power for downstream I/O modules.
- H. PLCs shall be as manufactured by Rockwell Automation, CompactLogix 5380 L3 Series, or equal.
- I. PLC Programming and PLC Software: System Supplier shall provide all PLC programming and software required to meet this specification. The software shall include, but not be limited to, the following:
- 1. PLC logic programs to be written by System Supplier for the PLC systems to accomplish the monitoring and control functions as specified herein. The System Supplier shall document and annotate the programs, update them as required after startup, and then turn two copies of the programs over to OWNER on two USB flash drives with project-specific labels.
  - 2. System Supplier shall provide a commercially available PLC programming and documentation software package as developed by the system manufacturer for documenting and modifying the PLC programs. Modifications shall be accomplished from the Main SCADA server or the laptop.
  - 3. All I/O addressing that is to be viewed or manipulated by the HMI software shall be organized into contiguous blocks of integer tags for discrete bits and floating point tags for all other values to facilitate block data transfer between computers and PLCs.

## 2.03 UNINTERRUPTIBLE POWER SUPPLIES

- A. Provide a UPS backup in each SCC that will provide continuous communication for at least 30 minutes following a power failure. UPS power shall be provided, at a minimum, to the following equipment:
- 1. PLCs and I/O cards, controllers, and OIPs.
  - 2. Network switches, signal converters, and other communication devices.
  - 3. Power fail and communication indicating lights and alarm devices.
  - 4. Power supplies for loop-powered instruments.
  - 5. Automatic alarm dialers.
  - 6. Intrinsic safety barriers.
  - 7. Hazardous location detection and alarming instrumentation and notification devices.
  - 8. Intrusion detection system devices and video surveillance camera power supplies.
- B. Interior control panels with PLCs shall be provided with a true online 120-volt AC UPS.
- 1. Each UPS shall be provided with a dry contact output for remote indication of a common UPS alarm or if UPS batteries need replacement.
  - 2. UPS shall be APC with relay I/O module, Liebert GXT5 with relay card, or Eaton 9SX.
- C. Exterior control panels with PLCs shall be provided with a 24 VDC battery controller for a UPS system.

1. UPS shall have a rated current of 40 A, battery charging current of 2 A, and dry contacts rated for 30 VDC, 1 A for DC Bus OK, Battery Fail, and Battery Discharged.
2. UPS shall be Delta Model DRU-24V40ABN, or equal, with external battery sizes and quantities needed meet the runtime requirements specified herein.

## 2.04 INDUSTRIAL CONTROL RELAYS AND CONTACTORS

- A. Industrial control and power relays shall be installed in motor control centers, pump control panels, and motor controller enclosures where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, alarm lights, alarm horns, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays. Relays for monitoring the output voltage of uninterruptable power supplies shall be UPS voltage monitoring relays. Contactors for lighting circuits, branch circuits, or loads greater than 15 amps shall be industrial, electrically-held lighting contactors. Contactors for motor power control shall be industrial, electrically-held power contactors.
- B. Relays shall meet the following requirements:
  1. Interposing/isolation relays:
    - a. Configuration: SPDT or DPDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC, or as required by System Supplier.
    - d. Contact rating: 8 A (DPDT), 16 A (SPDT).
    - e. Operating life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HK, or equal.
  2. General purpose relays:
    - a. Configuration: DPDT or 3PDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC.
    - d. Contact rating: 15 A, minimum; 3/4 hp.
    - e. Operating life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
  3. UPS voltage monitoring relays:
    - a. Configuration: SPDT.
    - b. Mounting: DIN rail.
    - c. Voltage: 120 VAC.
    - d. Contact rating: 15 A.
    - e. Operating life: 10 million cycles.
    - f. Over-voltage range: 80 to 150 VAC, adjustable.
    - g. Under-voltage range: 30 to 95% of pickup, adjustable.
    - h. Drop-out time delay: 0.1 to 10 seconds, adjustable.
    - i. UL listed.
    - j. Manufacturer: Macromatic, VWKE120A, or equal.
  4. Lighting contactors:
    - a. Configuration: Electrically-held, 2-12 poles.
    - b. Mounting: DIN rail.
    - c. Voltage: 120 VAC.
    - d. Contact rating: 30 A continuous.

- e. UL listed.
- f. Manufacturer: Square D, Class 8903L, or equal.
- 5. Power contactors:
  - a. Configuration: Electrically-held, 3 poles.
  - b. Mounting: DIN rail.
  - c. Voltage: 120 VAC.
  - d. Minimum contact rating: 20 A continuous, 1 hp.
  - e. Operating life: 1.3 million cycles.
  - f. UL listed.
  - g. NEMA rated.
  - h. Manufacturer: Allen-Bradley, Bulletin 300, or equal.
- 6. Duplex alternation relays:
  - a. Configuration: DPDT or DPDT cross wired.
  - b. Mounting: DIN rail with screw terminal base socket.
  - c. Voltage: 120 VAC.
  - d. Contact Rating: 10 A, minimum; 1/8 hp.
  - e. Operating Life: 10 million mechanical operations and 100,000 electrical operations.
  - f. Status: Output position indicating LEDs.
  - g. Control: Three-position toggle switch permitting selection of normal duplexing action, locking in the A-B sequence, or locking in the B-A sequence. Alternation shall be able to be toggled every time a 120 VAC control signal is removed.
  - h. Manufacturer: Diversified Electronics, ARA, or equal.

## 2.05 FIBER-OPTIC COMMUNICATION SYSTEMS

- A. System Supplier shall provide the design, layout, and configuration of the fiber-optic communication system based on schematic interconnections shown on the Drawings. Network switches connected to fiber-optic cabling shall be configured to provide a self-healing-ring configuration. Device-to-device, line-connected networks and daisy chaining of switches and other network-connected devices is not acceptable, except where shown on the Drawings.
- B. System Supplier shall provide the necessary communication modules for all switches and other network-connected devices specified herein or shown on the Drawings to be connected to fiber-optic cabling. System Supplier shall coordinate the necessary final connections provided by CONTRACTOR as needed to prevent excessive signal attenuation between switches and other network-connected devices.
- C. System Supplier shall provide all fiber-optic patch cabling within control panels and equipment furnished by System Supplier that does not extend outside of control panels and equipment. All fiber-optic cabling extending outside of control panels and equipment provided by System Supplier shall be provided, terminated, and tested by CONTRACTOR with supervision by System Supplier. CONTRACTOR shall terminate spare runs of fiber-optic cable in all patch panels, including patch panels furnished by System Supplier, or terminate spare runs of fiber-optic cable with connectors with suitable covers at each terminating location without a patch panel.

## 2.06 RADAR LEVEL TRANSMITTERS

- A. Radar level transmitters shall utilize a microwave, non-contacting method with a beam angle of 8 degrees to measure level with an accuracy of  $\pm 2$  mm. Transmitter adjustments shall be performed from a smartphone, tablet, or notebook using Bluetooth. The transmitter shall be loop-powered at 24-volts DC and the output shall be 4-20 mA DC.

- B. Transmitters in non-hazardous locations shall be FM approved and have an operating range of -40°F to 176°F.
- C. Transmitters in hazardous locations shall be FM approved as being suitable for Class I, Division 1, Groups C and D locations and have an operating range of -40°F to 176°F. Provide an intrinsically safe wiring barrier as required.
- D. Transmitter enclosures shall be PVDF with an IP66/IP67 protection rating and be rated NEMA 4X. The enclosure shall have threaded NPT connections on the process connection and conduit/cable connection and be provided with all required mounting hardware. The transmitter shall be provided with an interconnecting cable with length as required to reach the point of connection as shown on the Drawings.
- E. Radar level transmitters shall be as manufactured by VEGA Model VEGAPULS C 21, or equal. Provide cable length as required for a continuous run to the terminating point as shown on the Drawings. Transmitters shall not be supported using the cables.
- F. Provide a remote-mounted display for radar level transmitters where shown on the Drawings. Displays shall have an aluminum housing with an IP66/IP67 protection rating and have an operating range of -4°F to 158°F. Displays in non-hazardous locations shall be FM approved and displays in hazardous locations shall be FM approved as being suitable for Class I, Division 1, Groups C and D locations. The display housing shall have threaded NPT connections. The display shall be loop-powered at 24-volts DC and the output shall be 4-20 mA DC. Remote-mounted displays shall be as manufactured by VEGA Model VEGADIS 82, or equal.

## 2.07 OPEN-CHANNEL RADAR FLOW TRANSMITTERS

- A. Radar open-channel flow transmitters shall utilize a microwave, non-contacting method with a beam angle of 8 degrees to measure flow with an accuracy of  $\pm 0.1\%$  of measurement. Transmitter adjustments shall be performed from a smartphone, tablet, or notebook using Bluetooth. The transmitter shall be loop-powered at 24-volts DC and the output shall be 4-20 mA DC.
- B. Flow calculations shall be performed by a remote-mounted controller and display. Controller adjustments shall be performed from a smartphone, tablet, or notebook using Bluetooth or using buttons on the controller.
- C. Transmitters in non-hazardous locations shall be FM approved and have an operating range of -40°F to 176°F.
- D. Transmitters in hazardous locations shall be FM approved as being suitable for Class I, Division 1, Groups C and D locations and have an operating range of -40°F to 176°F. Provide an intrinsically safe wiring barrier as required.
- E. Transmitter enclosures shall be PVDF with an IP66/IP67 protection rating and be rated NEMA 4X. The enclosure shall have threaded NPT connections on the process connection and conduit/cable connection and be provided with all required mounting hardware. The transmitter shall be provided with an interconnecting cable with length as required to reach the point of connection as shown on the Drawings.



- F. Controllers shall accept 120-volt AC power. Controllers shall have one 4-20 mA DC input, one 4-20 mA DC output, and three relay outputs capable of transmitting a totalized flow pulse signal.
- G. Controller enclosures shall have an IP66/IP67 protection rating and be rated NEMA 4X. The enclosure shall have threaded NPT connections. Controllers shall have an operating range of -40°F to 140°F.
- H. Radar flow transmitters shall be as manufactured by VEGA Model VEGAPULS C 21, or equal. Provide cable length as required for a continuous run to the terminating point as shown on the Drawings. Transmitters shall not be supported using the cables. Radar flow controllers shall be as manufactured by VEGA Model VEGAMET 841, or equal.
- I. For all controllers located outdoors, the controller shall be installed in a fiberglass, hinged-cover, NEMA 4X enclosure with window and front door-mounted, rotating handle, Hoffman Model Ultrix, or equal. Enclosures with side clamps or hasps are not allowed. Enclosure shall include a main circuit breaker disconnect, surge protection devices specified herein, anti-condensation heater, Hoffman DAH Series, or equal, with temperature control switch model ATEM. Mount the controller off the enclosure back panel so the display is visible at the enclosure window. Provide sun shield for all controllers located outdoors.

## 2.08 OPERATOR INTERFACE PANEL

- A. The operator interface shall meet the following general specifications:
  - 1. Voltage: 85 VAC to 264 VAC.
  - 2. Temperature: 0°C to 55°C.
  - 3. Humidity: 5% to 95% noncondensing.
  - 4. RFI: MIL-STD-461B.
  - 5. EMI: IEEE 472-1974.
  - 6. Communication Port: Ethernet.
- B. The operator interface shall have the following minimum features:
  - 1. Type: Color Active Matrix Thin Film Transistor (TFT) touchscreen LCD.
  - 2. Display Size: 6 1/2-inch.
  - 3. Resolution: 640 by 480, 18-bit color graphics.
  - 4. Clock: Battery-backed real time.
  - 5. Application Memory: 512 MB.
  - 6. Enclosure: NEMA Type 12.
- C. The operator interface panel shall be as manufactured by Allen-Bradley, Panelview Plus 7 Performance, or equal. Provide Factory Talk View Studio for Machine Edition programming software.

## 2.09 SURGE PROTECTIVE DEVICES FOR CONTROL PANELS, INSTRUMENTATION, AND NETWORK EQUIPMENT

- A. The incoming power supply of each supervisory control center shall be protected with a surge protective device (SPD). SPD unit shall be as manufactured by Citel, Model DS72US, or equal. Surge protection shall be provided for all phases and neutral.
- B. Each analog signal entering or leaving a supervisory control panel and leaving a building shall be provided with a DIN-rail mounted surge protection device as manufactured by Citel, Model DLA-24D3, or equal. Each transmitter shall be provided with a surge protection

device as manufactured by Citel, Model TSP15M, or equal, on the output and Citel, Model DS72US, or equal, on the power supply. Surge protection shall be provided for all phases and neutral.

- C. Each Ethernet cable entering or leaving a supervisory control panel and leaving a building shall be provided with a DIN-rail-mounted surge protection device rated up to 10 Gbps as manufactured by Phoenix Contact, Model DT-LAN-CAT6+, or equal.

## 2.10 PATCH PANELS

- A. Fiber-optic patch panels shall be installed where shown on the Drawings and shall be used to terminate incoming fiber-optic cable serving its associated structure. Patch panels shall be as manufactured by Siemon Company, or equal, Model SWIC3-M-01. Each patch panel shall include the following.
  - 1. Wall-mounting enclosure with 6- to 48-fiber port terminations.
  - 2. Fiber port designation labels with removable pocket.
  - 3. Dust-proofing grommets, strain relief hardware, cable ties, and mounting hardware.
  - 4. Thumb turn enclosure latch.
  - 5. Bend radius guides to provide proper storage of fiber slack.
  - 6. Adapter plates with the appropriate fiber terminating connectors. Adapters shall be universal to accept multimode or single-mode fiber.
  - 7. Minimum of 25% spare ports available for future fiber terminations.

## 2.11 INDUSTRIAL ETHERNET SWITCHES

- A. Managed Switches:
  - 1. Full Gigabit: Provide full Gigabit, managed Ethernet network switches where shown on the Drawings. Network switches shall be as manufactured by Allen-Bradley Stratix 5400 series or Hirschmann Model BRS40 series. Each switch shall include, but not be limited to, the following:
    - a. Selectable Gigabit Ethernet star or ring topology with redundant fail-over. Switches shall be configured for a ring topology, unless noted otherwise.
    - b. DIN rail mounting and redundant 24-volt DC power supply inputs. Provide redundant power supplies, Hirschmann Model RPS series, or equal.
    - c. Command line interface, DHCP, and store and forward switching.
    - d. SNTP real time clock.
    - e. IP and MAC port security and SNMPv3.
    - f. Compliance with the following IEEE Standards: 802.1D, 802.1p QoS, 802.3, 802.3u, 802.3x flow control, 802.1w RSTP, and 802.1Q VLAN.
    - g. SNMP with web browsing for switch configuration, diagnostics, and monitoring.
    - h. Dry contact alarm output for indication that the primary fiber loop or switch has failed.
    - i. Up to 4 combo SFP ports and a minimum of 4 copper ports. Provide SFP transceiver modules as required for the connections shown on the Drawings. The SFP transceiver shall operate on the 850 nm wavelength for 1000BASE-SX communications over multi-mode fiber optic cable using LC-type connectors.
  - 2. Gigabit Uplink: Provide managed Ethernet network switches with Gigabit-Uplink SFP ports where shown on the Drawings. Network switches shall be as manufactured by Allen-Bradley Stratix 5700 series or Hirschmann BRS30 series. Each switch shall include, but not be limited to, the following:
    - a. Selectable Gigabit Ethernet star or ring topology with redundant fail-over. Switches shall be configured for a ring topology, unless noted otherwise.
    - b. DIN rail mounting and redundant 24-volt DC power supply inputs. Provide redundant power supplies, Hirschmann Model RPS series, or equal.

- c. Command line interface, DHCP, and store and forward switching.
  - d. SNTP real time clock.
  - e. IP and MAC port security and SNMPv3.
  - f. Compliance with the following IEEE Standards: 802.1D, 802.1p QoS, 802.3, 802.3u, 802.3x flow control, 802.1w RSTP, and 802.1Q VLAN.
  - g. SNMP with web browsing for switch configuration, diagnostics, and monitoring.
  - h. Dry contact alarm output for indication that the primary fiber loop or switch has failed.
  - i. Up to two combo SFP, Gigabit Ethernet uplink ports and up to 16 copper 10/100 Fast Ethernet ports. The switch shall have a minimum of 25% spare ports. Provide copper SFP transceiver modules as required for the Gigabit Ethernet uplink connections shown on the Drawings. The SFP transceiver shall operate on the 850 nm wavelength for 1000BASE-SX communications over multi-mode fiber optic cable using LC-type connectors.
  - j. Provide PoE network switches where shown on the Drawings. PoE switches shall be in compliance with IEEE Standards 802.3af PoE and 802.3at PoE+ and shall support minimum 90 watts of PoE loading. Provide additional switches for installations where one switch will not provide adequate PoE port quantities or total power demand.
- B. Provide unmanaged Ethernet switches for networks shown on the Drawings that include only personal computers and/or PLCs. Unmanaged switches shall be as manufactured by Hirschman, Spider Series, or Allen-Bradley Stratix 2000 Series and include fiber and copper ports to accommodate wiring shown on the Drawings. Each switch shall include the following.
- 1. Full/half-duplex operation.
  - 2. Auto-sensing speed and flow control.
  - 3. IEEE 802.3 compliance.
  - 4. DIN rail mounting and a 24-volt DC power supply input. Provide a dedicated power supply, Hirschmann Model RPS Series, or equal.
  - 5. Store and forward switching.
  - 6. Minimum of 4 copper ports.
  - 7. Eight spare copper ports.
- C. Provide fiber-to-copper media converters where shown on the Drawings. Media converters shall be unmanaged Ethernet switches as manufactured by Hirschmann, Spider III Premium Series, or equal, and include one combo SFP port and copper ports to accommodate wiring shown on the Drawings. Each media converter shall include the following:
- 1. DIN rail mounting and a 24-volt DC power supply input. Provide a dedicated power supply, Hirschmann Model RPS series, or equal.
  - 2. Provide fiber SFP transceiver modules as required for the connections shown on the Drawings. SFP transceiver shall operate on the 850 nm wavelength for 1000BASE-SX communications over multi-mode fiber optic cable using LC-type connectors.

## 2.12 PROTOCOL CONVERTERS

- A. Protocol converters shall support communications between the following protocols to provide a communication interface between the plant SCADA System PLCs and third-party devices:
- 1. EtherNet/IP to Modbus TCP.
  - 2. EtherNet/IP to Modbus RTU.
  - 3. EtherNet/IP to DF1 serial.
  - 4. EtherNet/IP to DNP3.

- B. The protocol converter shall have the following built-in interfaces plus one open expansion port for adding additional interface modules to expand port types and quantities:
  - 1. Two RS-232 serial ports.
  - 2. One RS-422/485 serial port.
  - 3. One 10/100 Base-TX Ethernet port.
  - 4. USB for configuration only.
- C. Up to four protocols shall be able to be simultaneously converted via the Ethernet interface. Provide all required firmware, drivers, and communication interface modules.
- D. Protocol converters shall be Red Lion Model Data Station Plus, or equal.

## 2.13 MAGNETIC FLOW METERS

- A. The magnetic flow meters shall be suitable for measuring plant effluent flows in the range indicated in the table below. The magnetic flow meters shall consist of a flanged flow tube with grounding rings and remote transmitter. The flow tube shall be of 304 stainless steel with hard rubber liner. Flanges shall be carbon steel and conform to ANSI B16.5, Class 150.
- B. The meters shall utilize bipolar DC coil excitation or other means to automatically rezero. Meters shall be provided with grounding rings made of material compatible with electrode material. Electrodes shall be bullet nose, 316 stainless steel.
- C. The meter shall incorporate design features to minimize the effect of greasy (nonconductive) coatings or incorporate a means to automatically clean the electrodes during continuous operation. Meter accuracy shall not be affected by greasy coatings, and cleaning of the meter manually shall not be required.
- D. Meter accuracy shall be  $\pm 0.5\%$  of rate from 1.0 to 30.0 ft/sec and 0.1% of scale below 1.0 ft/sec when installed with the appropriate upstream and downstream pipe diameters. The meters shall be wet-calibrated in a primary flow laboratory traceable to the National Institute of Standards and Technology. Transmitters and flow tubes shall be interchangeable.
- E. The transmitter shall be designed to operate on 120 VAC, 60 Hz. Power consumption shall not exceed 20 watts. Connections at the flow tube shall be factory-potted. Outputs shall be 4-20 mA and totalizer scaled pulse, suitable for driving a solid-state counter. Pulse width and volume of flow per pulse shall be widely adjustable before or after installation to allow interface with PLC input cards and other devices.
- F. Outputs shall be field-adjustable for range changes. Response time or damping shall be adjustable from 0.8 to 8.0 seconds. The meters shall be operable in all liquids with 5.0 umhos/cm or more conductivity.
- G. The meters shall include empty pipe detection. Meters shall be capable of reading forward and reverse flow. Provide a single analog output representing instantaneous flow. If directional flow is required, provide a digital direction output and include dedicated forward and reverse flow totalizers.
- H. Enclosure Ratings:
  - 1. Flow tube enclosure shall be IP68 rated for continuous submergence.
  - 2. Remote transmitter enclosure shall be NEMA 4X.

- I. The magnetic flow meters and remote transmitters shall be Siemens FM MAG 5100W, or equal. Meters shall be sized to match the nominal pipe diameter in which they are installed. Provide cable, length as required, to reach from the flow tube to the remote transmitter; CONTRACTOR shall coordinate. Flow meters shall be provided as follows:

Tag No.	Transmitter	Size (Inches)	Maximum Scale	Directional
F 20-01	REMOTE	60	0-40 MGD	---
F 20-02	REMOTE	60	0-40 MGD	---

- J. Remote transmitter shall be furnished by the meter manufacturer.
- K. Transmitter shall be FM approved and CSA certified. Remote and integral transmitter shall include back-lit display and push buttons or other means for local operation and maintenance. Display shall include instantaneous flow and totalized flow and indication of present faults.
- L. For all remote transmitters located outdoors, the transmitter shall be installed in a fiberglass, hinged-cover, NEMA 4X enclosure with window and front door-mounted, rotating handle. Enclosure shall include a main circuit breaker disconnect, surge protection devices specified herein, and anti-condensation heater, with temperature control switch. Mount the transmitter off the enclosure back panel so the display is visible at the enclosure window. Provide sun shield for all transmitters located outdoors.
- M. Provide stainless steel information tag that indicates instrument number, service, and calibration range.

### PART 3-EXECUTION

#### 3.01 CONTROL DESCRIPTIONS

- A. Non-Potable Water Pump Control:
1. The four Non-Potable Water Pumps shall be controlled by the plant SCADA system through PLC-NPW. All I/O between the PLC and the four pump VFDs shall be through Ethernet communication.
  2. When pump "Automatic" control is selected, the PLC shall automatically start/stop and control speed for each pump to maintain a preset, operator adjustable, non-potable water system pressure at the pump station discharge.
  3. The pumps will operate in a Lead-Lag 1-Lag 2-Lag 3 control mode. When multiple pumps are required to maintain preset system pressure they shall operate at the same speed and ramp together.
  4. An operator adjustable set-point shall be provided for non-potable water system pressure.
  5. The operator shall be able to selected which pumps are the Lead-Lag 1-Lag 2-Lag 3 pump.
  6. If a pump fails to operate when called, the next pump in the rotation will be called to start.
  7. Operator adjustable setpoints will be provided for "High System Pressure" and "Low System Pressure." Either of these conditions will be annunciated in the SCADA system and indicated at the PLC.

- B. Thickener Dilution Water Pumps No. 1 and No. 2 (two total):
1. H-O-A Selector Switch:
    - a. With the H-O-A selector switch in the "Hand" position the motor shall be run continuously.
    - b. With the H-O-A selector switch in the "Off" position the motor shall be inoperable.
    - c. With the H-O-A selector switch in the "Auto" position the motor shall be controlled through a discrete output from the gravity thickeners through the plant SCADA system.
  2. The starter shall be provided with a Green run indicating light and elapsed time meter.
  3. The starter shall provide a discrete output to the plant SCADA system to indicate "Auto" control selected.
  4. The pump is provided with a motor overtemperature/seal fail monitor unit. The module is provided by the pump manufacturer for installation in the motor control center bucket. On a motor overtemperature condition, motor shall not operate until condition is reset through a starter mounted reset pushbutton. On a seal fail condition motor shall be operable. On a seal fail or motor overtemperature condition the starter shall provide a discrete output to the plant SCADA system to indicate each condition. A Red indicating light mounted on the starter door shall be energized to indicate motor overtemperature condition. An Amber indicating light mounted on the starter door shall be energized to indicate seal fail condition.
  5. The starter shall provide discrete outputs to the plant SCADA system to indicate pump run, motor OL condition and breaker out of service.
- C. Aeration Foam Spray Pump (one total):
1. H-O-A Selector Switch:
    - a. With the H-O-A selector switch in the "Hand" position the motor shall be run continuously.
    - b. With the H-O-A selector switch in the "Off" position the motor shall be inoperable.
    - c. With the H-O-A selector switch in the "Auto" position the motor shall be controlled through a discrete output from the gravity thickeners through the plant SCADA system.
  2. The starter shall be provided with a Green run indicating light and elapsed time meter.
  3. The starter shall provide a discrete output to the plant SCADA system to indicate "Auto" control selected.
  4. The pump is provided with a motor overtemperature/seal fail monitor unit. The module is provided by the pump manufacturer for installation in the motor control center bucket. On a motor overtemperature condition, motor shall not operate until condition is reset through a starter mounted reset pushbutton. On a seal fail condition motor shall be operable. On a seal fail or motor overtemperature condition the starter shall provide a discrete output to the plant SCADA system to indicate each condition. A Red indicating light mounted on the starter door shall be energized to indicate motor overtemperature condition. An Amber indicating light mounted on the starter door shall be energized to indicate seal fail condition.
  5. The starter shall provide discrete outputs to the plant SCADA system to indicate pump run, motor OL condition and breaker out of service.

END OF SECTION

**SCADA SYSTEM I/O LISTING**

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
 LEXINGTON, KENTUCKY  
 TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION  
 PROCESS REPLACEMENT PROJECT  
 CONTRACT 131-2024  
 SCADA SYSTEM I/O LISTING - P6 ADDITIONS

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	<b>MCC-UV</b>							
P6	MCC-UV Line 1 Power		0	0	1	0	ENET	From MCC-UV
P6	MCC-UV Line 2 Power		0	0	1	0	ENET	From MCC-UV
P6	MCC-UV Main CB 1 Status		1	0	0	0	ENET	From MCC-UV
P6	MCC-UV Main CB 2 Status		1	0	0	0	ENET	From MCC-UV
P6	MCC-UV Tie CB Status		1	0	0	0	ENET	From MCC-UV
P6	Channel 1 PDC 1A-1C OOS		1	0	0	0	ENET	From MCC-UV
P6	Channel 1 PDC 2A-2C OOS		1	0	0	0	ENET	From MCC-UV
P6	Channel 1 HSC 1A-1C OOS		1	0	0	0	ENET	From MCC-UV
P6	Channel 1 HSC 2A-2C OOS		1	0	0	0	ENET	From MCC-UV
P6	Channel 2 PDC 3A-3C OOS		1	0	0	0	ENET	From MCC-UV
P6	Channel 2 PDC 4A-4C OOS		1	0	0	0	ENET	From MCC-UV
P6	Channel 2 HSC 3A-3C OOS		1	0	0	0	ENET	From MCC-UV
P6	Channel 2 HSC 4A-4C OOS		1	0	0	0	ENET	From MCC-UV
P6	Decant Pipe No. 1 OOS		1	0	0	0	ENET	From MCC-UV
P6	Decant Pipe No. 2 OOS		1	0	0	0	ENET	From MCC-UV
P6	Decant Pipe No. 3 OOS		1	0	0	0	ENET	From MCC-UV
P6	Decant Pipe No. 4 OOS		1	0	0	0	ENET	From MCC-UV
P6	Sluice Gate No. 1 OOS		1	0	0	0	ENET	From MCC-UV
P6	Sluice Gate No. 2 OOS		1	0	0	0	ENET	From MCC-UV
P6	Sluice Gate No. 3 OOS		1	0	0	0	ENET	From MCC-UV
P6	Sluice Gate No. 4 OOS		1	0	0	0	ENET	From MCC-UV
P6	Electrical Room Air Conditioner OOS		1	0	0	0	ENET	From MCC-UV
P6	UV Bridge Crane OOS		1	0	0	0	ENET	From MCC-UV
	***TOTALS***		21	0	2	0		



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 SCADA SYSTEM I/O LISTING - PLC-NPW

PLC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	<b>MCC-B</b>							
NPW	MCC-B Line 1 Power		0	0	1	0	ENET	From MCC-B
NPW	MCC-B Line 2 Power		0	0	1	0	ENET	From MCC-B
NPW	Non-Potable Water System Pressure		0	0	1	0	SH.PR	From Non-Potable Water Pressure Transmitter
NPW	Plant Effluent Flow		0	0	1	0	SH.PR	From Effluent Flow Meter Transmitter
NPW	MCC-B Main CB 1 Status		1	0	0	0	ENET	From MCC-B
NPW	MCC-B Main CB 2 Status		1	0	0	0	ENET	From MCC-B
NPW	MCC-B Tie CB Status		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 1 OOS		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 1 in Auto		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 1 Run		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 1 Motor OT		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 1 Seal Fail		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 1 VFD Fail		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 1 Motor Speed		0	0	1	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 1 Start Control		0	1	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 1 Speed Control		0	0	0	1	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 2 OOS		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 2 in Auto		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 2 Run		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 2 Motor OT		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 2 Seal Fail		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 2 VFD Fail		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 2 Motor Speed		0	0	1	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 2 Start Control		0	1	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 2 Speed Control		0	0	0	1	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 3 OOS		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 3 in Auto		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 3 Run		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 3 Motor OT		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 3 Seal Fail		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 3 VFD Fail		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 3 Motor Speed		0	0	1	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 3 Start Control		0	1	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 3 Speed Control		0	0	0	1	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 4 OOS		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 4 in Auto		1	0	0	0	ENET	From MCC-B

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PLC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
NPW	Non-Potable Water Pump No. 4 Run		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 4 Motor OT		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 4 Seal Fail		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 4 VFD Fail		1	0	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 4 Motor Speed		0	0	1	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 4 Start Control		0	1	0	0	ENET	From MCC-B
NPW	Non-Potable Water Pump No. 4 Speed Control		0	0	0	1	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 1 OOS		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 1 in Auto		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 1 Run		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 1 Motor OT		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 1 Seal Fail		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 1 OL Fail		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 1 Start Control		0	1	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 2 OOS		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 2 in Auto		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 2 Run		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 2 Motor OT		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 2 Seal Fail		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 2 OL Fail		1	0	0	0	ENET	From MCC-B
NPW	Thickener Dilution Water Pump No. 2 Start Control		0	1	0	0	ENET	From MCC-B
NPW	Foam Spray Water Pump OOS		1	0	0	0	ENET	From MCC-B
NPW	Foam Spray Water in Auto		1	0	0	0	ENET	From MCC-B
NPW	Foam Spray Water Pump Run		1	0	0	0	ENET	From MCC-B
NPW	Foam Spray Water Pump Motor OT		1	0	0	0	ENET	From MCC-B
NPW	Foam Spray Water Pump Seal Fail		1	0	0	0	ENET	From MCC-B
NPW	Foam Spray Water Pump OL		1	0	0	0	ENET	From MCC-B
NPW	Foam Spary Water Pump Start Control		0	1	0	0	ENET	From MCC-B
NPW	UV Influent Gate No. 1 OOS		1	0	0	0	ENET	From MCC-B
NPW	UV Influent Gate No. 2 OOS		1	0	0	0	ENET	From MCC-B
NPW	UV Effluent Gate OOS		1	0	0	0	ENET	From MCC-B
NPW	UV Effluent Gate Open		1	0	0	0		
NPW	UV Effluent Gate Closed		1	0	0	0		
NPW	UV Effluent Gate Close Control		0	1	0	0		
NPW	UV Effluent Gate Open Control		0	1	0	0		

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SCADA SYSTEM I/O LISTING - PLC-NPW

PLC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
NPW	Eyewash/Shower in Use		0	1	0	0	2~#14	From Flow Switch at Eyewash/Shower
	***TOTALS***		50	10	8	4		

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SCADA SYSTEM I/O LISTING - PLC-UV

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	<b>MCC-H</b>							
PLC-UV	MCC-H Line 1 Power		0	0	1	0	ENET	From MCC-H
PLC-UV	MCC-H Line 2 Power		0	0	1	0	ENET	From MCC-H
PLC-UV	MCC-H Main CB 1 Status		1	0	0	0	ENET	From MCC-H
PLC-UV	MCC-H Main CB 2 Status		1	0	0	0	ENET	From MCC-H
PLC-UV	MCC-H Tie CB Status		1	0	0	0	ENET	From MCC-H
PLC-UV	Channel 1 PDC 1A-1C OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Channel 1 PDC 1D-1E OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Channel 1 HSC 1A-1D OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Channel 1 HSC 1F OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Channel 2 PDC 2A-2C OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Channel 2 PDC 2D-2E OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Channel 2 HSC 2A-2D OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Channel 2 HSC 2F OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Electrical Room EUH OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Scrubber Room EUH OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Sulfur Dioxide Feed Room EUH OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Chorine Feed Room EUH OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Sulfur Dioxide Storage Room EUH OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Chorine Storage Room EUH OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Sulfur Dioxide Storage Room Hoist OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Chorine Storage Room Hoist OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Chorine Storage Room EUH OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Chorine Storage Room EUH OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Sulfur Dioxide Storage Room EUH OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Outside Lighting Contactor OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Decant Pipe No. 1 OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Decant Pipe No. 2 OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	Electrical Room Air Conditioner OOS		1	0	0	0	ENET	From MCC-H
PLC-UV	UV Channel Hoist OOS		1	0	0	0	ENET	From MCC-H
	<b>AUTOMATIC TRANSFER SWITCH 1</b>							
PLC-UV	In Normal Position		1	0	0	0	2-#14	From ATS Auxilliary Contact
PLC-UV	In Emergency Position		1	0	0	0	2-#14	From ATS Auxilliary Contact
PLC-UV	Power Fail		1	0	0	0	2-#14	From ATS Normal Source Available Auxilliary Contact
	<b>AUTOMATIC TRANSFER SWITCH 2</b>							
PLC-UV	In Normal Position		1	0	0	0	2-#14	From ATS Auxilliary Contact
PLC-UV	In Emergency Position		1	0	0	0	2-#14	From ATS Auxilliary Contact

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
 LEXINGTON, KENTUCKY  
 TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION  
 PROCESS REPLACEMENT PROJECT  
 CONTRACT 131-2024  
 SCADA SYSTEM I/O LISTING - PLC-UV

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
PLC-UV	Power Fail		1	0	0	0	2~#14	From ATS Normal Source Available Auxilliary Contact
	<b>GENERATOR</b>							
PLC-UV	Running		1	0	0	0	2~#14	From Generator Control Panel
PLC-UV	Common Fail		1	0	0	0	2~#14	From Generator Control Panel
PLC-UV	Battery Charger Fail		1	0	0	0	2~#14	From Generator Battery Charger
PLC-UV	Low Coolant Temperature		1	0	0	0	2~#14	From Generator Control Panel
	***TOTALS***		37	0	2	0		

## SECTION 26 09 10

### CONTROLS AND INSTRUMENTATION DRAWINGS

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit drawings in accordance with provisions of Section 01 33 00–Submittals.

##### 1.03 COORDINATION

- A. The requirements set forth in this section are intended to apply to the drawings provided as specified in Section 26 09 00–Controls and Instrumentation, Section 26 24 19–Motor Control, and drawings provided by equipment manufacturers for control panels provided with equipment specified in Divisions 43 and 46.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

##### 3.01 GENERAL REQUIREMENTS

- A. A bound set of as-built drawings shall be provided in the associated equipment enclosure.
- B. All drawings shall have the following information:
  - 1. Project information, including name of OWNER and specific project name.
  - 2. Drawing title, accurately representing what is on the drawing.
  - 3. Unique drawing identifier, consisting of a unique drawing number or drawing number with individual sheet number. If sheet numbers are used, total number of sheets must be identified on each sheet.
  - 4. System Supplier company name, address, and phone number.
  - 5. Original design information, including person responsible for design, date of original design, person responsible for checking of design, and date of design check.
  - 6. Revision block indicating revision number, date, description of revision, and person responsible for revision.
- C. All drawings shall have line numbers that can be uniquely referenced from other drawings.
- D. All drawings showing wiring shall include unique wire numbers assigned to wiring that is installed between devices in the panel. The wire number shall be shown on the drawings.

- E. All drawings showing relays shall include reference to the drawings where the relay contacts are shown. Spare relay contacts that are not used shall be identified.

### 3.02 DRAWINGS REQUIRED

- A. Index of Drawings: Index of Drawings shall list drawing number, sheet number (if applicable), and drawing title for each drawing in drawing package.
- B. Symbol Sheet: Symbol Sheet shall include:
  - 1. Explanation of all symbols used on the drawings, including, but not limited to, normally open/normally closed contacts, flow switches, limit switches, pressure switches, selector switches, pushbuttons, timers, control relays, solenoids, fuses, circuit breakers, terminal blocks, and contactors. Symbol sheet does not need to be specific to project, but must contain explanation of all symbols used on the drawings (i.e., special symbols used for a particular project must be added to standard symbol sheets).
  - 2. List of abbreviations used on the drawings.
  - 3. Explanation of continuation method for circuits that cannot be shown on a single sheet.
- C. Exterior Enclosure Layout Drawing: Exterior layout drawing shall show location of all externally-mounted equipment. Exterior layout drawing shall include:
  - 1. Enclosure dimensions, enclosure NEMA rating (i.e., NEMA 1, NEMA 4X stainless steel, NEMA 4X nonmetallic, etc.), and enclosure color or finish.
  - 2. Location and actual depiction of panel latches, hinges, mounting holes and lifting eyes.
  - 3. Location and accurate representation of equipment mounted on enclosure (i.e., switches should look like actual switches being installed; indicating lights should look like actual lights being installed).
  - 4. Equipment nameplate location.
  - 5. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
  - 6. Nameplate list including nameplate wording, size, construction (i.e., lamicoid with Black background and White letters), and mounting method (i.e., stainless steel screws). Label size must include size in inches or reference to standard sizes included on symbol sheet, or elsewhere in drawing package.
  - 7. Identification of area reserved for equipment located inside enclosure, but not actually mounted on enclosure back panel, such as UPSs, fiber optic patch panels, and lighting packages.
- D. Interior Enclosure Layout Drawing: Interior layout drawing shall show location of all internally-mounted equipment. Interior layout drawing shall include:
  - 1. Back panel dimensions and finish.
  - 2. Location and accurate representation of equipment (i.e., terminal blocks should look like actual terminal blocks; receptacle should look like actual receptacle, etc.).
  - 3. Dimensions of internally-mounted equipment are not necessary, but equipment should be drawn to scale such that an accurate representation of the way equipment will be mounted is shown on the drawing.
  - 4. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
- E. Interconnection Diagram, Network Diagram or Block Diagram: Interconnection Diagram, Network Diagram or Block Diagram shall show all cabling between system components and identify any station addressing or node numbers that are assigned to equipment. All cables shall be identified by cable type, including specific manufacturer and model/part number.

Party responsible for furnishing and installing cable shall also be included. Some examples of cables that must be shown are:

1. Antenna cables.
2. Communications cables between system components (fiber and/or copper). This includes fiber optic jumpers between fiber patch panels and equipment, and Ethernet patch cables between switches and devices.
3. Communications cables (fiber and/or copper) between PLCs, controllers, operator interface equipment and security devices (e.g., card readers, electric strikes, and motion detectors) that are not shown on the elementary schematics.

F. Elementary Schematic: Elementary schematics shall be developed for each motor or supplied equipment and shall include:

1. Nominal voltage, AC or DC designation, number of phases (if AC), and frequency in hertz (if AC) for each source of electrical supply to the enclosure.
2. Prospective short-circuit current available at the point of electrical supply to the enclosure.
3. Type of power supply system grounding (e.g., wye phase midpoint grounded, delta phases corner grounded, wye phases midpoint grounded, delta phases ungrounded, etc.).
4. Complete documentation of electrical circuit from supply to motor or supplied equipment. Documentation shall include disconnecting means, main overcurrent protection (when supplied), branch overcurrent protection (when supplied), control circuit and special purpose control protection, motor control, overload protection, local disconnect (when supplied) and motor horsepower, and full load amps from nameplate or supplied equipment full load amps.
5. Documentation of PLC or controller inputs and outputs.
6. Documentation of all circuit breaker/motor protector ratings, fuse sizes, control power transformer VA ratings, dip switch settings, etc.
7. Documentation of all RVSS and VFD settings (e.g., under-voltage shutdown, ramp time, overload, excessive starts/hour, etc.) which have been changed from the factory default setting.

G. Wiring Diagram: Wiring diagrams shall show all terminations for all cables external to the enclosure. Terminations may be shown on the elementary schematics as long as the termination information is concise and easily understood by the personnel installing the field wiring. Termination information shall be shown for all devices, including devices that are not part of System Supplier's scope of supply. A box with two dots or continuation arrows indicating continuation to a piece of equipment are not acceptable. Information shown on System Supplier's wiring diagrams shall include a description of the drawings where terminations are found (i.e., drawing title), drawing number where the terminations are found, and terminal blocks referenced on the drawing. System Supplier shall coordinate with supplier of other wiring diagram to provide information on System Supplier's wiring diagrams.

H. Calculations Summary: Calculations summary shall include calculations performed to:

1. Determine size of UPS.
2. Determine air conditioning equipment requirement.
3. Determine control power transformer sizing. Control power transformer sizing calculations may be generic based on typical circuits.

I. Functional Testing Recommendations: Testing recommendations shall include description of functional tests that must be performed by operators. Functional test description shall be



included for UPS, indicating lights, and other devices whose condition can only be determined by testing.

END OF SECTION

## SECTION 26 22 13

### DRY-TYPE TRANSFORMERS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Distribution transformers for nonlinear loads.
  - 2. Dry-type transformers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/NEMA ST 1—Specialty Transformers.
- B. ANSI/NEMA ST 20—Dry-Type Transformers for General Applications.
- C. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 “Energy Efficiency Program for Certain Commercial and Industrial Equipment.”

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of electrical equipment, cable, and wire products of the types and ratings necessary, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.
- E. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute and other standards pertaining to material, construction, and testing, where applicable.
- F. Transformer shall bear the UL Energy Efficiency Verification Mark to confirm that the unit meets the requirements of 10 CFR Part 431.

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

- B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, loss data, efficiency at 25%, 50%, 75%, and 100% rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products under provisions of Section 01 60 00—Materials and Equipment.
- B. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet or snow, if handled in inclement weather.

### PART 2—PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Square D.
- B. Eaton.
- C. Substitutions: Under provisions of the General Conditions.

#### 2.02 DRY-TYPE TRANSFORMERS

- A. Dry-Type Transformers: ANSI/NEMA ST 20; factory-assembled, air-cooled, dry-type, two-winding, ventilated transformers; ratings as shown on the Drawings. Transformers shall be DOE 2016 Efficiency rated.
- B. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635. Insulation system and average winding temperature rise for rated kVA shall be as follows:

kVA Rating	Class	Temperature Rise (°C)
1-500	220	115

- C. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above a 40°C ambient.
- D. Winding Taps, Transformers Less than 15 kVA: Two 5% below rated voltage, full-capacity taps on primary winding.
- E. Winding Taps, Transformers 15 kVA and Larger: Two at +2 1/2% FCAN and four at -2 1/2% FCBN.
- F. Sound Levels: ANSI/NEMA ST 20.

- G. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
- H. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- I. Mounting: Transformers 75 kVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 kVA shall be suitable for floor or trapeze mounting.
- J. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction. Terminals shall be welded to the leads of the coils for better conductivity, less maintenance, and lower risk of hot spots. Terminals shall not be spot welded or bolted to the coil leads.
- K. Enclosure: ANSI/NEMA ST 20; NEMA Type 2. Provide lifting eyes or brackets.
- L. Isolate core and coil from enclosure using vibration-absorbing mounts.
- M. Include engraved metal nameplate from manufacturer with transformer connection data. Also provide engraved phenolic nameplate as specified in Section 26 05 53–Electrical Identification.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Install equipment per manufacturer's recommendations and as indicated on the Drawings. Coordinate final locations of equipment with CONTRACTOR and review final locations with ENGINEER prior to setting equipment.
- B. Protect equipment during installation to prevent twisting or deformations, exposure to potentially damaging environments, and work of other trades. Maintain protection until completion of construction.
- C. Set transformer plumb and level.
- D. Use liquidtight flexible metal conduit, 3 feet maximum length, for connections to transformer case. Make conduit connections to side panel or bottom of enclosure only. Provide grounding as required by code.
- E. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- F. All transformers with a 4-wire secondary shall be grounded as a separately derived system per the NEC.

### 3.02 ADJUSTMENTS AND CLEANING

- A. Immediately prior to final inspection, make final adjustments and thoroughly clean all equipment. Refinish all damaged enclosures to original quality.

### 3.03 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate adjustments.
- C. Visually inspect all equipment and components at time of delivery. Submit report to ENGINEER with list of items to be corrected.
- D. Electrically test and inspect all equipment. Submit final report to ENGINEER. Adjust or replace equipment to comply with manufacturer's specifications and resubmit corrected test report. Testing shall be done in accordance with NETA testing specifications for equipment supplied.

END OF SECTION

## SECTION 26 24 16

### PANELBOARDS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Lighting and appliance panelboards.
  - 2. Power distribution panelboards.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of electrical equipment, cable, and wire products of the types and ratings necessary, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical equipment installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.
- E. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material, construction, and testing, where applicable.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

##### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All electrical equipment and material shall be received and stored with the factory tamperproof wrapping intact. Provide factory-wrapped waterproof flexible barrier material for factory packaging of equipment and material to protect against physical damage in transit. Do not install damaged equipment or material; remove from project site. Store equipment in factory coverings in a clean, dry, indoor space that provides protection against weather.

## PART 2-PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Square D.
- B. Eaton.
- C. Substitutions: Under provisions of the General Conditions.
- D. The Drawings and Specifications were prepared based on Square D. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

### 2.02 PANELBOARDS

- A. Lighting and appliance and power distribution panelboards shall be provided as indicated on the drawings and as scheduled. Panelboards shall be factory-assembled and constructed in accordance with latest NEMA, UL, and NEC requirements and shall bear the UL label. Panelboard cabinets, including boxes and fronts, shall be code gauge galvanized steel. Front covers shall be hinged to allow access to wiring gutters without removal of panel trim (door-in-door type). All fronts shall be complete with cylinder-type lock and catch, and all cylinders shall be keyed alike. Provide two keys per panelboard to OWNER.
- B. Gutter and wiring space shall be provided according to NEMA and UL standards, except provide additional 6-inch-wide or -high wiring space for all double-lugged two or more section panels, feed-through panels; or panels that subfeed other panels at 100 amperes or more. CONTRACTOR shall instruct manufacturer as to where additional wiring space is needed, i.e., top, bottom, right, left, or combination. Where oversized cabinets are necessary for one section of a panelboard, all sections of the panelboard shall be the same size.
- C. Panelboards shall have full ampacity bussing throughout (full length of panel) and shall be full-size in regard to number of possible pole spaces. All lighting and appliance panels shall have poles as shown on the drawings. Power distribution panels shall have number of poles as scheduled or shown on the drawings. Panelboards shall be identified with phases reading left to right and circuits alternately numbered left to right, odd numbers on the left, even numbers on the right.
- D. Panelboards shall have copper bussing. Provide copper ground bus in all panelboards.
- E. Lugs for incoming feeders shall be UL listed for use with copper conductors. Lugs shall be sized by CONTRACTOR in accordance with feeder sizes shown. Main lugs or main breakers shall be top- or bottom-mounted to coordinate with incoming feeder entrance location. Location shall be selected by CONTRACTOR.
- F. Branch circuit breakers shall be quick-make, quick-break, with thermal magnetic trip bolt-on type. Multipole breakers shall have common internal trip, UL listed as multipole units; handle ties are not permitted. All breakers shall be of the same manufacturer as the panelboard and provided at ampere capacity as scheduled.

- G. Main and feeder circuit breakers larger than 225 amps and circuit breakers feeding lighting panel transformers shall have adjustable trip settings as specified in Section 26 28 00–Overcurrent Protective Devices.
- H. Lighting and appliance panelboards shall be provided as follows (types listed are Eaton):

Type	Maximum Voltage	Maximum Bus Amps	Maximum Brk. Amps	Minimum I.C.
Pow-R-Line 1X	240	600	100	10,000
Pow-R-Line 2X	277/480	600	100	14,000
Pow-R-Line 3X	600	600	225	14,000

- I. All panelboards scheduled with main circuit breakers shall be individually mounted main circuit breaker panels. Main circuit breakers installed in the location of branch circuit devices (branch-mounted mains) are not acceptable.

### PART 3–EXECUTION

#### 3.01 INSTALLATION

- A. Panelboards shall be provided as indicated. Final locations, sizes, and mounting of panelboards shall be reviewed with ENGINEER prior to installation.
- B. Each panelboard shall have a typewritten circuit schedule provided on the inside cover. This schedule shall be covered with clear plastic in a metal frame and shall include room numbers, room name, and area or item served by each branch circuit. Room numbers used shall be those used by OWNER, except as otherwise requested by ENGINEER.
- C. Flush panels in finished areas shall have factory-applied primer coat painted trim for finish painting by CONTRACTOR to match the walls.
- D. Prior to final inspection, clean all panelboard interiors, adjust trims, covers, hinges and locks, and refinish covers to original condition.
- E. Panel trim shall have enamel finish as selected by OWNER.
- F. Balance load on all panelboards so phases are balanced to 15% of each other. Reconnect or redistribute circuits and/or circuit breakers to achieve balanced condition. Submit ammeter readings for all panelboard feeders indicating normal operating load and phase balance.

END OF SECTION



## SECTION 26 24 19

### MOTOR CONTROL

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Motor control devices, accessories, and general requirements.
  - 2. Manual motor starters.
  - 3. Magnetic motor starters.
  - 4. Variable frequency drives.
  - 5. Motor control centers.
- B. Related Sections and Divisions:
  - 1. Applicable provisions of Division 01 shall govern work in this section.
  - 2. All other sections of Division 26.

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##### 1.02 REFERENCES

- A. ANSI/NEMA ICS 6–Enclosures for Industrial Controls and Systems.
- B. NEMA AB 1–Molded Case Circuit Breakers.
- C. NEMA ICS 2–Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS-18–Motor Control Centers.

- E. NEMA KS 1–Enclosed Switches.
- F. NEMA PB 1–Panelboards.
- G. NEMA PB 1.1–Instruction for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

#### 1.03 QUALITY ASSURANCE

- A. Manufacturers of Motor Control Equipment: Firms regularly engaged in the manufacture of motor control equipment of the types and capacities required whose products have been in satisfactory use in similar service for not less than 10 years.
- B. UL Labels: Provide motor control devices, manual motor controllers, magnetic motor starters, solid-state starters, variable frequency drives, combination motor starters, motor control centers, etc., which have been listed and labeled by Underwriters Laboratories.

#### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Provide product data on motor starters and combination motor starters, VFDs, relays, pilot devices, and switching and overcurrent protective devices.

#### 1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

#### 1.07 COORDINATION

- A. To provide proper coordination between CONTRACTOR, equipment manufacturer, and equipment specified herein, all equipment specified in this section shall have shop drawing submittals provided by equipment manufacturer. This shall include, but not limited to, equipment such as stand-alone VFDs, stand-alone combination starters, and control stations. Drawings for combination starters, VFDs, and motor control equipment shall be specific to the project and factory engineered by equipment manufacturer. Generic drawings from equipment manufacturer will not be accepted as shop drawings or O&M documents.

## 1.08 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year in accordance with GC12.6.

## PART 2-PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Motor control devices, motor starters, variable frequency drives, and motor control centers shall be as manufactured by Square D, Eaton, Allen-Bradley, or equal in accordance with provisions of the General Conditions. All equipment specified in this section and provided by CONTRACTOR shall be by the same manufacturer.
- B. The Drawings and Specifications were prepared based on Square D. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

### 2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS

- A. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts minimum, in addition to seal-in contact, or as necessary.
- B. Push buttons: NEMA ICS 2; heavy-duty, oiltight (30 mm) as specified herein and shown on the Drawings. Pushbuttons in exposed, outdoor locations shall be rated NEMA 4X.
- C. Indicating Lights: NEMA ICS 2; heavy-duty, oiltight (30 mm), LED, push-to-test type as specified herein and shown on the Drawings. Indicating lights in exposed, outdoor locations shall be rated NEMA 4X.
- D. Selector Switches: NEMA ICS 2; heavy-duty, oiltight, (30 mm) as specified herein and shown on the Drawings. Selector switches in exposed, outdoor locations shall be rated NEMA 4X.
- E. Contactors: NEMA ICS 2. All contactors for starters specified herein, including VFD and bypass starters, shall be NEMA rated. IEC contactors are not allowed.
- F. Control Power Transformers: 240/120-volt secondary. Each motor controller shall have a dedicated control power transformer.
- G. Elapsed Time Meters: Redington/Engler 722 series, or equal, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.
- H. Industrial control and power relays shall be installed in motor control centers, pump control panels, and motor controller enclosures where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, alarm lights, alarm horns, field wiring, or loads up to 15 amps shall be industrial, general

purpose square base relays. Relays for lighting circuits or loads greater than 15 amps shall be industrial, electrically held power relays. Relays shall meet the following requirements:

1. Interposing/isolation relays:
    - a. Configuration: SPDT or DPDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC, or as required by System Supplier.
    - d. Contact rating: 8A (DPDT), 16 A (SPDT).
    - e. Operating life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700 HK, or equal.
  2. General purpose relays:
    - a. Configuration: DPDT or 3 PDT as required by system supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC.
    - d. Contact rating: 15 A, minimum; 3/4 hp.
    - e. Operating life: 10 million cycles.
    - f. Status: On-Off flag type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
  3. Power relays.
    - a. Configuration: Electrically-held, 2-12 poles.
    - b. Mounting: DIN rail, square base.
    - c. Voltage: 120 VAC.
    - d. Contact rating: 20 A continuous; 1 hp.
    - e. Operating life: 10 million cycles.
    - f. UL listed.
    - g. NEMA rated.
    - h. Manufacturer: Allen-Bradley, 700-PK, or equal.
  4. All timing relays shall have On and timing Out LEDs. Timing relays shall be Allen-Bradley, 700-HN, or equal
- I. Manufacturer of Accessories:
1. Terminal blocks shall meet the requirements of Section 26 05 19–Wire.
  2. Wire markers shall meet the requirements of Section 26 05 53–Electrical Identification.
- J. All motor control power shall be 120 volts with suitable protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- K. All motor controllers shall be equipped with the auxiliary devices to meet the requirements of the Drawings and Specifications. Each motor controller operating at other than 120-volt, single-phase shall be equipped with a control transformer providing 120-volt secondary for control power. Transformer shall have fused primary and secondary connections and shall be sized per manufacturer's recommendations. Coils and pilot lights in all motor controllers shall be 120 volts.
- L. Enclosures for Stand-Alone Controllers, Starters, and Control Devices:
1. Enclosures in indoor dry locations shall be NEMA 1 gasketed.
  2. Enclosures in indoor damp or wet locations, outdoor locations, or locations below grade shall be NEMA 4X, stainless steel.

3. Starters and disconnect devices for motors shall be installed in common enclosures, combination type, with all accessories such as terminal blocks, push-to-test pilot lights, and H-O-A switches.
4. All wiring within motor controller enclosures shall be landed on terminal blocks. This shall include internal control wiring, field wiring, and any spare or unused wiring.
5. Control stations shall include devices as shown on the Drawings and specified in Section 26 09 00–Controls and Instrumentation.

## 2.03 MANUAL MOTOR CONTROLLERS

- A. Where noted on the Drawings, controllers for motors rated 2 hp or less, for operation at 120 V or 240 V single-phase, shall be specification grade wall switches as specified in Section 26 27 26–Wiring Devices.

## 2.04 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Each magnetic starter shall be equipped with a solid-state overload relay. Starters for submersible pumps, mixers, and motors installed outdoors shall include ground fault protection.
- B. Full-Voltage Starting: Nonreversing type as shown on the Drawings.
- C. Coil Operating Voltage: 120 volts, 60 Hz.
- D. Size: NEMA ICS 2; size based on actual motor nameplate data.
- E. Overload relays without Ethernet communications shall be Allen-Bradley E100, Bulletin 592-1EF, or equal, and have the following features:
  1. Self-powered, solid-state.
  2. Up to 5:1 adjustment range.
  3. DIP switch settings for trip class and reset mode.
  4. Current transformers (no heaters).
  5. Thermal memory.
  6. Ambient temperature compensation.
  7. Visible trip indicators.
  8. Phase loss protection.
  9. Low energy consumption.
  10. Ground fault protection as specified herein.
- F. Overload relays with Ethernet communications shall be Allen-Bradley E300, Bulletin 592-ESM sensing module, 193-EIO control module, 193-ECM communication module, and 193-EXP expansion modules, or equal, and have the following features:
  1. Externally powered, solid-state.
  2. Adjustable trip range and trip class.
  3. Ambient temperature compensation.
  4. True RMS current sensing.
  5. Visible trip indicators.
  6. Integrated I/O and Expansion I/O as required to accommodate all signals included in Section 26 09 90–SCADA System I/O Listing.
  7. High level, external ground fault protection (up to 5 amps).

8. Voltage monitoring, including undervoltage, overvoltage, phase failure, voltage unbalance, phase rotation, and frequency.
  9. Power protection and energy metering, including real power (kW), reactive power (KVAR), apparent power (kVA), and power factor.
- G. Magnetic motor starters in motor control centers shall be combined with magnetic only molded case circuit breakers. Magnetic motor starters in combination motor starters or control panels shall be combined with thermal-magnetic molded case circuit breakers.
- H. Through-the-door overload reset pushbuttons shall be provided for all magnetic starters installed in motor control centers and combination motor starters.

## 2.05 VARIABLE FREQUENCY DRIVES

- A. VFDs shall be provided to match the load type (constant or variable torque) of the specified application, as well as the full load amps of the motor furnished for the project.
- B. System Operating Conditions:
1. 480 VAC  $\pm 10\%$ .
  2. Three-phase, 3-wire, any phase sequence.
  3. 60 Hz  $\pm 2\%$ .
  4. Storage temperature  $-25^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ .
  5. Operating temperature 0 to  $40^{\circ}\text{C}$ .
  6. Altitude: 3,300 feet above sea level maximum.
  7. Humidity: 95% noncondensing maximum.
- C. Variable Frequency Unit:
1. Conform to NEMA and NEC standards.
  2. CSA and ETL approved and/or UL approved.
  3. Overall VFD efficiency shall be a minimum of 96.5%,  $\pm 1\%$ , at 100% speed and motor load at nominal line voltage. Efficiency rating shall include control power supplies, control circuits, and all cooling fans.
  4. Input:
    - a. Withstand without component failure line voltage transients up to 3,000 volts per ANSI C37.
    - b. Design shall include DC bus chokes (two) used in conjunction with one or more capacitors. The DC bus chokes shall be incorporated in the design to minimize line-side harmonics. Magnetic-only designs shall include line filters to limit harmonics to a value no greater than in a system using dual DC bus chokes.
    - c. Include MOV line-side protection.
    - d. Inverter input for six pulse VFDs shall have a true power factor of 0.95 or better at rated load and nominal line voltage throughout the entire speed range.
    - e. Units shall be capable of operating attached to the same power bus without affecting each other's operations. If operational problems occur, an isolation transformer shall be added to each drive at no additional Contract cost.
    - f. Three percent line reactors (drives smaller than 100 hp).
    - g. Drives larger than 40 hp shall include fuses on the drive input. Fuses shall be provided with indicating-type fuse blocks as manufactured by Bussman Model JM60, including see-through covers with integral open fuse indicating lights for each fuse. Fuses 60A and greater are allowed to have integral blown fuse indication and be provided with nonindicating type fuse blocks. Fuses shall be provided for all horsepower sizes for active-front-end VFDs.

- h. Active-front-end VFDs shall meet the following requirements:
  - (1) The drive system shall incorporate an LCL filter mounted in the drive structure as a common assembly to filter up to and including the 50th harmonic.
  - (2) The drive shall use a transistor-based active front end as the input rectifier that uses selective harmonic elimination to mitigate harmonics to meet the latest edition of IEEE 519. Total current harmonic distortion shall not exceed 5% at the VFD input terminals at full load conditions.
  - (3) The active-front-end rectifier shall be phase rotations tolerant and be capable of operating the motor at full load with up to a 10% drop on the input voltage.
- 5. Inverter Output:
  - a. Inverter shall utilize latest generation IGBTs, be microprocessor based, and isolated from power circuits.
  - b. Match motor specified.
  - c. Three-phase, 3-wire.
  - d. Pulse width modulated wave form with selectable Sensorless Vector, Flux Vector, Volts/Hertz, and adjustable voltage control modes.
  - e. Maximum output 460 volts.
  - f. Frequency 2 to 650 Hz.
  - g. Frequency accuracy  $\pm 1\%$  of setting at any point in the specified speed range in a 24-hour period.
  - h. Full load output current shall be rated in excess of the AC motor selected.
  - i. Motor performance:
    - (1) 3% regulation in the manual speed control mode.
    - (2) Normal duty overload rating: 110% continuous current for 1 minute; 150% for 3 seconds.
    - (3) Heavy-duty overload rating: 150% continuous current for 1 minute; 180% for 3 seconds.
    - (4) 110% starting torque minimum.
- 6. AC drive features:
  - a. Embedded I/O for discrete and analog signals. Analog signals shall include 4-20 mA circuitry mounted on separate printed circuit board to include offset, slope, minimum clamp, and separate acceleration and deceleration adjustments from 0 to 3600 seconds. An internal manual speed potentiometer is to be provided for simulating the 4-20 mA input for start-up and maintenance. The circuit is to be designed to accept either a positive or negative signal, grounded or ungrounded.
  - b. Embedded 100BASE-TX Ethernet port supporting the Ethernet/IP protocol (PowerFlex 755-Series only).
  - c. Slot-based architecture for expansion control and communication cards including Ethernet/IP, ControlNet, DeviceNet, Modbus TCP, discrete I/O, and analog I/O.
  - d. Real-time clock with battery for date/time stamping of events.
  - e. Integral thermostat control of door-mounted cooling fans.
  - f. Current limit circuitry: 20% to 160% of drive-rated amps.
  - g. Additional features for constant torque units shall include:
    - (1) IR compensation to provide automatic voltage boost or reduction to optimize both starting torque and system input kW.
    - (2) Slip compensation to provide 0.5% regulation with a 100% load change.
    - (3) Inner current loop regulator.
- 7. Enclosures:
  - a. The VFD system shall be furnished with NEMA-rated (as previously specified) floor-mounting MCC structure or structures. MCC structures shall be 91 1/2 inches

- high by 20 inches deep with a width to accept the unit specified. MCC structure shall incorporate bus where field wiring can be reduced.
- b. Items to be mounted in the VFD structure or structures:
    - (1) Inverter.
    - (2) Incoming door interlocked, thermal-magnetic, molded-case circuit breaker.
  - c. NEMA 4/13 items to be door-mounted on the MCC structure or portion of the structure enclosure:
    - (1) Control devices, pilot lights, selector switches, etc., as shown on the Drawings and specified herein.
    - (2) Interface to the drive shall be via a removable human interface module (HIM) with integral display. This unit shall be a 7-line by 21-character backlit LCD display with graphics capability. HIM shall be used to display drive-operating conditions, fault/alarm indications, and programming information with full text support in multiple languages. The LCD HIM shall be rated IP20/Type 1 and may also be used as a handheld terminal by connecting via a separate cable. The HIM keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog, and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow drive programming or operating functions to be accessed directly without knowledge of programming structure. The HIM unit shall be mounted on the front of the enclosure door so the operator does not have to open the enclosure to access the HIM.
    - (3) Control devices, pilot lights, selector switches, etc., as shown on the Drawings and specified herein.
8. Interlocks:
- a. Fault contact to terminals.
  - b. VFD run contact to terminals.
9. VFD protection:
- a. Adjustable current limit of 20 to 160% minimum.
  - b. Instantaneous overcurrent trip.
  - c. Electronic ground fault and short-circuit protection to shut down the drive without fuse or component failure. Electronic ground- and short-circuit protection to be functional with an input line of 480 VAC  $\pm 10\%$ . The drive manufacturer is to be prepared to demonstrate ground fault and short-circuit protection without the use of an isolation transformer at drive start-up.
  - d. Input thermal-magnetic ambient compensated circuit breaker with a through-the-door interlocked operator.
  - e. Shut down on loss of any input phase for longer than 3 cycles.
  - f. Output phase sequence to be independent of input phase sequence.
  - g. High- or low-sustained voltage.
  - h. 120 VAC grounded control circuits.
  - i. Electrically and/or optically isolated low voltage logic.
  - j. Corrosion protection:
    - (1) Gold-plated plugs (male and female section) on all printed circuit boards.
    - (2) Protective board coating (conformal coating).
  - k. MOV converter protection.
  - l. DC bus chokes to minimize line side current harmonics.
  - m. Additional features for constant torque units:
    - (1)  $I^2T$  protection to provide 150% current for one minute.
    - (2) Regenerative override protection.
10. VFD adjustments:
- a. Maximum speed: 50 to 100%.



- b. Minimum speed: 0 to 70%.
    - c. Current limit: 20 to 110%, 160% on constant torque units.
    - d. Linear acceleration 0 to 3,600 seconds.
    - e. Linear deceleration 0 to 3,600 seconds.
    - f. Output volts/Hz trim.
    - g. Voltage boosts.
    - h. Additional features for constant torque units:
      - (1) Slip compensation.
      - (2) IR compensation.
    - i. All drives shall attempt to restart three times prior to indicating failure.
  - 11. Inverter digital or LED diagnostic features:
    - a. Current limit signal.
    - b. Regenerative override signal.
    - c. External fault (e.g., motor overload).
    - d. Low line voltage.
    - e. High line voltage.
    - f. Current overload.
    - g. High DC bus voltage.
    - h. Current trip.
    - i. Short-circuit.
  - 12. Inverter construction: Modular construction for ease of maintenance.
  - 13. Mount modules on enclosure subpanel:
    - a. Easily accessible from front.
    - b. Interconnect with plugs.
    - c. Construct boards of fire-retardant materials in accordance with NEMA grade FR4 specifications.
- D. Inverter Quality Control:
- 1. Test all power devices at rated temperature and current for dv/dt, tq, TRR, and leakage.
  - 2. Test integrated circuits for programmed parameters at rated temperature.
  - 3. Treat printed circuit boards for corrosion resistance (conformal coating).
  - 4. Provide gold-plated connections at all points where plugs are used.
  - 5. Thermal cycle all printed circuit boards for 10 cycles between 0°C to 65°C prior to installation in inverter.
  - 6. All units to be tested at a rated load and temperature after assembly.
- E. The 6-pulse variable speed drives shall be Square D, or equal. All drives shall be by the same manufacturer.
- F. Drive manufacturer shall provide a dv/dt filter on the output of each drive. Dv/dt filter shall be manufactured by TCI, Model V1K Series, or equal. Dv/dt filter shall be installed in MCC bucket.
- G. Minimum, maximum, and harmonic skip speed setpoints shall be programmed into each VFD. CONTRACTOR shall coordinate these setpoints with the manufacturer of the equipment served. CONTRACTOR shall provide a table listing the minimum, maximum, and skip setpoints programmed into each VFD on the project to ENGINEER and OWNER.
- H. Provide expansion I/O cards, quantity as required, so that signals noted in the I/O list are transmitted/received to/from the plant SCADA System via the Ethernet network.

- I. Provide single-port, 100BASE-TX Ethernet communications module (20-COMM-E) supporting the Ethernet/IP protocol for each drive so that signals noted in the I/O List–Section 26 09 90 are transmitted/received via the plant SCADA System Ethernet network.

## 2.06 COMBINATION MOTOR STARTERS

- A. Magnetic motor starters not installed in MCCs shall be individually mounted as specified herein or noted on the Drawings. Overloads specified herein shall be combined with molded case circuit breakers, and enclosure type shall be as specified herein or noted on the Drawings. Control devices and starter components shall be provided as specified herein or noted on the Drawings.
- B. All combination starters shall be factory assembled, wired, and tested. All internal wiring shall be color-coded and numbered, and each wire shall be terminated on terminal strips. Schematic and wiring layout drawings, following JIC Standards, which show all connections to external devices, a complete bill of materials, and a detailed description of operation shall be submitted for each piece of equipment.
- C. Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.
- D. Nonfusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle lockable in “Off” position.
- E. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle lockable in “Off” position. Fuse Clips: Designed to accommodate Class R fuses.
- F. Combination starters shall be Square D, Eaton, or equal.

## 2.07 MOTOR CONTROL CENTERS

- A. Starters, VFDs, and disconnect devices for motors shall be installed in MCCs except where shown to be remote-mounted at the motor location. Starters and disconnect devices shall be NEMA rated, sized according to application as specified. NEMA Class IIB drawings shall be supplied by the MCC manufacturer.
- B. Color shall be manufacturer standard gray.
- C. Auxiliary contacts shall be of quantity necessary for equipment functions.
- D. MCC design shall be in accordance with latest applicable NEMA standards, shall have been tested to prove adequate mechanical and electrical capabilities, and all major components shall have been individually tested.

E. Ethernet Construction:

1. Each MCC shall have integral Ethernet/IP wiring and network communications incorporated into its construction in the vertical structure assemblies. Industrial Ethernet cable shall be routed through the top, bottom, and vertical wireways to connect each Ethernet-enabled device to the MCC network switch via adapters located in the vertical wireway of each MCC section. Provide a minimum of eight Ethernet ports in each MCC section vertical wireway. The addition or removal of a device from the Ethernet system shall not interrupt the operation of other devices within the system.
2. When there is more than one Ethernet switch in an MCC, the switches shall be connected in a ring at the switch level and utilize a resilient Ethernet protocol to provide a single fault tolerant connection to the plant SCADA System network. The first and last Ethernet switches in the switch ring in the MCC shall be connected to the plant SCADA System network as shown on the Drawings.
3. Provide top or bottom-mounted MCC buckets, locations as shown on the Drawings, to house Ethernet switches with total port quantity as required to accept Ethernet cabling from all Ethernet-enabled devices in the MCC. Ethernet switches shall be as specified in Section 26 09 00-Controls and Instrumentation and shall include a minimum of four spare ports and a dry contact output to indicate switch failure at the SCADA System.
4. Industrial Ethernet cabling in the MCC shall be shielded, 600-volt and power limited tray cable rated, UL listed CAT5e cable. Provide Ethernet cable with length as required for connection to the nearest Ethernet jack located in the vertical wireway for each Ethernet-enabled device.
5. Provide redundant power supplies for 24-volt DC power to all network switches. Each set of redundant power supplies shall be mounted in a dedicated MCC bucket and be powered from the MCC. Minimum power supply rating shall be 8 amps. Provide an interface relay with dry contact to indicate power supply failure for each power supply at the SCADA System. Redundant power supplies shall include a DC buffer unit to bridge power faults without interruption. 24-volt DC shall be routed through the top, bottom, and vertical wireways to connect power to 24-volt DC devices via adapters located in the vertical wireway of each MCC section.
6. Provide a dedicated 24-volt DC DIN rail-mounted UPS in the associated redundant power supplies MCC bucket to provide power to associated components for a minimum of 60 minutes. Provide an interface relay with dry contact to indicate a replace battery alarm at the SCADA System.
7. Provide additional redundant Ethernet power supply and UPS buckets as required to power additional Ethernet switches if required to incorporate all Ethernet-enabled devices shown on the Drawings.
8. Power to overload relays shall be 120-volts AC from the control power transformer in the associated MCC motor controller bucket.
9. In the event that Ethernet communications are lost, equipment shall still be capable of being started using the "Hand" or "On" position of the selector switch on the associated MCC motor controller bucket.
10. The project-specific IP address, Subnet Mask, and Default Gateway shall be set on each Ethernet-enabled device, shall be documented to correspond to equipment labels noted on the Drawings, and shall be printed on a labeling tag located on the inside of each MCC bucket door. Coordinate IP addressing with the Section 26 09 00 System Supplier prior to testing and shipment. Provide a label on both ends of each Ethernet cable indicating the device it serves and an overall legend identifying labeling format.
11. MCC manufacturer shall test the MCC and Ethernet/IP system so that all wiring and devices communicate properly prior to shipment.

- F. Provide industrial Ethernet switches with location, type, and port quantity in dedicated MCC buckets in each MCC as shown on the Drawings. The network switches shall be powered from redundant 24-volt DC power supplies located in the associated building's SCC as specified in Part 3 of Section 26 09 00-Controls and Instrumentation. Power supplies in the SCC shall be powered from the SCC UPS. Provide disconnects for the incoming 24-volt DC power circuits from the SCC and terminal blocks for all field wiring. Provide a label on the front door of the MCC bucket that reads "Network switches are powered from external, UPS-powered, 24-volt DC power supplies located in the SCC."
- G. Structures shall be totally enclosed, dead front, free-standing vertical sections, 90 inches high and not less than 20 inches deep for front-mounted units and not more than 40 inches deep for units mounted back-to-back. Each vertical section shall have side panels extending the full height of the section to minimize fault-propagation to adjacent sections.
- H. Each structure shall contain a main horizontal bus continuously braced within each section, with rating as specified, and vertical bus feeding unit compartments with a minimum rating of 300 amperes, or as necessary for load and feeder breakers. All horizontal and vertical bus of all MCC sections shall be powered regardless of location of transfer switch, unless otherwise noted. All motor control centers shall include a 1/4-inch by 2-inch ground bus. All bus shall be tin-plated copper and braced to withstand short-circuit currents as indicated.
- I. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus, and shall be readily accessible by removal of its cover plate. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference and accessible without disrupting service.
- J. A vertical wireway with a minimum of 28 square inches of cross-sectional area shall be adjacent to each vertical unit compartment and shall be covered by its own door. These vertical wireways shall be free of all live parts and shall contain vertical wireway tie bars. Exceptions to this are as shown on the Drawings.
- K. All units shall be provided with a mechanical interlock with the unit door to prevent access unless the disconnect is in the off position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect.
- L. Padlocking facilities shall be provided to positively lock the disconnect in either the on or off position with from one to three padlocks whether the door is open or closed.
- M. All disconnect operating handles located higher than 6 feet 7 inches above finished floor in the on position (including the MCC pad height) shall be provided with handle extensions. All disconnect operating handles above this height must operate in the vertical direction.
- N. All unit heights shall be of modular dimensions to allow for unit layout, in any combination, without structural interference. Drawout units shall have a tin-plated stab assembly for connection to the vertical bus; no wiring to these stabs shall extend into the bus compartments. All bus access openings shall be provided with automatic shutters that close when the unit (e.g., motor controller or breaker) is withdrawn.
- O. Terminal blocks for NEMA Type B assemblies shall be mounted within the unit and shall be factory-wired. Provide a minimum of 25% spare terminals for all terminal blocks furnished.

- P. Control centers shall be NEMA Class II.
- Q. Wiring in control centers shall be Type B. All conductors supplying power from the MCC bus to frame-mounted equipment shall have the phases identified as specified in Section 26 05 53–Electrical Identification.
- R. Provide neutral landing lugs for all MCCs accepting utility service-entrance conductors. Neutral landing lugs shall be bonded to the ground bus at the utility service entrance, unless otherwise noted.
- S. Control centers shall include NEMA 1 gasketed enclosures, unless otherwise noted.
- T. Remote-mounted controls shall be heavy-duty, oiltight (30 mm) of same quality and type furnished in starters and as shown on the Drawings. Equipment controls that require a manual reset shall be accomplished through a reset push button on the enclosure or MCC bucket for the associated piece of equipment. All reset buttons shall be appropriately labeled, including mechanical type.
- U. MCC enclosures must be in accordance with area designations shown on the Drawings.
- V. All lighting and small power transformers shall be dry type, Class H insulation, DOE 2016 Efficiency rated, 115°C rise (kVA as indicated on Drawings). Coil windings shall be copper, glass-taped, dipped in silicone varnish, with two taps 2 1/2% above and below, 480-volt primary, Delta with 120/240- or 120/208-volt, single- or three-phase, 3- or 4-wire secondary, unless indicated otherwise. Circuit breakers that feed lighting panel transformers shall be provided with electronic sensing, timing, and tripping circuits for adjustable current settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.
- W. All lighting panelboards shall be Square D, Eaton, or equal, with 10,000 amps interrupting capacity, at 120/240- or 120/208-volt, single- or three-phase, 3- or 4-wire with bolt-on branch breakers as shown on the Drawings, unless indicated otherwise. Branch-mounted main circuit breakers will not be allowed. Minimum size shall be 20 inches wide by 5 3/4 inches deep. All bus shall be aluminum. Provide laminated, typewritten panel schedule for all panelboards at project final completion.
- X. All motor control centers shall be factory-assembled, wired, and tested. All internal wiring shall be numbered, and each wire shall be terminated on terminal strips, including internal spares, field wiring, and spare field wires. Schematic and wiring layout drawings following JIC Standards which show all connections to external devices, a complete bill of materials, and a detailed description of operation, shall be submitted for each piece of equipment.
- Y. Arrangement and physical locations of all equipment within each motor control center shall be subject to shop drawing approval.
- Z. All components shall be properly identified with laminated engraved nameplates with 3/8-inch-high letters (white or black). Nameplates located outdoors shall be stainless steel screw on type. Nameplates located indoors shall be adhesive type.
- AA. Unless otherwise indicated, all conduit entrances shall be through the bottom only.
- BB. MCC interrupting rating shall be as shown on the Drawings, minimum 42,000 A.

- CC. The main breaker of each MCC shall be provided with a surge protection device and a three-phase monitor. This surge protection device shall be on the load side of the main and be as specified in Section 26 43 13–Surge Protective Devices. SPD red and green LED indicators, to indicate if one or more modules have reduced protection and if power is present on each phase, shall be displayed on the front of the bucket door. The three-phase monitor shall be on the load side of the main and be Timemark \*269, or equal. CONTRACTOR shall select voltage to match electrical service.
- DD. Each MCC shall be provided with a power meter and appropriately sized metering-class current transformers (CTs) installed on the load side of the MCC main breaker. Provide CT cabling as specified in Section 26 05 23–Instrument and Communication Wire and Cable, for the specified CT accuracy class, minimum 14 AWG. Power meter shall be provided with an Ethernet/IP communications module matching the SCADA System communication protocol so that all readings can be monitored at the SCADA System HMI. Power meter shall be mounted in a dedicated MCC bucket, where shown on the Drawings. The MCC bucket shall be provided with a control power transformer, fused disconnects for the control power circuit and voltage sensing lines, and CT shorting blocks as specified in Section 26 05 19–Wire.
- EE. Main Breaker: Molded case circuit breaker, three-pole, amperes as shown on the Drawings with lugs for 480-volt, three-phase, 4-wire, 60-cycle entrance. Breakers noted on the Drawings shall be GFI and 100% rated. When main breaker is the disconnecting means for a structure, breaker shall be service entrance rated.
- FF. Main, tie, and feeder circuit breakers shall be provided in accordance with the requirements specified in Section 26 28 00–Overcurrent Protective Devices.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Provide motor control equipment in accordance with manufacturer's instructions and Drawings.
- B. Panelboard Installation: In conformance with NEMA PB 1.1.
- C. Provide fuses in fusible switches.
- D. Overloads shall be selected on the basis of nameplate horsepower and service factor. Selection of overloads based on horsepower shown on the Drawings is not acceptable. Where power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current because of improved power factor.
- E. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.
- F. Wireways in MCCs shall be used only for routing of conductors. Splices are not allowed within wireways.

- G. All wiring within MCCs shall be landed on terminals inside buckets or equipment compartments and not left unterminated within wireways. This shall include all internal MCC wiring and external field wiring, including spare wires.
- H. Motor Data: Provide neatly typed label inside each motor controller enclosure identifying motor served, nameplate horsepower, full-load amperes, code letter, service factor, and voltage/phase rating.
- I. Control wiring and field wiring (120 V and below) within MCCs shall be separated from power wiring (277 V and above). Where possible, route control and field wiring in separate raceways or wireways. Provide a minimum of 2 inches separation between control wiring, field wiring, and power wiring.
- J. All motors will be provided by other divisions, ready for connections. CONTRACTOR shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.
- K. Provide motor circuit wiring for each motor from the source of supply to the terminal box on the motor including all intermediate connections at devices such as motor starters, VFDs, disconnect switches, etc.
- L. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits, as specified in Section 26 05 19–Wire.
- M. Provide motor controllers as specified for all motors, unless shown or specified that motor controllers or control equipment will be furnished by others.
- N. Provide motor circuit disconnect devices for all motors, unless shown or specified that disconnect devices or starters are furnished with other equipment.

### 3.02 CONTROL DESCRIPTIONS

- A. Non-Potable Water Pumps No. 1, No. 2, No. 3, and No. 4 (Four Total):
  - 1. H-O-A Selector Switch:
    - a. With the H-O-A selector switch in the “Hand” position the motor shall start and operate. The pump speed shall be manually controlled from the front of the VFD enclosure. The pump shall shut down if motor overtemperature or motor overload conditions are detected.
    - b. With the H-O-A selector switch in the “Off” position the motor shall be inoperable.
    - c. With the H-O-A selector switch in the “Auto” position the motor shall be controlled through Ethernet from PLC-NPW. The pump speed shall be controlled from PLC-NPW through Ethernet.
  - 2. The VFD shall be provided with a Green run indicating light and elapsed time meter.
  - 3. The VFD shall provide an output through Ethernet 000to the plant SCADA system to indicate “Auto” control selected.
  - 4. Motor is provided with a temperature switch that is closed on motor overtemperature. On overtemperature condition, motor shall not operate until condition is reset through a VFD mounted reset pushbutton. VFD shall provide an Ethernet output to the plant SCADA system to indicate motor overtemperature. A Red indicating light mounted on the VFD door shall be energized to indicate motor overtemperature condition.
  - 5. Pump is provided with a seal fail detector. On seal fail condition motor will still continue to operate. VFD shall provide an Ethernet output to the plant SCADA system to

indicate seal fail. An Amber indicating light mounted on the VFD door shall be energized to indicate pump seal fail.

6. The VFD shall provide discrete outputs to the plant SCADA system to indicate pump run, motor OL condition and breaker out of service.

END OF SECTION



## SECTION 26 27 26

### WIRING DEVICES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Wall switches.
  - 2. Receptacles.
  - 3. Cover plates.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NEMA WD 1—General-Color Requirements for Wiring Devices.
- B. NEMA WD 5—Specific-Purpose Wiring Devices.
- C. Drawings—Bill of Materials.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

## PART 2-PRODUCTS

### 2.01 WALL SWITCHES

- A. A-C general use Industrial specification grade, snap switch, 20 amperes, 277 volts, one of the following: Eaton 122\*, Leviton 122\*, or Pass and Seymour PS20AC\*.
- B. Class I Switches: AC general use snap switch, 20 amperes, Crouse-Hinds EDS, or equal.
- C. Provide ivory-colored handles.
- D. Manual motor switches or manual motor controllers for 120 V or 240 V motors on circuits 20 amps or less shall be specification grade snap switch as specified above. Manual motor switches or manual motor controllers for 120-volt, 208-volt, or 240-volt motors and single-pole or two-pole switches for other equipment up to 277 volts on circuits 30 amps or less shall be Eaton 303\*, Leviton 303\*, or Pass and Seymour PS30AC\*. Manual motor switches for three-phase motors 30 amps or less shall be as specified in Section 26 28 16-Disconnect Switches.

\*Complete catalog number for pole arrangement necessary.

- E. Dimmer switches shall be rated for LED, fluorescent, and incandescent use.

### 2.02 RECEPTACLES

- A. Twenty ampere, 125-volt, NEMA 5-20R, Industrial specification grade, straight blade, 3-wire duplex grounded outlets, one of the following: Eaton 5362, Leviton 5362, Pass and Seymour 5362. 208-volt receptacles shall be grounded type, rated same as circuit indicated on the Drawings. Provide ivory color.
- B. Weather-Resistant Receptacle: Weather-resistant receptacles shall include GFCI protection and be UL 498 listed, 20 ampere, 125-volt, NEMA 5-20R, heavy-duty, commercial grade, with WR marking on the face, Eaton WRS GF20, or equal.
- C. Locking-Blade Receptacles: NEMA WD 5.
- D. GFCI Receptacle: GFCI receptacles shall be UL 943 listed, Pass and Seymour 2097, Eaton TRSGF20 receptacle with integral ground fault current interrupter. Provide ivory color.

### 2.03 COVER PLATES

- A. Each and every flush box shall be provided with standard 302 series stainless steel plates, blank, receptacle, switch, or cord as designated by outlet symbol. Surface boxes shall have plates to match Crouse-Hinds, Appleton, or equal, cast boxes.
- B. Thermoplastic ivory cover plates shall be used in all "finished" areas.
- C. NEMA 4X and weatherproof switch covers shall be Thomas and Betts, Industrial Gray, toggle switch cover, Model E98TSCN-CAR, Eaton S2983 or equal.
- D. While in use receptacle covers for exterior use shall be Leviton IUM1V-GY, or equal. Receptacle covers for NEMA 4X locations shall be Leviton 5980, Eaton WIU-1VX, or equal.

- E. Cover plates for manual motor switches, manual motor controllers, and NEC required equipment disconnects shall have provisions for locking the switch in the On or Off position.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Weather-resistant receptacles shall be provided in all damp and wet locations.
- B. GFCI receptacles shall not be series wired.
- C. Install wall switches 48 inches above floor (top of box), "Off" position down, unless otherwise noted.
- D. Install receptacles vertically with the grounding pole on the top and at the heights shown on the Drawings, unless otherwise noted. Heights listed on the Drawings are to the bottom of the box.
- E. Install thermostats 48 inches above floor (top of box).
- F. Install devices and cover plates flush and level.
- G. Back wiring is not allowed for switches and receptacles. Wires shall be terminated with the device screw terminal.
- H. Individual labels shall be placed on the back of all switch faceplates and receptacle faceplates indicating the lighting panel and circuit from which the switch or receptacle is fed. Labels shall be white background with black lettering no smaller than 12-point font. Provide permanently attached self-adhesive type, machine fed, and self-laminating labels, or equal. All labels must be by the same manufacturer, same size, and same font. Handwritten labels are not acceptable.
- I. Individually adjust each occupancy sensor's sensitivity and install sensor shields as required such that the sensor properly serves movement in all areas of the room, but does not energize lighting due to movement in adjacent rooms or due to ambient noise in the space when unoccupied (e.g., noise from pumps, refrigerators, HVAC equipment, servers, etc.). Adjust off-delay timers as required so that sensors operate in a manner that is acceptable to OWNER.

END OF SECTION

## SECTION 26 28 00

### OVERCURRENT PROTECTIVE DEVICES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Provide overcurrent protective devices as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop Drawings and product data in accordance with provisions of Section 01 33 00—Submittals, including electrical ratings, physical size, interrupt ratings, trip curves, I<sup>2</sup>t curves, and manufacturer's detailed specifications.

##### 1.03 QUALITY ASSURANCE

- A. Comply with the following requirements:
  - 1. NFPA 70 National Electrical Code (NEC).
  - 2. Local codes and ordinances.
  - 3. Provide overcurrent protective devices by same manufacturer for each type of device.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Section 01 60 00—Materials and Equipment.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

#### PART 2—PRODUCTS

##### 2.01 CIRCUIT BREAKERS

- A. General:
  - 1. Comply with UL 489 requirements.
  - 2. Provide thermal and magnetic protection unless noted otherwise.
- B. Main and Tie Breakers:
  - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
  - 2. Provide solid-state circuit breakers with electronic sensing, timing, and tripping circuits with adjustable settings. Provide adjustable ground fault pickup and delay settings, adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.

- C. Feeder Breakers:
  - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
  - 2. Solid-State Circuit Breakers:
    - a. Circuit breakers with frame sizes 400 amperes and larger shall be provided with electronic sensing, timing, and tripping circuits with adjustable settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.
    - b. Circuit breakers that feed lighting panel transformers, including transformers installed in MCCs, shall be provided with electronic sensing, timing, and tripping circuits with adjustable settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.
  - 3. Field-Adjustable Thermal-Magnetic Trip Circuit Breaker: NEMA AB1. Provide circuit breakers with frame sizes less than 400 amperes with adjustable instantaneous pickup setting for automatic operation. Range of adjustment shall be three to ten times the trip rating.
  - 4. Field-Changeable Magnetic-Only Ampere Rating Circuit Breakers/Motor Circuit Protectors: UL 489. Provide circuit breakers with frame sizes 200 amperes and larger with changeable trip units.
- D. All lugs shall be rated to accept copper conductors.

## 2.02 ENCLOSURES

- A. Circuit breakers shall be installed within switchgear, switchboard, MCC, panelboard, etc. as shown on the Drawings.
- B. Provide fused switch or circuit breaker with enclosures where required as listed below, unless noted otherwise on the Drawings:
  - 1. Indoor: NEMA 12, steel.
  - 2. Outdoor, corrosive, or wet location: NEMA 4X, stainless steel.

## 2.03 ACCESSORIES

- A. Provide accessories for MCC main and tie breakers as listed below:
  - 1. Auxiliary switch: 120 volts AC DC.
  - 2. Handle lock: Include provisions for padlocking.
  - 3. Provide mechanical trip device.
  - 4. Provide handle extension for all molded case circuit breakers 600 amps and larger.

# PART 3—EXECUTION

## 3.01 INSTALLATION

- A. Install overcurrent protective devices in accordance with manufacturer's recommendations.

### 3.02 ADJUSTMENT

- A. Set and record adjustable settings on circuit breakers to provide selective coordination and proper operation.

END OF SECTION

SECTION 26 28 16  
DISCONNECT SWITCHES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Disconnect switches.
  - 2. Fractional hp motor switches.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NEMA KS 1–Enclosed Switches.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short-circuit.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Disconnect Switches: Square D Class 3110 or Eaton Type DH.
- B. Manual Motor Switches: Square D Class 2510 Type K or Eaton B330.
- C. Substitutions: Under provisions of the General Conditions.

2.02 DISCONNECT SWITCHES

- A. Fusible Disconnect Switches: NEMA KS 1; heavy-duty; quick-make, quick-break, load interrupter enclosed knife switch with externally-operable handle interlocked to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle shall be lockable in “Off” position. Provide fuse clips designed to accommodate Class R fuses, and auxiliary contacts to remove control power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the disconnect manufacturer.
- B. Nonfusible Disconnect Switches: NEMA KS 1; heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally-operable handle interlocked to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this

interlock. Handle lockable in “Off” position. Provide auxiliary contacts to remove control power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the disconnect manufacturer.

- C. Manual Motor Switches: Where noted on the Drawings, manual motor switches shall be provided for three-phase motors with circuit rating of 30 amps, or less. Manual motor switches shall have toggle operator without overload protection or indicator light. Provide cover plate for all switches to meet the finish or classification of the space. Cover plate shall have provisions for locking the switch in the “On” or “Off” position.

#### 2.03 SINGLE-PHASE MOTOR SWITCHES (2 HP OR LESS)

- A. Where noted on the Drawings, motors rated 2 hp or less, for operation on 120 V or 240 V, single-phase, shall be provided with a specification-grade wall switch as disconnecting means. See Section 26 27 26—Wiring Devices for additional information.

#### 2.04 ENCLOSURES

- A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the Drawings:
  - 1. Indoor dry locations: NEMA 12, steel.
  - 2. Outdoor, corrosive, or wet locations: NEMA 4X, stainless steel.
- B. Provide manual motor switch enclosures as listed below, unless noted otherwise on the Drawings. Indoor dry, outdoor, or wet locations: NEMA 4, die cast zinc.

### PART 3—EXECUTION

#### 3.01 INSTALLATION

- A. Provide disconnect switches where indicated on the Drawings. Maximum mounting height shall be 42 inches above finished floor unless noted otherwise, or acceptable to ENGINEER based on field conditions.
- B. Provide fuses in fusible disconnect switches where necessary and in accordance with Section 26 28 00—Overcurrent Protective Devices.
- C. Provide wall switch for each single-phase fractional horsepower motor.
- D. Disconnect enclosures that house wiring powered from a source separate from the motor power wiring (e.g., MAS units, space heaters) shall have a nameplate installed on the front of the disconnect indicating that power may be present at the motor when the disconnect is in the “Off” position.
- E. Wiring within disconnects shall only be for loads or equipment served by that disconnect. Foreign wiring within disconnect enclosures is not allowed. All wiring within disconnect enclosures shall be landed on lugs or terminals provided by the disconnect manufacturer, or on dedicated terminal strips for instrumentation equipment or field devices. Splices and spring wire connectors are not allowed within disconnect enclosures.



- F. Manual motor switches shall not be installed in corrosive and NEMA 4X locations. Provide disconnect switches.

END OF SECTION

## SECTION 26 32 13.1

### STANDBY POWER SYSTEM WEST HICKMAN WWTP

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Steel base assembly, diesel engine, generator, engine-generator set controls, environmental systems.
- B. Related Sections and Divisions:
  - 1. Applicable provisions of Division 01 shall govern work in this section.
  - 2. The following listing of related sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this work. All other sections of Division 26.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop drawings shall include the following:
  - 1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
  - 2. Detailed layouts of all equipment and ancillary items.
  - 3. The manufacturer shall furnish schematic and wiring diagrams for the generator and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.

##### 1.03 QUALITY ASSURANCE

- A. The generator shall be listed by Underwriters Laboratories, Inc., UL2200, and be certified by the Canadian Standards Association.

##### 1.04 OPERATING CONDITIONS

- A. Engine-generator set shall be capable of continuous standby rating at 1,800 rpm, 0.8 PF, three-phase, 3-wire, 480 volts, at 60 hertz, and shall have a minimum capability of 800 kW, 1,000 kVA standby.
- B. The generator set manufacturer shall verify the engine is capable of driving the generator with all accessories in place and operating, at the generator set kW rating after derating for the range of temperature expected in service, and the altitude of the installation. Site conditions are 100°F maximum ambient and 900 feet altitude.
- C. Voltage regulation shall be  $\pm 0.5\%$  of rated voltage for any constant load between no load and rated load.

- D. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed  $\pm 0.5\%$ .
- E. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed  $\pm 0.5\%$  of rated voltage for constant loads from no load to rated load, with constant ambient and operating temperature.
- F. Total Harmonic Distortion: The sum of AC voltage wave-form harmonics shall meet NEMA MG1 and shall not exceed 5% of rated voltage (L-N, L-L, L-L-L), and no single harmonic shall exceed 3% of rated voltage.
- G. Telephone Influence Factor shall be less than 50 per NEMA MG1-22.43.
- H. The engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

#### 1.05 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year in accordance with GC 12.6.

### PART 2-PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. The AC engine-generator set shall be as manufactured by Caterpillar, Cummins Power Generation, or Kohler.
- B. The Drawings and Specifications were prepared based on Caterpillar with a maximum single-step voltage dip less than 15%. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

#### 2.02 STEEL BASE ASSEMBLY

- A. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
- B. The steel base assembly shall be provided with an integral fuel tank with a minimum usable fuel capacity as required to provide a minimum continuous runtime of 24 hours at full load without re-fueling when combined with the existing above ground fuel tank. A fuel gauge shall be mounted within the tank. The fuel tank shall be furnished with a rust preventative coating. The fuel tank shall be pressure tested for a minimum of 2 hours to provide its integrity. The fuel tank shall be UL-142 listed and labeled, and include secondary containment. Fuel tank shall be Kentucky-labeled and manufactured in accordance with the Kentucky Building Code. CONTRACTOR shall obtain tank installation plan review and

written approval from the authority having jurisdiction prior to tank installation. All costs associated with plan approval shall be included in the bid.

- C. Provide a low-level alarm activated at 40% for fuel tank with spare contacts for remote indication. Provide a high-level alarm activated at 90% with spare contacts for remote indication.
- D. Provide a float switch in the rupture basin for remote indication of fuel tank leak.

## 2.03 ACCESS STAIRS AND PLATFORMS

- A. Provide stairway-type access platforms on both sides of the generator as shown on the Drawings. Stairs and platforms shall be designed to support a uniform 100 PSF live load, and shall conform to the requirements of OSHA performance standards for public and industrial applications and the 2015 International Building Code. Platform heights shall be flush with bottom of entrance door frames, be 54 inches wide, and length as required to extend continuously along the side of the generator and for all entrance doors to use the same platform and stairway. Stairway and platform structure shall be aluminum construction with aluminum handrail extended above the platform to meet the requirements of OSHA performance standards for public and industrial applications and the 2015 International Building Code. Stairway and platform walking surfaces shall be molded, fire-resistant, grit-injected, yellow fiberglass grating in a square-mesh pattern. Fiberglass grating shall be as manufactured by McNICHOLS, or equal. Bolt fiberglass grating section together with stainless-steel hardware as required. Generator enclosure shall include corrosion-resistant, stainless-steel hardware as required to rigidly attached stairway and platform structure to generator enclosure.

## 2.04 ENGINE

- A. The engine shall be stationary, liquid-cooled, diesel for use with No. 2 diesel fuel. The design shall be 4-cycle, 8-cylinder, turbo charged, after cooled as required by engine manufacturer. Engine shall be certified as capable of driving the generator of the rating indicated above on a continuous standby basis for the duration of normal source interruptions.
- B. Engine accessories shall include the following:
  - 1. A 24-volt DC electric starter as required by the engine manufacturer.
  - 2. Replaceable dry element air cleaner with restriction indicator.
  - 3. Positive displacement, mechanical, full-pressure lubrication oil pump, full-flow lubrication oil filters with replaceable elements, pressure relief valve, dipstick oil level indicator, and oil drain valve with hose extension. Provide all lubricants for proper operation of the unit.
  - 4. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, and accelerating to rated speed.
  - 5. Engine protective devices to indicate alarm and engine shutdown for the following:
    - a. Low coolant temperature alarm.
    - b. Low coolant level alarm and shutdown.
    - c. Low lubrication oil pressure alarm and shutdown.

- d. High coolant temperature alarm and shutdown.
- e. Over-speed shutdown.
- f. Over-crank shutdown.
- 6. Battery charging alternator, 40 amp minimum, with solid-state voltage regulator.
- 7. Engine shall be radiator-cooled by engine-mounted radiator system including belt-driven pusher fan, coolant pump, and thermostat temperature control. Rotating parts shall be guarded against accidental contact. The cooling system shall be rated for full-rated load operation in a 104°F ambient condition. Provide radiator drain extension to the side of the generator. Extension shall include shutoff valve.
- 8. Provide engine-mounted heat exchangers for use with water cooling. Cooling systems shall be rated for full-load operation. Heat exchangers shall be sized based on a water temperature of 65°F or higher. The generator manufacturer shall fill the cooling system with a 50/50 ethylene glycol/water mixture. Furnish two water solenoids (one for each heat exchanger) to open when the generator receives a start signal. Solenoid valves shall be installed by CONTRACTOR. Furnish a thermostatic control valve/water saver for installation by CONTRACTOR. CONTRACTOR shall provide flexible connections to heat exchangers.
- 9. The equipment supplier shall provide 50% ethylene glycol antifreeze solution to fill engine cooling system.
- 10. Engine-mounted thermostatically controlled coolant heater to aid in quick starting. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104°F in a 40°F ambient, in compliance with NFPA 110 requirements. Heater shall be rated single-phase, 120 volts, 1,000 watts and be disconnected whenever the engine starts. Heater shall be UL 499 listed and labeled. The coolant heater(s) shall include provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. CONTRACTOR shall provide proper circuit from normal utility power source.
- 11. Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.
- 12. Flexible fuel lines, fuel strainer, and fuel solenoid. CONTRACTOR shall install fuel lines and fuel solenoid per manufacturer's recommendations.
- 13. An engine-driven, mechanical, positive displacement fuel pump and fuel filter with replaceable spin-on canister element.
- 14. Flexible supply and return fuel lines.
- 15. The engine shall be provided with all fuel system piping required for automatic operation of the system. All piping shall be black iron and be sized to provide proper fuel flow for the engine. Division 23 shall provide all external supply, return, vent, and fill lines as required and as shown on the Drawings. Provide a check valve in the fuel supply line to prevent drain back of diesel fuel. Provide connections for connecting fuel system to the engine in compliance with applicable codes and regulations. All fuel piping shall be pressure-tested for a minimum of 2 hours.

## 2.05 ENGINE EXHAUST SYSTEM

- A. Exhaust muffler shall be provided for the engine of size as recommended by manufacturer. Muffler shall be of the critical grade-type.
- B. Stainless steel flexible exhaust connections shall be provided as required for connection between engine exhaust manifold and exhaust line in compliance with applicable codes and regulations.

- C. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation to prevent condensation from entering the engine.

## 2.06 BATTERY CHARGER (GENERATORS LARGER THAN 25 KW)

- A. A UL-listed/CSA-certified 10-ampere voltage regulated battery charger shall be provided for the engine-generator set.
- B. Charger shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.
- C. The charger shall be compliant with UL 991 requirements for vibration resistance.
- D. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL labeled with the maximum battery amp-hour rating that can be recharged within 24 hours. The label shall indicate that the charger is suitable for charging of 200 AH batteries in accordance with NFPA requirements.
- E. The charger shall incorporate a 4-rate charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100% of charge, and a float stage to maintain a fully charged battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.
- F. The DC output voltage regulation shall be within  $\pm 1\%$ . The DC output ripple current shall not exceed 1 amp at rated output current level.
- G. The charger shall include the following features:
  - 1. Two-line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming.
  - 2. LED indicating lamps to indicate normal charging (green), equalize charge state (amber), and fault condition (red).
  - 3. AC input overcurrent, over voltage, and under voltage protection.
  - 4. DC output overcurrent protection.
  - 5. Alarm output relay.
  - 6. Corrosive-resistant aluminum enclosure.

## 2.07 STARTING AND CONTROL BATTERIES

- A. A calcium/lead antimony storage battery set of the heavy-duty starting-type shall be provided. Battery voltage shall be compatible with starting system. The battery set shall be capable of a minimum of three 15-second cranking cycles. A battery rack constructed in conformance with NEC requirements and necessary cables and clamps shall be provided.

## 2.08 GENERATOR

- A. The generator shall be a single prelubricated bearing, self-aligning, 4-pole, two-thirds pitch, brushless, synchronous-type, revolving field with amortisseur windings, and with direct driven centrifugal blower fan for proper cooling and minimum noise. No brushes will be

allowed. Generator shall be directly connected to engine fly wheel housing and driven through a flexible coupling to provide permanent alignment. Generator design shall prevent potentially damaging shaft currents.

- B. Insulation shall meet NEMA standards for Class H and shall be UL 1446 listed. The maximum temperature rise shall not exceed 125°C at 40°C ambient.
- C. The generator shall be three-phase, broad-range, reconnectable and shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
- D. The generator set shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5% above or below rated voltage.
- E. Generators over 25 kW shall utilize a permanent magnet generator (PMG) to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single-phase or three-phase fault at approximately 300% of rated current for not more than 10 seconds.
- F. The subtransient reactance of the alternator shall not exceed 15%, based on the standby rating of the generator set.
- G. Provide a 1200-amp mainline circuit breaker with the engine-generator set. Provide a second 600-amp circuit breaker for connection to a remote-mounted or portable load bank. Circuit breaker shall meet the requirements specified in Section 26 28 00—Overcurrent Protective Devices.

## 2.09 ENGINE-GENERATOR SET CONTROL

- A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- B. The generator set-mounted controls shall include the following features and functions for control switches:
  - 1. Mode Select Switch: The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
  - 2. EMERGENCY STOP switch: Switch shall be Red “mushroom-head” pushbutton. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.
  - 3. RESET switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
  - 4. PANEL LAMP switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
- C. Generator Set AC Output Metering: The generator set shall be provided with a metering set including the following features and functions:

1. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current (all three phases), frequency, output current, output kW, kWh, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.
2. The control system shall log total number of operating hours and total kWh, as well as total values since reset.

D. Generator Set Alarm and Status Display:

1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
  - a. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
  - b. The control shall include a flashing red lamp to indicate that the control is not in automatic state and red common shutdown lamp.
  - c. The control shall include an amber common warning indication lamp.
2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. Conditions required to be annunciated shall include:
  - a. Low oil pressure (warning).
  - b. Low oil pressure (shutdown).
  - c. Oil pressure sensor failure (warning).
  - d. Low coolant temperature (warning).
  - e. High coolant temperature (warning).
  - f. High coolant temperature (shutdown).
  - g. High oil temperature (warning).
  - h. Engine temperature sensor failure (warning).
  - i. Low coolant level (warning).
  - j. Fail to crank (shutdown).
  - k. Fail to start/overcrank (shutdown).
  - l. Overspeed (shutdown).
  - m. Low DC voltage (warning).
  - n. High DC voltage (warning).
  - o. Weak battery (warning).
  - p. Low fuel tank (warning).
  - q. High AC voltage (shutdown).
  - r. Low AC voltage (shutdown).
  - s. Under frequency (shutdown).
  - t. Overcurrent (warning).
  - u. Overcurrent (shutdown).
  - v. Short circuit (shutdown).
  - w. Overload (warning).
  - x. Emergency stop (shutdown).
  - y. (4) configurable conditions.
3. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. All contacts shall be rated for 5 amps at 120 VAC. Relays shall be provided when necessary. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.



- E. Engine Status Monitoring:
1. The following information shall be available from a digital status panel on the generator set control:
    - a. Engine oil pressure (psi or kPA).
    - b. Engine coolant temperature (degrees F or C).
    - c. Engine oil temperature (degrees F or C).
    - d. Engine speed (rpm).
    - e. Number of hours of operation (hours).
    - f. Number of start attempts.
    - g. Battery voltage (DC volts).
  2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set.
- F. Engine Control Functions:
1. The control system provided shall include a cycle cranking system which allows for user selected crank time, rest time, and number of cycles. Initial settings shall be for three cranking periods of 15 seconds each, with 15-second rest period between cranking periods and a 75-second overcrank lockout per NFPA 110.
  2. Manual Run/Stop Control Switch: When the mode control switch is in the MANUAL position and the MANUAL RUN/STOP switch is pressed, the Generator set shall start, bypassing time delay start. If the generator set is running in the MANUAL mode, pressing the RUN/STOP switch shall cause the generator set to shut down after a cool-down at idle period.
  3. The control system shall include an engine governor control which functions to provide steady state frequency regulation, as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
  4. The control system shall include sensor failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sensor or wiring components, and an actual failure conditions.
- G. Alternator Control Functions:
1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
  2. A microprocessor-based protection device shall be provided to individually monitor all phases of the output current of the generator set and initiate an alarm (overcurrent warning) when load current exceeds 110% (adjustable) of the rated current of the generator set on any phase for more than 60 seconds (adjustable). The device shall shut down and lockout the generator set when output current level approaches the

thermal damage point of the alternator (overcurrent shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.

3. A microprocessor-based protection device shall be provided to monitor all phases of the output current for short-circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lockout the generator set when output current level approaches the thermal damage point of the alternator (short-circuit shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
  4. Controls shall be provided to monitor the kW load on the generator set and initiate an alarm condition (overload) when total load on the generator set exceeds the generator set rating for longer than 5 seconds (adjustable). Controls shall include a load shed control to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
  5. A microprocessor-based AC over and undervoltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% (adjustable) of the operator-set voltage level for more than 10 seconds (adjustable), or with no intentional delay when voltage exceeds 130% (adjustable). Undervoltage shutdown shall occur when the output voltage of the alternator is less than 85% (adjustable) for more than 10 seconds (adjustable). The system shall monitor individual phases and be connected line to neutral on three-phase 4-wire generator sets and for systems that are solidly grounded.
- H. A common fail contact for remote indication at the SCADA system shall be provided. Two auxiliary generator running contacts shall also be provided for remote indication at the SCADA System and to open the intake and exhaust dampers. All contacts shall be rated for 5 amps at 120 VAC.

## 2.10 WEATHER-PROTECTIVE GENERATOR ENCLOSURE

- A. Generator set weather-protective housing shall be provided factory-assembled to generator set base and radiator cowl. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two-step electrocoating paint process, or equal, meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
1. Primer thickness 0.5 to 2.0 mils. Top coat thickness 0.8 to 1.2 mils.
  2. Gloss according to ASTM D523, 80%  $\pm$ 5%. Gloss retention after 1 year shall exceed 50%.
  3. Crosshatch adhesion according to ASTM D3359, 4B-5B.
  4. Impact resistance according to ASTM D2794, 120-inch pounds to 160-inch pounds.
  5. Salt spray according to ASTM B117, 1000+ hours.
  6. Humidity according to ASTM D2247, 1000+ hours.
  7. Water soak according to ASTM D2247, 1000+ hours.
- B. Painting of hoses, clamps, wiring harnesses, and other nonmetallic service parts shall not be acceptable. Fasteners used shall be corrosion-resistant and designed to minimize marring of the painted surface when removed for normal installation of service work.
- C. The enclosure shall include hinged doors for access to both sides of the engine and alternator and the control equipment. Key locking and padlockable door latches shall be

provided for all doors. All hardware and door hinges shall be stainless steel. All doors shall be provided with door stops to hold them in the open position.

- D. The enclosure shall include flexible coolant and lubricating oil drain lines that extend to the exterior of the enclosure, with internal drain valves and external radiator fill provision.
- E. The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure. Silencer exhaust shall include a raincap and rainshield.
- F. The enclosure shall be insulated with nonhygroscopic materials.

## 2.11 LABELING AND SIGNS

- A. Provide the following warning signs/placards on each of the long sides of the generator enclosure.
  - 1. Flammable Liquids Sign: Sign shall be of a durable material. Sign shall have white lettering on a red background and shall read: "DANGER-FLAMMABLE LIQUIDS." Letters shall be not less than 3 inches in height and 1/2 inch in stroke.
  - 2. No Smoking Sign: Sign shall be of durable material. Sign shall have white letter on red background and shall read: "NO SMOKING WITHIN 25 FEET OF THIS ENCLOSURE." Letters shall be not less than 3 inches in height and 1/2 inch in stroke.
  - 3. Material Placard: Placard shall be of durable material, such as adhesive-backed plastic. Placard shall comply with NFPA 704 Hazard Identification System as to size, information displayed, and color coding.
- B. Sign/placard wording, size, and color shall be approved by the Authority Having Jurisdiction during shop drawing review.
- C. Signs/placards shall be shipped loose for installation by CONTRACTOR.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. The standby power system shall be installed as shown on the Drawings and in accordance with the manufacturer's recommendations and all applicable codes.
- B. Installation of equipment shall include providing all interconnecting wiring between all major equipment provided for the on-site power system. CONTRACTOR shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site. All connections (e.g., fuel, water, electrical) to generator shall be made with flexible material/fitting to accommodate unit vibration.
- D. Equipment shall be initially started and operated by representatives of the manufacturer.
- E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly

cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

- F. Generator fuel storage tank and system shall be installed by a certified installer in accordance with the Kentucky Building Code.
- G. CONTRACTOR shall install signs and placards furnished by the equipment supplier.
- H. CONTRACTOR shall perform an on-site vacuum test of the subbase fuel tank and submit results to ENGINEER, OWNER, and the State Fire Marshall.

### 3.02 FIELD START-UP AND COMMISSIONING

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist CONTRACTOR in installation and start-up of the equipment specified in this section. The manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general operation of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional testing of the system. Upon completion of the manufacturer's start-up and testing, the manufacturer shall generate a Certificate of Proper Installation site start-up and test report, as specified in Section 01 91 00–Starting of Systems, documenting all systems checked, as well as any incomplete work remaining and operational deficiencies.
- C. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal work day (not including start-up) at a job-site location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly and major components within the assembly.
- D. CONTRACTOR shall provide three copies of the manufacturer's site start-up and test report to ENGINEER for review. Once ENGINEER has reviewed the report and all equipment is operating in accordance with the specifications, ENGINEER will make one site visit to check operation of the system. If the system is not ready or does not operate as specified, OWNER shall deduct payment to CONTRACTOR and make payment to ENGINEER for additional travel, expenses, and site visits until the equipment operates as specified. CONTRACTOR shall be responsible for all fuel, and electrical costs required to check operation of the system.

### 3.03 TESTING

- A. In addition to the standard factory tests, there shall be a 4-hour continuous load bank test at the jobsite before connection to load transfer switch, with loads from 10% to 100% of rated capacity to check voltage, frequency, fuel, air cooling, and ventilating systems so that they can be determined adequate for the application. This test shall be accomplished with a portable three-phase resistive load bank. All emergency warning and detection equipment shall be demonstrated to be operable by simulating failures. A signed test report shall be submitted to OWNER and ENGINEER with deficiencies noted, if any. After this test, the generator shall be connected to the plant and the operation and maintenance of the unit comprehensively demonstrated to OWNER. Correct phasing between the engine-generator

and station shall be checked so that it will handle load. A minimum of two power failures shall be simulated.

- B. In addition to the load bank test above, after the unit is connected to the system, three simulated outages and a 4-hour run period on the actual facility shall also be provided.
- C. CONTRACTOR shall be responsible for all fuel costs for these tests.

END OF SECTION

## SECTION 26 32 13.2

### STANDBY POWER SYSTEM TOWN BRANCH WWTP

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Steel base assembly, natural gas engine, generator, engine-generator set controls, environmental systems.
- B. Related Sections and Divisions:
  - 1. Applicable provisions of Division 01 shall govern work in this section.
  - 2. The following listing of related sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this work. All other sections of Division 26.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop drawings shall include the following:
  - 1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
  - 2. Detailed layouts of all equipment and ancillary items.
  - 3. The manufacturer shall furnish schematic and wiring diagrams for the generator and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.

##### 1.03 QUALITY ASSURANCE

- A. The generator shall be listed by Underwriters Laboratories, Inc., UL2200, and be certified by the Canadian Standards Association.

##### 1.04 OPERATING CONDITIONS

- A. Engine-generator set shall be capable of continuous standby rating at 1,800 rpm, 0.8 PF, three-phase, 4-wire, 480 volts, at 60 hertz, and shall have a minimum capability of 300 kW, 375 kVA standby.
- B. The generator set manufacturer shall verify the engine is capable of driving the generator with all accessories in place and operating, at the generator set kW rating after derating for the range of temperature expected in service, and the altitude of the installation. Site conditions are 100°F maximum ambient and 900 feet altitude.
- C. Voltage regulation shall be  $\pm 0.5\%$  of rated voltage for any constant load between no load and rated load.

- D. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed  $\pm 0.5\%$ .
- E. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed  $\pm 0.5\%$  of rated voltage for constant loads from no load to rated load, with constant ambient and operating temperature.
- F. Total Harmonic Distortion: The sum of AC voltage wave-form harmonics shall meet NEMA MG1 and shall not exceed 5% of rated voltage (L-N, L-L, L-L-L), and no single harmonic shall exceed 3% of rated voltage.
- G. Telephone Influence Factor shall be less than 50 per NEMA MG1-22.43.
- H. The engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

#### 1.05 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year in accordance with GC 12.6.

### PART 2-PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. The AC engine-generator set shall be as manufactured by Caterpillar, Cummins Power Generation Model DKA-E, or Kohler.
- B. The Drawings and Specifications were prepared based on Caterpillar with a maximum single-step voltage dip less than 15%. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

#### 2.02 STEEL BASE ASSEMBLY

- A. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

#### 2.03 ACCESS STAIRS AND PLATFORMS

- A. Provide stairway-type access platforms on both sides of the generator as shown on the Drawings. Stairs and platforms shall be designed to support a uniform 100 PSF live load, and shall conform to the requirements of OSHA performance standards for public and industrial applications and the 2015 International Building Code. Platform heights shall be flush with bottom of entrance door frames, be 54 inches wide, and length as required to extend continuously along the side of the generator and for all entrance doors to use the

same platform and stairway. Stairway and platform structure shall be aluminum construction with aluminum handrail extended above the platform to meet the requirements of OSHA performance standards for public and industrial applications and the 2015 International Building Code. Stairway and platform walking surfaces shall be molded, fire-resistant, grit-injected, yellow fiberglass grating in a square-mesh pattern. Fiberglass grating shall be as manufactured by McNICHOLS, or equal. Bolt fiberglass grating section together with stainless-steel hardware as required. Generator enclosure shall include corrosion-resistant, stainless-steel hardware as required to rigidly attached stairway and platform structure to generator enclosure.

## 2.04 ENGINE

- A. The engine shall be stationary, liquid-cooled, natural gas. The design shall be 4-cycle, 6-cylinder, minimum displacement of 14.2 liter, turbo charged, after cooled as required by engine manufacturer. Engine shall be certified as capable of driving the generator of the rating indicated above on a continuous standby basis for the duration of normal source interruptions.
- B. Engine accessories shall include the following:
  - 1. A 24-volt DC electric starter as required by the engine manufacturer.
  - 2. Replaceable dry element air cleaner with restriction indicator.
  - 3. Positive displacement, mechanical, full-pressure lubrication oil pump, full-flow lubrication oil filters with replaceable elements, pressure relief valve, dipstick oil level indicator, and oil drain valve with hose extension. Provide all lubricants for proper operation of the unit.
  - 4. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, and accelerating to rated speed.
  - 5. Engine protective devices to indicate alarm and engine shutdown for the following:
    - a. Low coolant temperature alarm.
    - b. Low coolant level alarm and shutdown.
    - c. Low lubrication oil pressure alarm and shutdown.
    - d. High coolant temperature alarm and shutdown.
    - e. Over-speed shutdown.
    - f. Over-crank shutdown.
  - 6. Battery charging alternator, 40 amp minimum, with solid-state voltage regulator.
  - 7. Engine shall be radiator-cooled by engine-mounted radiator system including belt-driven pusher fan, coolant pump, and thermostat temperature control. Rotating parts shall be guarded against accidental contact. The cooling system shall be rated for full-rated load operation in a 104°F ambient condition. Provide radiator drain extension to the side of the generator. Extension shall include shutoff valve.
  - 8. The equipment supplier shall provide 50% ethylene glycol antifreeze solution to fill engine cooling system.
  - 9. Engine-mounted thermostatically controlled coolant heater to aid in quick starting. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104°F in a 40°F ambient, in compliance with NFPA 110 requirements. Heater shall be rated single-phase, 120 volts, 1,000 watts and be disconnected whenever the engine starts. Heater shall be UL 499 listed and labeled.



The coolant heater(s) shall include provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. CONTRACTOR shall provide proper circuit from normal utility power source.

10. Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.
11. Flexible fuel lines, fuel strainer, and fuel solenoid. CONTRACTOR shall install fuel lines and fuel solenoid per manufacturer's recommendations.

## 2.05 ENGINE EXHAUST SYSTEM

- A. For natural gas generators, engine emissions shall meet current EPA NSPS Compliant capable Gas engine emission regulations. Engines shall be emission-tested and documented EPA Compliant Capable, and all costs associated with any on-site EPA-required emissions testing shall be included in the Bid. Provide EPA-approval documentation to OWNER prior to final completion.
- B. Exhaust muffler shall be provided for the engine of size as recommended by manufacturer. Muffler shall be of the critical grade-type.
- C. Stainless steel flexible exhaust connections shall be provided as required for connection between engine exhaust manifold and exhaust line in compliance with applicable codes and regulations.
- D. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation to prevent condensation from entering the engine.
- E. Provide a suitable rain cap at the stack outlet. Provide all necessary flanges and special fittings for proper installation.

## 2.06 BATTERY CHARGER (GENERATORS LARGER THAN 25 KW)

- A. A UL-listed/CSA-certified 10-ampere voltage regulated battery charger shall be provided for the engine-generator set.
- B. Charger shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.
- C. The charger shall be compliant with UL 991 requirements for vibration resistance.
- D. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL labeled with the maximum battery amp-hour rating that can be recharged within 24 hours. The label shall indicate that the charger is suitable for charging of 200 AH batteries in accordance with NFPA requirements.
- E. The charger shall incorporate a 4-rate charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100% of charge, and a float stage to maintain a fully charged battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.

- F. The DC output voltage regulation shall be within  $\pm 1\%$ . The DC output ripple current shall not exceed 1 amp at rated output current level.
- G. The charger shall include the following features:
  - 1. Two-line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming.
  - 2. LED indicating lamps to indicate normal charging (green), equalize charge state (amber), and fault condition (red).
  - 3. AC input overcurrent, over voltage, and under voltage protection.
  - 4. DC output overcurrent protection.
  - 5. Alarm output relay.
  - 6. Corrosive-resistant aluminum enclosure.

## 2.07 STARTING AND CONTROL BATTERIES

- A. A calcium/lead antimony storage battery set of the heavy-duty starting-type shall be provided. Battery voltage shall be compatible with starting system. The battery set shall be capable of a minimum of three 15-second cranking cycles. A battery rack constructed in conformance with NEC requirements and necessary cables and clamps shall be provided.

## 2.08 GENERATOR

- A. The generator shall be a single prelubricated bearing, self-aligning, 4-pole, two-thirds pitch, brushless, synchronous-type, revolving field with amortisseur windings, and with direct driven centrifugal blower fan for proper cooling and minimum noise. No brushes will be allowed. Generator shall be directly connected to engine fly wheel housing and driven through a flexible coupling to provide permanent alignment. Generator design shall prevent potentially damaging shaft currents.
- B. Insulation shall meet NEMA standards for Class H and shall be UL 1446 listed. The maximum temperature rise shall not exceed 125°C at 40°C ambient.
- C. The generator shall be three-phase, broad-range, reconnectable and shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
- D. The generator set shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5% above or below rated voltage.
- E. Generators over 25 kW shall utilize a permanent magnet generator (PMG) to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single-phase or three-phase fault at approximately 300% of rated current for not more than 10 seconds.
- F. The subtransient reactance of the alternator shall not exceed 15%, based on the standby rating of the generator set.
- G. Provide a 400-amp mainline circuit breaker with the engine-generator set. Circuit breaker shall be 100% rated. Provide a second 400-amp circuit breaker for connection to a remote-mounted or portable load bank. Circuit breaker shall meet the requirements specified in Section 26 28 00—Overcurrent Protective Devices.

## 2.09 ENGINE-GENERATOR SET CONTROL

- A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- B. The generator set-mounted controls shall include the following features and functions for control switches:
  - 1. Mode Select Switch: The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
  - 2. EMERGENCY STOP switch: Switch shall be Red "mushroom-head" pushbutton. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.
  - 3. RESET switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
  - 4. PANEL LAMP switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
- C. Generator Set AC Output Metering: The generator set shall be provided with a metering set including the following features and functions:
  - 1. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current (all three phases), frequency, output current, output kW, kWh, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.
  - 2. The control system shall log total number of operating hours and total kWh, as well as total values since reset.
- D. Generator Set Alarm and Status Display:
  - 1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
    - a. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
    - b. The control shall include a flashing red lamp to indicate that the control is not in automatic state and red common shutdown lamp.
    - c. The control shall include an amber common warning indication lamp.
  - 2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. Conditions required to be annunciated shall include:
    - a. Low oil pressure (warning).
    - b. Low oil pressure (shutdown).
    - c. Oil pressure sensor failure (warning).
    - d. Low coolant temperature (warning).
    - e. High coolant temperature (warning).
    - f. High coolant temperature (shutdown).
    - g. High oil temperature (warning).

- h. Engine temperature sensor failure (warning).
  - i. Low coolant level (warning).
  - j. Fail to crank (shutdown).
  - k. Fail to start/overcrank (shutdown).
  - l. Overspeed (shutdown).
  - m. Low DC voltage (warning).
  - n. High DC voltage (warning).
  - o. Weak battery (warning).
  - p. Low fuel tank (warning).
  - q. High AC voltage (shutdown).
  - r. Low AC voltage (shutdown).
  - s. Under frequency (shutdown).
  - t. Overcurrent (warning).
  - u. Overcurrent (shutdown).
  - v. Short circuit (shutdown).
  - w. Overload (warning).
  - x. Emergency stop (shutdown).
  - y. (4) configurable conditions.
3. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. All contacts shall be rated for 5 amps at 120 VAC. Relays shall be provided when necessary. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

E. Engine Status Monitoring:

1. The following information shall be available from a digital status panel on the generator set control:
  - a. Engine oil pressure (psi or kPA).
  - b. Engine coolant temperature (degrees F or C).
  - c. Engine oil temperature (degrees F or C).
  - d. Engine speed (rpm).
  - e. Number of hours of operation (hours).
  - f. Number of start attempts.
  - g. Battery voltage (DC volts).
2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set.

F. Engine Control Functions:

1. The control system provided shall include a cycle cranking system which allows for user selected crank time, rest time, and number of cycles. Initial settings shall be for three cranking periods of 15 seconds each, with 15-second rest period between cranking periods and a 75-second overcrank lockout per NFPA 110.
2. Manual Run/Stop Control Switch: When the mode control switch is in the MANUAL position and the MANUAL RUN/STOP switch is pressed, the Generator set shall start, bypassing time delay start. If the generator set is running in the MANUAL mode, pressing the RUN/STOP switch shall cause the generator set to shut down after a cool-down at idle period.
3. The control system shall include an engine governor control which functions to provide steady state frequency regulation, as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

4. The control system shall include sensor failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sensor or wiring components, and an actual failure conditions.
- G. Alternator Control Functions:
1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
  2. A microprocessor-based protection device shall be provided to individually monitor all phases of the output current of the generator set and initiate an alarm (overcurrent warning) when load current exceeds 110% (adjustable) of the rated current of the generator set on any phase for more than 60 seconds (adjustable). The device shall shut down and lockout the generator set when output current level approaches the thermal damage point of the alternator (overcurrent shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
  3. A microprocessor-based protection device shall be provided to monitor all phases of the output current for short-circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lockout the generator set when output current level approaches the thermal damage point of the alternator (short-circuit shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
  4. Controls shall be provided to monitor the kW load on the generator set and initiate an alarm condition (overload) when total load on the generator set exceeds the generator set rating for longer than 5 seconds (adjustable). Controls shall include a load shed control to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
  5. A microprocessor-based AC over and undervoltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% (adjustable) of the operator-set voltage level for more than 10 seconds (adjustable), or with no intentional delay when voltage exceeds 130% (adjustable). Undervoltage shutdown shall occur when the output voltage of the alternator is less than 85% (adjustable) for more than 10 seconds (adjustable). The system shall monitor individual phases and be connected line to neutral on three-phase 4-wire generator sets and for systems that are solidly grounded.
  6. The generator set control shall include a 120 VAC control heater.
- H. A common fail contact for remote indication at the SCADA system shall be provided. Two auxiliary generator running contacts shall also be provided for remote indication at the SCADA System and to open the intake and exhaust dampers. All contacts shall be rated for 5 amps at 120 VAC.

- I. Generator control panel shall be mounted a maximum of 5 feet 6 inches above the finished floor equipment pad. CONTRACTOR shall be responsible for all required coordination.

## 2.10 WEATHER-PROTECTIVE GENERATOR ENCLOSURE

- A. Generator set weather-protective housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two-step electrocoating paint process, or equal, meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
  - 1. Primer thickness 0.5 to 2.0 mils. Top coat thickness 0.8 to 1.2 mils.
  - 2. Gloss according to ASTM D523, 80%  $\pm$ 5%. Gloss retention after 1 year shall exceed 50%.
  - 3. Crosshatch adhesion according to ASTM D3359, 4B-5B.
  - 4. Impact resistance according to ASTM D2794, 120-inch pounds to 160-inch pounds.
  - 5. Salt spray according to ASTM B117, 1000+ hours.
  - 6. Humidity according to ASTM D2247, 1000+ hours.
  - 7. Water soak according to ASTM D2247, 1000+ hours.
- B. Painting of hoses, clamps, wiring harnesses, and other nonmetallic service parts shall not be acceptable. Fasteners used shall be corrosion-resistant and designed to minimize marring of the painted surface when removed for normal installation of service work.
- C. The enclosure shall include hinged doors for access to both sides of the engine and alternator and the control equipment. Key locking and padlockable door latches shall be provided for all doors. All hardware and door hinges shall be stainless steel. All doors shall be provided with door stops to hold them in the open position.
- D. The enclosure shall include flexible coolant and lubricating oil drain lines that extend to the exterior of the enclosure, with internal drain valves and external radiator fill provision.
- E. The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure. Silencer exhaust shall include a raincap and rainshield.
- F. The enclosure shall be insulated with nonhygroscopic materials.

## 2.11 LABELING AND SIGNS

- A. Provide the following warning signs/placards on each of the long sides of the generator enclosure.
  - 1. No Smoking Sign: Sign shall be of durable material. Sign shall have white letter on red background and shall read: "NO SMOKING WITHIN 25 FEET OF THIS ENCLOSURE." Letters shall be not less than 3 inches in height and 1/2 inch in stroke.
  - 2. Material Placard: Placard shall be of durable material, such as adhesive-backed plastic. Placard shall comply with NFPA 704 Hazard Identification System as to size, information displayed, and color coding.
- B. Sign/placard wording, size, and color shall be approved by the Authority Having Jurisdiction during shop drawing review.

- C. Signs/placards shall be shipped loose for installation by CONTRACTOR.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. The standby power system shall be installed as shown on the Drawings and in accordance with the manufacturer's recommendations and all applicable codes.
- B. Installation of equipment shall include providing all interconnecting wiring between all major equipment provided for the on-site power system. CONTRACTOR shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site. All connections (e.g., fuel, water, electrical) to generator shall be made with flexible material/fitting to accommodate unit vibration.

### 3.02 FIELD START-UP AND COMMISSIONING

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist CONTRACTOR in installation and start-up of the equipment specified in this section. The manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general operation of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional testing of the system. Upon completion of the manufacturer's start-up and testing, the manufacturer shall generate a Certificate of Proper Installation site start-up and test report, as specified in Section 01 91 00-Starting of Systems, documenting all systems checked, as well as any incomplete work remaining and operational deficiencies.
- C. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal work day (not including start-up) at a job-site location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly and major components within the assembly.
- D. CONTRACTOR shall provide three copies of the manufacturer's site start-up and test report to ENGINEER for review. Once ENGINEER has reviewed the report and all equipment is operating in accordance with the specifications, ENGINEER will make one site visit to check operation of the system. If the system is not ready or does not operate as specified, OWNER shall deduct payment to CONTRACTOR and make payment to ENGINEER for additional travel, expenses, and site visits until the equipment operates as specified. CONTRACTOR shall be responsible for all fuel, and electrical costs required to check operation of the system.

### 3.03 TESTING

- A. In addition to the standard factory tests, there shall be a 4-hour continuous load bank test at the jobsite before connection to load transfer switch, with loads from 10% to 100% of rated capacity to check voltage, frequency, fuel, air cooling, and ventilating systems so that they can be determined adequate for the application. This test shall be accomplished with a portable three-phase resistive load bank. All emergency warning and detection equipment shall be demonstrated to be operable by simulating failures. A signed test report shall be submitted to OWNER and ENGINEER with deficiencies noted, if any. After this test, the generator shall be connected to the plant and the operation and maintenance of the unit comprehensively demonstrated to OWNER. Correct phasing between the engine-generator and station shall be checked so that it will handle load. A minimum of two power failures shall be simulated.
- B. In addition to the load bank test above, after the unit is connected to the system, three simulated outages and a 4-hour run period on the actual facility shall also be provided.

END OF SECTION



## SECTION 26 36 23

### AUTOMATIC TRANSFER SWITCHES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Provide an automatic transfer switch control system where shown on the Drawings.
  - 2. The system shall be a completely integrated assembly for automatic, unattended operation and control of the standby power system. System operation shall be as described in the following sections.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop drawings shall include the following:
  - 1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
  - 2. Detailed layouts of all cubicles and equipment.
  - 3. The manufacturer shall furnish schematic and wiring diagrams for the automatic transfer switch and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.

##### 1.03 QUALITY ASSURANCE

- A. The transfer switch shall be listed by Underwriters Laboratories, Inc. (Std. 1008) and be approved by the Canadian Standards Association.

##### 1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year in accordance with GC12.6.

#### PART 2—PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. The automatic transfer switches shall be as manufactured by Russelectric, 400-amp, 3-pole, or equal.
- B. The Drawings and Specifications were prepared based on Russelectric. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate

other equipment. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

## 2.02 AUTOMATIC TRANSFER SWITCH

- A. Provide two new automatic transfer switches, rated 400 amps at 277/480 volt, 3 phase, 3 pole, 4 wire, 60 Hz. The switch shall be capable of switching all classes of loads and shall be rated for continuous duty, when installed in a non-ventilated enclosure. The switch shall be mounted in a free-standing enclosure as shown on the Drawings.
- B. The complete switch assembly shall be listed under UL-1008 for use on emergency systems.
- C. The transfer switch shall be double throw, actuated by two electrical operators momentarily energized and connected to the transfer mechanism by a simple over-center linkage to provide "quick-make", "quick-break" operation of the contacts when operated electrically or manually. The switch shall provide a time delay in the "Off" position between the opening of the closed contacts and the closing of the open contacts to allow for the demagnetizing of motor and transformer loads. The time delay shall be a minimum of 25 Hz., and shall be adjustable 0-2 minutes. In-phase monitor systems are not acceptable. The manufacturer shall have a minimum of 25 years experience in building off-time switches.
- D. The transfer switch shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.
- E. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Designs relying on electrical interlocks only are not acceptable. Main contacts shall be mechanically locked in position in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver tungsten alloy. Separate arcing contacts, with magnetic blowouts, shall be provided on all transfer switches. Interlocked molded case circuit breakers or contact are not acceptable.
- F. The transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel. the manual operator shall provided the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. Manual operation shall be safe even if the electrical operator becomes energized and shall not require any prior disconnection of operators or control wiring. Safe manual transfer shall be possible under all load conditions, energized or non-energized.
- G. All control wire shall be terminated with locking spade slips and sleeve markers for positive connections and permanent identification. All wiring shall be 600 volt SIS flame-retardant type.
- H. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with Nicad battery back-up.
- I. The CPU shall be equipped with self-diagnostics which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit.

- J. The controller shall use industry standard open architecture communication protocol for high speed serial communications via multidrop connection to other controllers and to a master terminal with up to 4,000 feet of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.
- K. The serial communication port shall allow interface to either the manufacturers or the owner's furnished remote supervisory control.
- L. The switch shall be equipped with the serial communication port.
- M. The controller shall have password protection required to limit access to qualified and authorized personnel.
- N. The controller shall included a 20-character, LCD display, with a keypad, which allows access to the systems.
- O. The controller shall included three phase over/under volt, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.
- P. The controller shall be capable of storing the following records in memory for access either locally or remotely:
  - 1. Number of hours transfer switch is in the emergency position (total since record reset).
  - 2. Number of hours emergency power is available (total since record reset).
  - 3. Total transfer in either direction (total since record reset).
  - 4. Date, time, and description of the last four source failures.
  - 5. Date of the last exercise period.
  - 6. Date of record reset.
- Q. When the voltage on any phase of the normal source drops below 80% or increases to 120% or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contact shall close to start the generating plant.
- R. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.
- S. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source shall fail during this time delay period, the switch shall automatically return to the normal source.
- T. After retransfer to normal, the engine generator shall be allowed to operator at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.
- U. Automatic Transfer Switch Accessories:
  - 1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency.

- Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
2. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
  3. Time delay on override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds, if not otherwise specified.
  4. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.
  5. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 3 seconds.
  6. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
  7. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
  8. A time delay bypass on retransfer to normal shall be included. keypad initiated.
  9. Contact, rated 10 Amps 30 volts DC to close on failure or normal source to initiate engine starting.
  10. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
  11. Light emitting diodes shall be mounted on the microprocessor panel to indicate: switch is in normal position, switch is in emergency position and controller is running.
  12. A plant exerciser shall be provided with ten 7-day events, programmable for any day of the week and twenty-four calendar events, programmable for any month/day, to automatically exercise generating plant programmable in one minute increments, Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad initiated.
  13. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the emergency source has reach 90% of its rated values (switch will remain in normal). In the "commit position" the load will transfer to the emergency position after any normal power failure. Keypad initiated.
  14. Two auxiliary contacts rated 15-amp, 120 volts AC shall be mounted on the main shaft, one closed on normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections.
  15. A three-phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and emergency source.
  16. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
  17. An LCD readout shall display normal source and emergency source availability.
- V. Switches shall be listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3 cycle short circuit closing and withstand as follows:

## RMS SYMMETRICAL AMPERES @ 480 VAC

<u>AMPERES</u>	<u>3 CYCLE CLOSING &amp; WITHSTAND</u>
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400 amp	65,000
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- W. During the 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle test shall be performed without the use of current limiting fuses, and oscillograph traces across the main contacts shall be furnished to verify that contact separation has not occurred, and there is contact continuity across all phases after completion of testing. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories Inc.
- X. When conducting temperature rise tests to UL-1008, the manufacture shall include post-endurance temperature rise test to verify the ability to the transfer switch to carry full rated current after completing the overload and endurance tests.
- Y. Manufacturer shall provide copies of test reports upon request.
- Z. The automatic transfer switch shall be a Russelectric, or equal.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. The installation of this system shall comply with the directions and recommendations of authorized factory representatives. These representatives shall offer the supervision necessary for proper installation.
- B. A final inspection and an initial start-up of the system shall be provided by the factory representatives.
- C. A Certificate of Proper Installation as specified in Section 01 91 00-Starting of Systems, shall be provided by the authorized factory representatives which states that the system is properly installed and does properly function as recommended by the factory and as described herein shall be submitted to ENGINEER.
- D. A test run shall be performed by the authorized factory representatives in the presence of CONTRACTOR and ENGINEER or their representatives; the time of this test run shall be mutually agreed upon by all persons concerned.

### 3.02 START-UP AND TRAINING

- A. CONTRACTOR shall include 8 hours of start-up by a certified, factory-trained engineer. Start-up services shall include, but not be limited to, inspection of CONTRACTOR installation and functional testing of the ATS assembly. On-site time shall be over and above the cost of travel and travel time to the site.
- B. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal workday (not including start-up) at a job site location determined by OWNER.

The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly, simulated outages, and review of major components within the assembly.

END OF SECTION

## SECTION 26 43 13

### SURGE PROTECTIVE DEVICES (SPD)

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Service entrance devices.
  - 2. Distribution panel devices.
  - 3. Local panel devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/IEEE C62.41 and C62.45.
- B. NFPA 70, and 75.
- C. UL 1449, most recent issue.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of SPDs. Firms regularly engaged in the manufacture of these products of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide surge protective devices which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1. Test reports

certified by the manufacturer shall be provided to ENGINEER upon request for each model submitted.

#### 1.05 WARRANTIES

- A. Manufacturer shall provide a minimum 10-year warranty from the date of substantial completion to cover repair or replacement of the device.

### PART 2-PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. The Drawings and Specifications were prepared based on MCG. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, upsizing overcurrent protective devices to meet manufacturer recommendations. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

#### 2.02 GENERAL

- A. These specifications describe the electrical and mechanical requirements for high energy SPDs.
- B. The system individual units shall be UL listed under UL1449, latest edition, Standard for Surge Protective Devices (SPD). Surge ratings shall be permanently affixed to the SPD.
- C. Operating Temperature: Operating temperature range shall be -40 to +55°C (-40 to 131°F).
- D. Storage Temperature: Storage temperature range shall be -40 to +85°C.
- E. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% noncondensing relative humidity.
- F. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.
- G. Design Life: >15 years.
- H. Operating Voltage: Maximum continuous operating voltage shall be no less than 115% of the nominal rated line voltage.
- I. Power Frequency: SPD power frequency shall be rated for use on 50 and 60 Hertz power systems.
- J. All SPDs shall be MOV type. Noise filtering capabilities shall be provided as an option for the devices specified herein.

#### 2.03 SERVICE ENTRANCE DEVICES

- A. The maximum surge current capacity of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least 160 kA per phase. The surge life (8/20) shall



be at least 6 kA for 10,000 occurrences or 10 kA at 20 kV for 16,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a nominal discharge rating ( $I_n$ ) of 10 kA.

- B. The SPD shall have a minimum Short Circuit Rating (SCCR) of 100 KAIC. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
- C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the manufacturer's installation notes for best performance.
- D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple fuse protected metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector shall provide redundant protection within each phase module with multiple surge rated fuses per module or one fuse per MOV.
- E. Red and green solid-state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.
- F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Surge protected normally open and normally closed contacts shall be provided.
- G. The system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.
- H. The SPD shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-2002 location Category C3 environments. Testing shall be per ANSI/IEEE C62.45-2002 using ANSI/IEEE C62.41 Category C3 waveforms and amplitudes.
- I. A 14 gauge, NEMA Type 4, steel enclosure, with corrosion-resistant hardware shall be provided for the unit. Unless otherwise noted, SPDs installed within distribution or control equipment enclosures do not require a separate enclosure.
- J. Service entrance devices shall be as manufactured by MCG 160M Series, Square D EMA/IMA Series, Eaton SPD Series, or equal.
- K. SPD shall be suitable for use in Type 2 locations.
- L. Unit shall provide maximum ANSI/UL 1449 VPRs for 480Y/277-volt, three-phase systems.
  - 1. L-N = 1500 V.
  - 2. L-G = 1500 V.
  - 3. N-G = 1200 V.

4. L-L = 2500 V.

M. Unit shall provide maximum ANSI/UL 1449 VPRs for 480-volt, three-phase systems.

1. L-G = 1800 V.

2. L-L = 2000 V.

## 2.04 DISTRIBUTION PANEL DEVICES

- A. The maximum surge current capacity per phase of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least 120 kA per phase. The surge life (8/20us) shall be at least 4 kA for 10,000 occurrences or 10 kA at 20 kV for 16,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a nominal discharge rating ( $I_n$ ) of 10 kA.
- B. The SPD shall have a minimum SCCR of 100 KAIC. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
- C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the installation notes.
- D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple (minimum of two) metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector will provide redundant protection within each phase module with multiple surge rated fuses per module or one fuse per MOV.
- E. Red and green solid-state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.
- F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Surge protected normally open and normally closed contacts shall be provided.
- G. The specified system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.
- H. The SPD shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-2002 location Category B3 environments. Testing shall be per ANSI/IEEE C62.45-2002 using ANSI/IEEE C62.41 Category B3 waveforms and amplitudes.
- I. A 14-gauge enclosure, NEMA Type 4 steel, with corrosion-resistant hardware shall be provided. Unless otherwise noted, SPDs installed within distribution or control equipment enclosures do not require a separate enclosure.

- J. Branch panel devices shall be as manufactured by MCG 120M Series, Square D EMA/IMA Series, Eaton SPD Series, or equal.
- K. SPD shall be suitable for use in Type 2 locations.
- L. Unit shall provide maximum ANSI/UL 1449 VPRs for 480Y/277-volt, three-phase systems.
  - 1. L-N = 1500 V.
  - 2. L-G = 1500 V.
  - 3. N-G = 1200 V.
  - 4. L-L = 2500 V.

## 2.05 LOCAL PANEL DEVICES

- A. The maximum surge current capacity per phase of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least 40 kA, the surge life (8/20 us) shall be at least 2 kA for 10,000 occurrences or 10 kA at 20 kV for 16,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a Nominal Discharge rating ( $I_n$ ) of 5 kA.
- B. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the installation notes for best performance.
- C. The suppressor shall be fused and constructed of multiple metal oxide varistors.
- D. An illuminated green solid-state LED indicator shall be provided on the front cover for each phase to indicate protection is present at the device on all phases.
- E. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Surge protected normally open and normally closed contacts shall be provided.
- F. The SPD shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-2002 location Category B3 environments. Testing shall be per ANSI/IEEE C62.45-2002 using ANSI/IEEE C62.41 Category B3 waveforms and amplitudes.
- G. Local panel devices shall be as manufactured by MCG Model PT40 Series, or equal.
- H. Unit shall provide maximum ANSI/UL 1449 VPRs for 240/120-volt, single-phase systems.
  - 1. L-N = 800 V.
  - 2. L-G = 1500 V.
  - 3. N-G = 700 V.
  - 4. L-L = 1500 V.
- I. Unit shall provide maximum ANSI/UL 1449 VPRs for 208Y/120-volt, three-phase systems.
  - 1. L-N = 800 V.
  - 2. L-G = 1500 V.
  - 3. N-G = 700 V.
  - 4. L-L = 1500 V.
- J. Unit shall provide maximum ANSI/UL 1449 VPRs for 480Y/277-volt, three-phase systems.
  - 1. L-N = 1200 V.

2. L-G = 2500 V.
3. N-G = 1200 V.
4. L-L = 2500 V.

### PART 3—EXECUTION

#### 3.01 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation and maintenance instructions and all national and local codes.
- B. Each installed device shall be fed by an appropriately sized circuit breaker, per the manufacturer's installation notes, in the protected panel. No SPD shall be installed without an upstream overcurrent device.
- C. Units shall be installed as close as practical to the electrical panel. Low impedance cabling furnished by the manufacturer shall be utilized for installations with lead lengths greater than, or equal to, 5 feet. Low impedance cabling furnished by the manufacturer or appropriately-sized standard cable, if acceptable to ENGINEER, may be utilized for installations with lead lengths less than 5 feet. SPD leads shall be as short as possible.

END OF SECTION

## SECTION 26 51 13

### LIGHTING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes a complete functional lighting system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. Underwriters Laboratories: Lighting fixtures shall be manufactured in accordance with the standards of the Underwriters Testing Laboratories and shall bear the UL label where practicable. In all cases the lighting fixtures shall be constructed with UL listed components.
- B. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electrical Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, and other applicable regulations.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.
- E. Lighting Standards:
  - 1. LM-79-08 or latest—IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
  - 2. LM-80-08 or latest—IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
  - 3. NEMA SSL 1-2016 or latest—Electronic Drivers for LED Devices, Arrays, or Systems.
- F. Fire Codes: Where necessary to meet Code requirements, enclosure housings shall be constructed to provide a 1-hour fire rating.

##### 1.03 SYSTEM DESCRIPTION

- A. Intent: It is the intent of these specifications to obtain a completed lighting fixture and lighting controls installation by CONTRACTOR. Completed means cleaned, adjusted, tested, and ready for occupancy and operation in accordance with the above-indexed paragraphs and in accordance with the other sections of these Contract Documents. It is the responsibility of CONTRACTOR to point out discrepancies, errors, and other problems.
- B. All lighting fixtures are to be provided complete with all necessary accessories for a proper installation. Catalog numbers shown are basic fixture types, and additional features,

accessories, and options specified, scheduled or required, are to be included for all fixtures provided.

#### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals. Shop drawings shall include, but not be limited to, the following:
  - 1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall and detail dimensions, finishes, prefinishes, metal thickness, fabrication methods, support method, ballasts, drivers, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents.
  - 2. Installation instructions.
  - 3. Certified photometric test data and reports.
  - 4. Shop drawings shall not only clearly indicate the assigned fixture type, but also the equipment location.
  - 5. Submittal should include, but not be limited to, wattage, lumen output, color temperature, and CRI value.

#### 1.05 QUALITY ASSURANCE

- A. Standards: Materials, equipment, and parts, as well as workmanship provided under this section, shall conform to the highest commercial standard as specified and as indicated on Drawings. Fixture parts and components not specifically identified or indicated shall use materials most appropriate to their intended use or function and as such be resistant to corrosion and thermal mechanical stresses encountered in the normal application and function of the fixtures.
- B. Measuring and Testing Equipment: CONTRACTOR shall have available at all times, instruments for the measurement of voltage, luminaire temperature, lighting level, and fixture brightness level.
- C. Manufacturers: Firms regularly engaged in the manufacture of lighting fixtures of the types and ratings for the project, whose products have been in satisfactory use in similar service for not less than 5 years.
- D. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices, and components necessary for the proper operation of the equipment.
- B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.
- C. Timely Purchasing: Luminaires and other appurtenances shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

## 1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year in accordance with GC 12.6.

## PART 2-PRODUCTS

### 2.01 LED LUMINAIRES

- A. LED Luminaires shall meet the following technical requirements:
  - 1. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
  - 2. Luminaire efficacy shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
  - 3. Luminaire Color Rendering Index (CRI) shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings; a minimum of 80 for interior luminaires and a minimum of 70 for exterior luminaires.
  - 4. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
  - 5. Luminaire lumen output shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
  - 6. Wattage shall be equal to that of the fixture model numbers shown in the fixture schedule on the Drawings.
  - 7. Luminaire color temperature shall match that of the fixture model numbers shown in the fixture schedule on the Drawings.
- B. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- C. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- D. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- E. Luminaire and driver shall be provided from a single manufacturer to promote compatibility.
- F. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10%.
- G. Luminaire shall have a maximum Total Harmonic Distortion (THD) of  $\leq 20\%$  at full input power and across specified voltage range.

### 2.02 LAMP HOLDERS

- A. Fluorescent Sockets: Fluorescent lamp sockets operating with an open-circuit voltage in excess of 300 volts shall be of the safety type that open the supply circuit when the lamp is removed from the sockets.
- B. All fluorescent fixtures installed that have no glass or metal enclosure shall be equipped with safety-type lamp holders so that lamps shall not become dislodged from the holders.

## 2.03 WIRING

- A. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified in Section 26 05 19—Wire.
- B. Wiring within fixture construction shall be concealed, except where the fixture design or mounting dictates otherwise.
- C. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear.
- D. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

## 2.04 LED DRIVERS

- A. General:
  - 1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated in the model numbers in the fixture schedule shown on the Drawings.
  - 2. Driver shall have a minimum rated life of 50,000 hours.
  - 3. Driver shall have a minimum power factor of 0.9 and a maximum crest factor of 1.5 at full input power and across the specified voltage range.
  - 4. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
  - 5. Driver shall have a maximum Total Harmonic Distortion (THD) of  $\leq 20\%$  at full input power and across specified voltage range.
  - 6. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
  - 7. Fuse Protection: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected per Class 2 UL listing.
  - 8. All fixtures located outdoors shall be provided with surge protection.
- B. Dimming Drivers:
  - 1. LED driver shall be compatible with dimming controls where dimming is indicated on the Drawings.
  - 2. Step-Dimming Drivers: One switch-leg input shall control 40% of the luminaire's light output equally, and two switch-leg inputs shall control 100% of the luminaire's light output.
  - 3. Continuous Dimming Drivers: LED luminaires shall dim without visible flicker and buzzing/noise. Continuous Dimming Drivers shall use 0-10 VDC control.

## 2.05 MARKING OF FIXTURES

- A. Voltage Identification: Fixtures designed for voltages other than 110- to 125-volt circuits shall be clearly marked.

## 2.06 FIXTURE TRIMS

- A. Trim Details: Provide trim details as shown on the Drawings or as specified. The trim finish and dimensions are subject to the shop drawing approval of ENGINEER. Mitered corners shall be smoothed before shop finish is applied. No lapping of trim metal for all flush-mounted ceiling trims for rectangular or square recessed fixtures.



## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install fixtures, lenses, etc., after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the complete spaces. All glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.
- B. All wall-mounted fixtures and all ceiling-mounted surface fixtures including exit lights, shall be fed through a fixture Stud/Hickey/Nipple assembly and with provisions to prevent fixture turning.
- C. All exterior wall-mounted fixtures shown over doorways shall be mounted centered, 6 inches above doorway, unless otherwise noted.
- D. All fixtures shall be securely and adequately supported and installed. Recessed lighting fixtures in suspended ceilings or in plaster ceilings shall have channel and supports provided by CONTRACTOR. CONTRACTOR shall provide plaster frames. Fixture shall be supported from structure and not from ceiling.
- E. Surface- or pendant-mounted fixtures shall be attached to and supported from structural part of the building in a manner acceptable to ENGINEER. Fixtures shall be supported by not fewer than two supports for each fixture. Where fixtures are to be suspended, they shall be mounted on steel channel with the channel supported directly from the structure by a minimum of 3/8-inch rod inside rigid conduit stems. Any fixture which has an individual fixture weight of greater than 25 pounds shall have safety cable installed, in addition to other support means. Cable shall be 3/16-inch airplane cable. All fittings and connectors shall be compression type. Cables must be secured to the building structure and to a point or points on the fixture to protect against falling parts.
- F. Industrial-type fixtures in unfinished areas which are near obstructions such as ducts and pipes shall be suspended so that the bottom of the fixture is no higher than the bottom of the obstruction. All fixtures in each room shall be located at the height of the lowest fixture, but not lower than 8 feet 0 inch above the finished floor. Fixtures shall not be located until the locations of these obstructions are determined, and fixtures shall be accessible after the installation of other equipment.
- G. Recessed fixtures in suspended ceilings shall have final connections made up of a length of flexible conduit not in excess of 6 feet, with THHN conductors and a green ground conductor.
- H. Provide inscription for exit and area of rescue assistance signs to conform to codes.
- I. Metal decking shall not be pierced for fixture support.
- J. All fixture whips shall be constructed of minimum No. 12 AWG conductors.

### 3.02 SUPPORTS

- A. Mounting Frames: Provide mounting frames (plaster frames for example), as necessary, for installation and as required under other sections. Frames shall be finished matte white baked enamel unless otherwise noted.

- B. Mounting Accessories: Provide bars, angles, or other supporting devices for all recessed fixtures. Fixtures shall be securely attached to prevent movement up, down, or sideways. Fixtures shall be mounted to permit access to wiring. Fastening devices shall be of a positive, locking type, and shall not require the use of special tools to apply or remove. Tie wires shall not be used in place of fastening devices.
- C. CONTRACTOR Responsibility: CONTRACTOR shall verify all ceiling conditions from the Drawings and provide appropriate mounting accessories for each lighting fixture.
- D. Pendant Mounting: Provide pendant- or surface-mounted fixtures with required mounting accessories, including hickey, stud extensions, ball aligners, canopies, and stems. Coordinate locations of fixtures in mechanical areas. Provide mounting stems on pendant fixtures of the correct length to uniformly maintain the fixture heights shown on the Drawings, or established in the field.
- E. Adequate rigid, sturdy support shall be provided to prevent the possibility of fixture falling. Surface and pendant fixtures must be supported with two supports per 4-foot section, except that continuous 8-foot sections shall have three supports. All pendants must have swivel aligners located at the top ends; pendants shall be minimum 3/8-inch threaded rod inside 3/4-inch rigid steel conduit, unless specifically indicated otherwise on the Drawings, pendant supports shall be painted on jobsite. Support surface-mounted fixtures from structural members other than ceiling tees by providing Unistrut members spanning main ceiling tees or by mounting directly to structure.

### 3.03 ADJUSTMENT

- A. Focusing/Adjustment: After the installation of lighting fixtures is completed, fixtures so requiring (both interior and exterior units), shall be adjusted after dark under the observation of OWNER.

### 3.04 CLEANING

- A. Installation Sequence: Lighting fixture mounting frames, plaster rings, etc., shall be installed prior to the finishing assembly which shall not be installed until the Project is at Final Completion. When the fixture location or construction prevents sequential installation, CONTRACTOR shall carefully protect all reflectors, lenses, flanges, and other visible surfaces.
- B. Cleaning: Before final acceptance by OWNER, all protective (strippable) coatings, dust, finger marks, paint spots, and any other materials deleterious to the appearance or functioning of the lighting fixtures must be removed. Abrasive cleaners are not permitted.

### 3.05 FINAL INSPECTION

- A. Upon completion of the installation, lighting equipment must be in first-class operating order and free from defects in condition and finish:
  - 1. Fixtures shall be completely clean and free from finger marks, dust, plaster, or paint spots.
  - 2. Any reflectors, lenses, diffusers, side panels, or other parts damaged prior to the final inspection, shall be replaced at no expense to OWNER.

3. Housing shall be rigidly installed and adjusted to a neat flush fit with the ceiling.

END OF SECTION

## SECTION 26 56 29

### EXTERIOR LIGHTING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Exterior lighting fixtures, poles, and controls as shown on the drawings and in schedules.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. Manufacturers: Firms regularly engaged in the manufacture of exterior lighting of the types and rating for the project, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with exterior lighting work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.
- E. Lighting Standards:
  - 1. LM-79-08 or latest–IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
  - 2. LM-80-08 or latest–IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
  - 3. NEMA SSL 1-2016 or latest–Electronic Drivers for LED Devices, Arrays, or Systems.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals. Shop drawings shall include, but not be limited to, the following:
  - 1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures, including overall and detail dimensions, finishes, prefinishes, metal thickness, fabrication methods, support method, ballasts, drivers, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents. Manufacturers' catalog cut sheets will not be acceptable. Submittal should include, but not be limited to, wattage, lumen output, color temperature, CRI value, and certified photometric test data and reports.
  - 2. Product data for all light poles, luminaire arms, and all accessories.

3. Manufacturer's dimensioned scale drawings of all light pole assemblies showing in complete detail the fabrication of all lighting fixtures together with light poles, arms, and all accessories.
4. Product data and wiring diagrams for all lighting controllers. Wiring diagrams shall include a detailed bill of materials, load center circuit schedule, controller short circuit interrupt rating, interior panel wiring schematic showing all control devices, circuit breakers, lighting contactors, and all accessories specified herein along with terminations, and interior and exterior panel elevations.

#### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver exterior lighting fixtures individually wrapped in factory-fabricated fiberboard-type containers.
- B. Handle exterior lighting fixtures and poles carefully to prevent breakage, denting, and scoring the fixture finish. Do not install damaged lighting fixtures and poles; replace and return damaged units to equipment manufacturer.
- C. Store exterior lighting fixtures in a clean, dry space. Store in original cartons and protect from dirt, physical damage, weather, and construction traffic.

#### 1.05 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year in accordance with GC 12.6.

### PART 2-PRODUCTS

#### 2.01 MATERIALS

- A. The Drawings and Specifications were prepared based on the light fixtures and pole types shown in the fixture schedule on the Drawings. The scheduled equipment shall be considered as establishing the type, function, appearance, and quality required. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate equipment deviating from the scheduled equipment including, but not limited to, photometric analysis and structural and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.
- B. All material requests deviating from the scheduled equipment shall show conformance with the following design and performance criteria:
  1. LED light fixtures shall provide illumination meeting the lighting design criteria as shown on the Drawings for each portion of the project area. Illumination criteria include, but are not limited to, minimum average maintained illuminance, minimum foot-candle level at any point, and average to minimum uniformity ratio.
  2. LED light fixtures shall be mounted on poles matching the heights shown on the Drawings and at the locations shown on the Drawings with no additional light fixtures or poles.
  3. LED light fixtures shall meet the material requirements described in Part 2.

4. LED light fixtures shall have similar aesthetics to the scheduled equipment and shall be subject to OWNER approval.
- C. The following information shall be submitted for review if CONTRACTOR chooses to provide LED light fixtures deviating from the scheduled equipment:
  1. A computer-generated photometric layout demonstrating the LED light fixture's ability to meet the performance criteria described herein and shown on the Drawings from the pole locations shown on the Drawings with no additional light fixtures or poles. Layout shall be generated using AGI32 software by Lighting Analysts. Submit all correction factors applied to photometric calculations including, but not limited to, luminaire dirt depreciation, lamp lumen depreciation, and total light loss factor.
  2. A photometric report in IES format by Independent Testing Laboratories for each light fixture.

## 2.02 LED LUMINAIRES

- A. LED Luminaires shall meet the following technical requirements:
  1. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
  2. Luminaire efficacy shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
  3. Luminaire Color Rendering Index (CRI) shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings; a minimum of 80 for interior luminaires and a minimum of 70 for exterior luminaires.
  4. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
  5. Luminaire lumen output shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
  6. Wattage shall be as shown in the fixture schedule on the Drawings.
  7. Luminaire color temperature shall match that of the fixture model numbers shown in the fixture schedule on the Drawings.
- B. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- C. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- D. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- E. Luminaire and driver shall be provided from a single manufacturer to promote compatibility.
- F. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10%.
- G. Luminaire shall have a maximum Total Harmonic Distortion (THD) of  $\leq 20\%$  at full input power and across specified voltage range.

## 2.03 LIGHT POLES

- A. Provide light poles and luminaire arms with model numbers as shown in the fixture schedule on the Drawings. Coordinate final light pole, arm, and luminaire color selections with OWNER and ENGINEER prior to shop drawing submittals. Verify luminaire arm orientations with light pole installation locations shown on the Drawings. Pole color shall match fixture color.

- B. Light poles shall include handholes with access cover fastened with stainless steel bolts or stainless steel screws.
- C. Light poles shall include provisions to accept grounding conductor sized as shown on the Drawings. Grounding lug shall be accessible from the handhole described above.
- D. CONTRACTOR shall confirm that each light pole and luminaire arm supports the proposed weight and effective projected area of the luminaire to be installed.
- E. Provide vibration dampeners inside light poles as recommended by the light pole manufacturer.
- F. Provide concrete light pole bases as shown on the Drawings. Coordinate light pole base plate bolt pattern with CONTRACTOR before concrete base installation. Provide bolt covers to prevent anchor bolt exposure to the elements.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Provide exterior lighting poles and fixtures of the types indicated, where shown on the drawings and at the indicated heights, in accordance with the fixture manufacturer's written instructions and with recognized industry practices. Comply with NEMA Standards and requirements of the National Electrical Code pertaining to installation of exterior lighting fixtures, and with applicable portions of NECA's "Standard of Installation."
- B. Entire exterior lighting assembly, including fixtures and poles, shall be capable of withstanding sustained winds of 100 mph.
- C. Fasten fixtures securely to concrete bases as shown on the Drawings and check so that fixtures are plumb and level and installed at the mounting heights shown on the Drawings without interference.
- D. Provide minimum 20 feet of wire slack in lighting control cabinets, 10 feet in pull boxes and handholes, and 3 feet at entrance to and exit from a light pole.

#### 3.02 ADJUST AND CLEAN

- A. Clean exterior lighting fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during the remainder of the construction period.

#### 3.03 FIELD QUALITY CONTROL

- A. When the exterior lighting system is installed and energized, demonstrate system functionality and performance after dark under the observation of OWNER and ENGINEER.
- B. CONTRACTOR is responsible to provide all testing equipment and after-hours labor as required to demonstrate that the exterior lighting installation provides the lighting design criteria shown on the Drawings. Installations that do not meet the design criteria shall be modified at no additional cost to OWNER until the design illuminance criteria are demonstrated.

- C. Coordinate photocell and timeclock activation settings with OWNER and ENGINEER.
- D. Malfunctioning or underperforming luminaires shall be replaced with new units.

END OF SECTION



## SECTION 31 23 00

### EXCAVATION, FILL, BACKFILL, AND GRADING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Excavating, filling, backfilling, and grading for this work includes, but is not necessarily limited to:
  - 1. Excavating for footings, foundations, roads, utilities, sidewalks, driveways, parking lots, restoration, and miscellaneous areas.
  - 2. Furnishing and placing all fill and backfill.
  - 3. Provide compaction of all fill and backfill.
  - 4. Rough and finish grading prior to paving, seeding, etc.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Allowances:
  - 1. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 100 cubic yards of unsuitable foundation material for structures and roads as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for structures and roads will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 100 cubic yards) and the unit price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting and filling or gravel bedding material required for placing concrete above water level as required under the concrete specifications. The Bid shall include any removal and replacement of excavated material so indicated on the Drawings or specified herein.
  - 2. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 100 cubic yards of unsuitable foundation material for utility trenches as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for utility trenches will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 100 cubic yards) and the unit price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting, filling, or bedding. The Bid shall include any removal and replacement of excavated material so indicated on the Drawings or specified herein.
- D. Payment: All common excavation shall be included in the Lump Sum Bid. Changes which require additions to or deductions from the excavation will be adjusted on the basis of the unit price for changes contained in the Contract.

##### 1.02 REFERENCED STANDARDS

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Kentucky, Transportation Cabinet, Department of Highways, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications. Unless specifically stated otherwise, the Measurement and

Payment sections of the Standard Specifications shall not apply. Measurement and payment will be made in accordance with terms of the Contract Documents.

- B. ASTM C33—Standard Specification for Concrete Aggregates.
- C. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- D. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).

#### 1.03 SUBMITTALS

- A. Submit sources and gradations for materials proposed for use as compacted fill, utility trench backfill, trench bedding and cover material, crushed stone mat, and granular cushion.
- B. Submit samples of materials proposed for use in Paragraph 1.03.A to a soils testing laboratory for analysis of its suitability and for recommendations on moisture content during compaction, compaction methods, or other appropriate information.
- C. Submit sufficient samples of each different type or classification of soil to obtain representative values.

#### 1.04 JOB CONDITIONS

- A. The elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. No extras will be allowed because of variations between drawings and actual grades.
- B. No soil borings were made for this project. CONTRACTOR shall conduct its own investigation to determine physical conditions at the site which may affect the work.

### PART 2—PRODUCTS

#### 2.01 COMPACTED FILL

- A. All fill and backfill material designated to be compacted fill shall be granular with no stones larger than 4 inches and shall be reasonably well-graded throughout the particle size range. A minimum 65% of the material shall pass the 3/4-inch sieve, and the material shall be capable of being compaction tested in accordance with ASTM D1557, as determined by the Project Soils Engineer. Of that portion of the material passing the No. 4 sieve, not more than 25% shall pass the No. 200 sieve, and material shall have less than 5% clay content. When placing fill during wet weather or in wet areas, this requirement shall be modified to not more than 5% passing the No. 200 sieve. Adequately dewatered areas are not defined as wet areas.
- B. Native material may be used as compacted fill if it meets the above specification. CONTRACTOR shall determine whether native material meets the above specification. CONTRACTOR shall provide all needed fill material whether from on-site or off-site at no additional cost to OWNER.

## 2.02 CRUSHED STONE MAT

- A. Crushed stone mat below foundation slabs and footings shall be 1-inch clear crushed stone and shall meet all requirements for No. 57 of Section 805 of Standard Specifications.

## 2.03 GRANULAR CUSHION

- A. Granular cushion beneath floor slabs-on-grade shall meet requirements for 3/4-inch dense-graded aggregate of Section 805 of Standard Specifications.

## 2.04 EMBANKMENT FILL

- A. Embankment fill shall contain no stumps, brush, rubbish, or other perishable material. The top 12 inches of the earth embankment shall be earthy material free from large stones.

## 2.05 CONCRETE FILL

- A. Concrete fill shall be Class X concrete as defined in Section 03 30 00—Cast-In-Place Concrete or flowable fill as defined in this section.

## 2.06 CLAY FILL

- A. Clay fill shall contain at least 25% clay minerals (material finer than 0.002 mm).

## 2.07 FLOWABLE FILL

- A. Flowable fill shall be a self-compacting, self-leveling, material consisting of a mixture of fine aggregate and filler (as needed), water, and cementitious materials (Portland cement, fly ash, granulated blast furnace slag) that is in a flowable state at the time of placement meeting the requirements of the National Ready Mixed Concrete Association Guide Specification for Controlled Low Strength Materials (CLSM). The flowable fill shall be proportioned by the ready mixed concrete supplier on the basis of field experience and/or laboratory trial mixtures to produce a cohesive and nonsegregating mixture which has the following properties:
  - 1. Minimum compressive strength: 50 psi.
  - 2. Maximum compressive strength: 150 psi.
- B. CONTRACTOR shall submit the following information well in advance of fill placement to avoid any delay in construction:
  - 1. Gradation of fine aggregate.
  - 2. Design mix.
  - 3. Previous test results with 7- and 28-day compressive strengths.
  - 4. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
  - 5. Brand, type, principle ingredient, and amount of each admixture if used.

## 2.08 TRENCH BEDDING MATERIAL

- A. Bedding material shall be hard and durable and shall be made by crushing sound limestone or dolomite ledge rock, or crushed gravel aggregate. Bedding material shall conform to the requirements of ASTM C33 and shall conform to gradations shown in the following table. No native soil shall be used for bedding material.

## PERCENTAGE BY WEIGHT PASSING INDICATED SIEVE

Size	2 1/2 IN	2 IN	1 1/2 IN	1 IN	3/4 IN	1/2 IN	3/8 IN	No. 4	No. 8	No. 16	No. 30	No. 100	No. 200
57			100	95-100		25-60		0-10	0-5				
67				100	90-100		20-50	0-10	0-5				
8						100	85-100	10-30	0-10	0-5			
9							100	85-100	10-40	0-10	0-5		
10							100	85-100				10-30	

- B. All rigid sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Class B bedding detail as shown on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- C. Concrete and other rigid pipe used in nonsanitary sewer applications may be bedded using the Class C bedding detail as shown on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- D. Ductile and cast iron pipe shall be bedded in accordance with Class C bedding detail as shown on Drawing 01-975-43A, or the Type 4 laying condition of AWWA C600. Bedding material shall conform to Size No. 57, No. 8, or No. 9. Where ductile iron pipe is polyethylene encased, bedding material shall conform to Size No. 8 or No. 9.
- E. Thermoplastic sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- F. All other sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Class B bedding detail as shown on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- G. PVC water main or force main shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A or in accordance with the Type 4 laying condition of AWWA C605. HDPE water main or force main shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A or in accordance with ASTM D2774. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used. No native materials may be used.
- H. Bedding material for copper water services shall conform to Size No. 9 or No. 10.

### 2.09 TRENCH COVER MATERIAL

- A. Material which is to be placed from the bedding material to 1 foot above the top of the pipe shall be termed cover material. All trenches shall be backfilled by hand to 1 foot above the top of the pipe with cover material. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings and appurtenances simultaneously in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers. Use special care in placing cover material to avoid injury to or movement of the pipe. Cover material shall consist of durable granular particles ranging in size from fine to a maximum size of 3/4 inch. Unwashed bank run sand and crushed bank run gravel will be considered generally

acceptable cover material. Cover material shall generally conform to the following gradation specifications:

#### COVER MATERIAL GRADATION

Sieve Size	Percentage by Weight Passing
1 inch	100
3/4 inch	85 to 100
3/8 inch	50 to 80
No. 4	35 to 65
No. 30	--
No. 40	15 to 30
No. 200	5 to 15

- B. Native trench materials may be used for cover material if they substantially conform to the above gradation specifications and a suitable credit is extended to OWNER.
- C. All bedding materials may be substituted for cover material when requested by CONTRACTOR except where polyethylene encasement is used. In such case, only those bedding materials specifically noted for polyethylene encasement may be used.
- D. Material that is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified, (a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable for cover material, (c) no stones larger than 3/4 inch in their greatest dimension shall be allowed in the cover material, and (d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be Size No. 10. Cover material for PVC pressure or other thermoplastic piping may be Size No. 10.

#### 2.10 TRENCH BACKFILL MATERIAL

- A. Backfill shall be that material placed between the top of cover material up to subgrade for placement of restoration materials. Backfill for storm inlets shall be bedding material.
- B. When the type of backfill material is not otherwise specified or shown on the Drawings, CONTRACTOR may backfill with the excavated material, provided that such material consists of loam clay, sand, gravel, or other materials which, in the opinion of Project Soils Engineer, are suitable for backfilling.
- C. All backfill material shall exceed a temperature of 35°F and be free from frost, cinders, ashes, refuse, vegetable or organic matter, boulders, rocks, or stone, frozen lumps, or other material which in the opinion of Project Soils Engineer is unsuitable. From 1 foot above the top of the pipe to the trench subgrade, well-graded material containing stones up to 8 inches in their greatest dimension may be used, unless otherwise specified. Care should be taken in backfilling so as not to damage the installed pipe.
- D. In refilling the trench, if there is not sufficient material excavated therefrom suitable for refilling, CONTRACTOR shall, without extra compensation, furnish the deficiency. Where indicated on the Drawings, fill shall be provided over projecting conduits. Such fill shall be

free of large boulders, and the top 6 inches shall be of suitable material to fit the adjoining ground.

- E. When called for on the Drawings, in the specifications, or requested by ENGINEER, backfill material shall be granular and shall consist of durable particles ranging in size from fine to coarse in a substantially uniform combination. Sufficient fine material shall be present to fill all the voids in the coarse material. No stones over 3 inches or clay lumps shall be present. Unless otherwise allowed by ENGINEER, granular backfill shall generally conform to the following gradation specification:

#### GRANULAR BACKFILL

Sieve Size	Percentage by Weight Passing
3 inches	100
2 inches	95 to 100
No. 4	35 to 60
No. 200	5 to 10

### PART 3-EXECUTION

#### 3.01 GENERAL

- A. Prior to all excavating, CONTRACTOR shall become thoroughly familiar with the site and site conditions.

#### 3.02 PROTECTION

- A. CONTRACTOR shall provide all necessary sheeting, shoring, or other soil retention systems including all labor, material, equipment, and tools required, or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of Contract work, and to protect adjacent property. CONTRACTOR shall be held liable for any damage which may result to property from excavation or construction operations. Sheeting, shoring, and other soil retainage systems shall be withdrawn or removed in a manner so as to prevent subsequent settlement of structures, utilities, and other improvements.
- B. Design of sheet piling and other soil retaining systems shall be the sole responsibility of CONTRACTOR. Where such systems are shown on the Drawings, no parameters such as embedment depth, section profile, presence or lack of walers, etc., nor system type or suitability shall be inferred. CONTRACTOR is responsible for designing and providing a fully functional system compatible with construction and site requirements.
- C. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

#### 3.03 FINISH ELEVATIONS AND LINES

- A. CONTRACTOR is responsible for establishing finish elevations and lines.

- B. Where lasers are used, CONTRACTOR shall check the Work against intermediate grade stakes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- C. If existing property stakes, not within the limits of the trench or street slope limits, are removed or damaged by CONTRACTOR, CONTRACTOR shall bear the cost of replacement. Replacement shall be made by a legal survey performed by a licensed Land Surveyor hired by OWNER. Cost for survey shall be deducted from the Contract Price.

### 3.04 COMMON EXCAVATION

- A. After the site has been cleared and stripped, the site shall be cut and filled to the indicated subgrade as shown or specified.
- B. All excavated material that does not meet the specification for compacted fill or embankment fill or meets the specification but is not required for backfill or fill shall be classified as excess material and shall be removed from the site and disposed of at CONTRACTOR's expense.
- C. All material other than suitable bearing soil or bedrock, as determined by the Project Soils Engineer, shall be removed from under concrete to be poured on ground.
- D. Excavation for all footings, foundation walls, pits, etc., shall be large enough to provide adequate clearance for the proper execution for the work within them.
- E. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered. See Section 31 23 19—Dewatering.
- F. No footings or slabs shall bear on the top 2 feet of existing soil. Where planned subgrade is within 2 feet of existing grade, remove soils to 2 feet below existing grade and backfill with compacted fill up to subgrade elevation.
- G. When excavations reach subgrade elevations as shown on the Drawings or as specified herein, the Project Soils Engineer will observe the bottom material. Where, in the opinion of the Project Soils Engineer, unsuitable foundation material is found at the level of the subgrade, unsuitable foundation material shall be removed and replaced with material and placing methods as specified under compacted fill and backfill.
- H. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation 1 foot plus a distance at least equal to the depth of undercut below footing grade.
- I. CONTRACTOR shall backfill and compact all overexcavated areas.
- J. All street excavation shall be performed as called for in Section 205 of the Standard Specifications and as herein modified.
- K. The following items of Work shall be included in common excavation:
  - 1. The excavation to subgrade elevations as detailed in the Drawings including road bed areas, terraces, sidewalks, bike paths, driveways, and other miscellaneous surface improvements.

2. Removal (and stockpiling, if the use of salvaged topsoil is required) of topsoil from all cut areas and fill areas within a 1:1 slope of finished street, sidewalks, bike paths, driveways, and other miscellaneous surface improvements.
  3. The preparation, grading, compaction, and proof-rolling of subgrade areas for roadbed, sidewalks, bike paths, driveways, and other miscellaneous surface improvements to the elevations detailed on the Drawings.
  4. Excavation and grading required to realign and/or create ditch lines and drainage ways to route drainage to or from storm facilities as shown on the Drawings, or as necessary to maintain positive drainage.
  5. Removal of temporary backfill placed in new utility trenches above the subgrade.
  6. The removal and disposal of all undesirable and surplus materials.
- L. Common excavation may be completed as part of utility construction prior to initiating general street excavation activities.
- M. All subgrade areas in streets and parking lots, including utility trench restoration areas, shall be proof-rolled with a heavily loaded triaxle dump truck or other similar equipment requested by ENGINEER prior to the placement of any fill materials or base course. ENGINEER must be present during proof-rolling to review the Work necessary for the stabilization of any unstable areas identified. Base course placed on unstable or yielding foundation or subgrade shall be removed and then replaced at CONTRACTOR's expense following excavation below subgrade or the affected area.
- N. Saw cuts shall be made in existing pavement, driveways, curb and gutter, and sidewalks to allow restoration to neat straight lines. Saw cuts damaged during construction shall be recut prior to beginning restoration.
- O. CONTRACTOR shall salvage suitable materials from utility and street construction activities to provide fill for street construction. Where sufficient quantities of materials suitable for street construction are not available from areas of the site, CONTRACTOR shall perform borrow excavation to make up the deficit in accordance with Section 208 of the Standard Specifications.
- P. CONTRACTOR shall be responsible for making its own determination of the common excavation quantity when compiling the lump sum bid.

### 3.05 UTILITY TRENCH EXCAVATIONS

- A. Caution In Excavation; CONTRACTOR shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures may be determined and shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on its part.
- B. Subsurface Exploration: When determined that it is necessary to explore and excavate to determine the location of existing underground facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is asked to perform additional Work in making the explorations and excavations, extra compensation will be allowed as specified In the General Conditions.
- C. The trench shall be dug so that the utilities can be laid to the alignment and depth specified. Unless otherwise allowed by ENGINEER, trenches shall not be excavated more than 100 feet in advance of pipe laying. Included in common excavation shall be removal of street paving of all types, existing structures, existing improvements and trees smaller than



4 inches in diameter measured 4 feet above the ground, all as necessary to complete the pipe installation.

- D. The trench shall be finished to the depth necessary to provide a uniform and continuous bearing and support for the pipe on the bedding material provided at every point between bell holes. Any part of the bottom of trench excavated below the specified grade shall be corrected with bedding material, thoroughly compacted in place. The bedding shall be shaped and finished with hand tools to fit the bottom quadrant to the pipe.
- E. If unstable soil conditions are encountered at subgrade, CONTRACTOR shall replace the unstable soil with special bedding. CONTRACTOR shall be allowed extra compensation for the special bedding, unless the unstable soil conditions are caused by CONTRACTOR's failure to adequately dewater the trench, in which case CONTRACTOR shall bear the entire cost.
- F. All excavated material shall be piled in a manner that will not endanger the Work. Stockpiles not for immediate backfilling shall have silt fences placed around their perimeter for erosion control. The Work shall be conducted in such a manner that pedestrian and motor traffic is not unnecessarily disrupted. Fire hydrants, valve boxes and manholes shall be left unobstructed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed.
- G. Excavated material designated by ENGINEER as being undesirable for backfilling and all surplus excavated material shall be immediately removed as excavation progresses. All such material shall be disposed of in an environmentally safe manner in accordance with local, state, and federal regulations. No such materials shall be disposed of in wetlands, floodplains, or other environmentally sensitive areas. Disposal sites are also subject to approval of OWNER. All undesirable and surplus material disposed of must be leveled off and graded to rough elevations as determined by OWNER. Appropriate erosion control measures shall be provided and maintained at disposal sites until disposal is complete and the disposal site is permanently stabilized.
- H. CONTRACTOR shall remove bituminous pavement and road surface as a part of the trench excavation. The width of pavement removed shall be the minimum possible, and acceptable, for convenient and safe installation of utilities and appurtenances.
- I. All bituminous pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the trench.
- J. Where it is necessary to trench through concrete pavement, a strip shall be sawed and removed in such a manner as not to disturb the remainder of the pavement. Paving and undermining of existing concrete pavement shall be prevented by CONTRACTOR. If CONTRACTOR unnecessarily removes or damages pavement or surfaces beyond limits acceptable to ENGINEER, such pavement and surfaces shall be replaced or repaired at the expense of CONTRACTOR.
- K. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.
- L. Pipe shall be placed only on dry foundations.
- M. Excavation shall include all necessary incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling.

- N. CONTRACTOR shall excavate whatever materials, are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown.
- O. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present underground services shown on the Drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions
- P. Any water, drainage, gas sewer, or electric lines encountered in the excavation that are not to be disturbed shall be properly underpinned and supported. Any service connections encountered that are to be removed shall be cut off at limits of the excavation and capped in accordance within the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.
- Q. CONTRACTOR shall be responsible for determining and providing the minimum width necessary to provide a safe trench in accordance with current OSHA standards and all other applicable standards. The top width of trench excavation shall be kept as narrow as is reasonably possible and acceptable to minimize pavement damage. Pay items related to maximum trench widths shall not limit CONTRACTOR's responsibility to provide safe trench conditions.
- R. Width of Trench—Rigid Pipe: The width of trench below the outside top of the pipe shall be as shown in the following table for the sizes listed. A minimum clearance of 8 inches between the outside of the pipe barrel and the trench wall at the pipe spring line shall be maintained to allow for bedding and haunching. If sheeting is used and is going to remain in place, the trench width shall be measured as the clear distance between inside faces of the sheeting. Otherwise, the trench width shall be based on the width between stable trench walls after sheeting is removed.

MAXIMUM WIDTH OF TRENCH BELOW TOP OF PIPE

Nominal Pipe Diameter (Inches)	Trench Width (Inches)
4	30
6	30
8	36
10	36
12	36
15	36
18 and larger	Pipe O.D. Plus 16 (Minimum 36)

- S. Where the width of trench below the outside top of the pipe barrel cannot be otherwise maintained within the limits shown above, CONTRACTOR, at its own expense, shall furnish an adequate pipe installation for the actual trench width which will meet design conditions. This may be accomplished by furnishing higher class bedding, a stronger pipe, concrete cradle, cap or envelope or by driving sheeting prior to excavation to subgrade. Removal of

sheeting below the top of the pipe, if allowed by ENGINEER, shall be gradual during backfilling.

- T. If the maximum trench width is exceeded for any reason other than by request of ENGINEER, the concrete cradle, cap, sheeting, bedding or the stronger pipe shall be placed by CONTRACTOR at its own expense. Where the maximum trench width is exceeded at the written request of ENGINEER, the concrete cradle, cap, sheeting, bedding or stronger pipe will be paid for on the basis of the price bid.
- U. Width of Trench—Thermoplastic and Ductile Iron Pipe: The trench width for flexible pipe shall be minimum three times the pipe outside diameter or the maximum trench width specified for rigid pipe, whichever is greater. A minimum clearance of 8 inches between the outside of the pipe barrel and the trench wall at the pipe spring line shall be maintained to allow for bedding and haunching.
- V. Special bedding shall consist of stone material and filter fabric as described herein. Where the bottom of the trench at subgrade is found to be unstable or of unsuitable material, which should be removed, CONTRACTOR shall excavate and remove such unstable or unsuitable material to the trench width and to a depth of 2 feet. The excavated area shall be lined with filter fabric, Mirafi 140 N, US Fabrics US 120NW, Propex Geotex 401, or equal, and backfilled with bedding material in maximum 12-inch layers. At subgrade the filter fabric shall be wrapped over the special bedding with an 18-inch overlap. Bedding material shall then be placed over the special bedding to support the piping. See Dewatering and Excavation to Subgrade sections for additional conditions.
- W. If soil conditions require it, concrete cradle or encasement shall be placed around the pipe as shown on Drawing 01-975-43A. Excavation shall be carried below the grade line to a depth requested by ENGINEER and concrete cradle or encasement placed. Before the concrete is placed, the pipe shall be laid to line and grade, blocked and braced, and the joint made. The cradle shall then be placed, taking care not to disturb the pipe. Concrete shall have a minimum 28-day compressive strength of 4,000 psi. Concrete cradle shall not be used for thermoplastic piping. See Trench Width section for additional conditions.
- X. Open-cut trenches shall be sheeted and braced as required by any governing federal regulations including OSHA, state laws, and municipal ordinances; and as may be necessary to protect life, property, improvements or the Work. Underground or aboveground improvements to be left in place shall be protected and, if damaged, shall be repaired or replaced at the expense of CONTRACTOR.
- Y. Sheet piling and bracing which is to be left in place must be removed for a distance of 4 feet below the present or proposed final grade of the street, road, or land, whichever is lower. Trench bracing, except that which shall be left in place, may be removed after backfilling has been completed or has been brought up to such an elevation as to permit its safe removal.
- Z. Portable Trench Box: Whenever a portable trench box or shield is used, special precautions shall be taken so as not to pull already jointed pipe apart or leave voids around the pipe wall. Whenever possible, the bottom edge of the box shall be kept at a level approximately even with the top of pipe. Cover material shall be placed to at least the top of pipe before moving the box ahead.
- AA. All trenches shall be backfilled using specified material so that excessive lengths of trench are not left open. In general, the backfilling operation shall proceed so that no more than 100 feet of trench is open behind the pipe laying operation.

- BB. Backfill shall be left below the original surface to allow for placement of restoration materials including pavement, base course, concrete, topsoil, sod, plus any pavement replacement specified in accordance with the Asphaltic Paving section herein. When settlement occurs, CONTRACTOR shall restore the surface improvements at its expense to maintain the finished surface.

### 3.06 PREPARATION OF SUBGRADE

- A. After the site has been cleared, stripped, and excavated to subgrade, thoroughly compact subgrade to the requirements specified for compacted fill below. Scarify and moisture condition the subgrade as recommended by the Project Soils Engineer.
- B. Remove all ruts, hummocks, and other uneven surfaces by surface grading prior to placement of fill.
- C. All slab-on-grade and road subgrades shall be proofrolled with a heavy rubber-tired construction vehicle (such as a fully loaded tandem-axle dump truck) in the presence of the Project Soils Engineer.
- D. ENGINEER may request the excavation of unsuitable materials in areas of unstable subgrade. The excavation of such materials, except in areas where CONTRACTOR has completed utility construction or placed street fill, shall be measured by ENGINEER for payment.
- E. The excavation and replacement of unstable utility trench backfill and/or street fill placed by CONTRACTOR shall be at CONTRACTOR's expense.
- F. Base course placed on unstable foundation shall be removed and replaced at CONTRACTOR's cost following excavation of the affected area.
- G. Where requested by ENGINEER in the field, excavation below subgrade areas shall be lined with geotextile material as specified in Section 31 23 19–Dewatering and backfilled with 3-inch crushed stone dense graded base as specified herein.
- H. Geotextile shall be placed where requested by ENGINEER to stabilize street subgrade areas. Fabric shall be as specified in Section 31 23 19–Dewatering. Vibratory compaction shall not be used in the compaction of base course in areas where geotextile fabrics are used.

### 3.07 COMPACTED FILL AND BACKFILL

- A. All fill and backfill, except as otherwise specified, shall be compacted fill placed to within 4 inches of the bottom of the topsoil or to the bottom of the structure or other improvement.
- B. Unless otherwise noted, structures with a top slab shall not be backfilled until the slab is in place and has reached its specified 28-day strength.
- C. In fill areas above existing grade around structures, compacted fill shall be placed within a minimum of 10 feet from the structure.
- D. No fill shall be placed under water or over unsuitable subgrade conditions.

- E. All fill and backfill, except embankment fill and clay fill, shall be compacted as follows:
  - 1. Class 1 Compaction: This class of compaction shall apply to all fill areas under buildings, structures, piping, bituminous roadway and parking areas, curb and gutter, and backfill within 10 feet of structure walls. All compacted material shall be placed in uniform layers not exceeding 8 inches in loose thickness prior to compaction. Each layer shall be uniformly compacted to a dry density at least 95% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D1557). Compaction shall be obtained by compaction equipment appropriate for the conditions.
  - 2. Class 2 Compaction: This class of compaction shall be used in excavated areas beyond 10 feet of structures without any piping or adjacent foundations. Material for backfill shall be granular material as specified above. The material shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer of the fill shall be compacted to at least 90% of the maximum dry density (testing same as Class 1). Compaction shall be obtained by compaction equipment appropriate for the conditions.
- F. No frozen material shall be placed nor shall any material be placed on frozen ground.
- G. Four inches of clay fill shall be placed and compacted to at least a firm consistency in areas to be seeded or sodded prior to placement of topsoil.

### 3.08 EMBANKMENT FILL

- A. Embankment fill may be placed in fill areas to be seeded or sodded if no piping exists in the fill and the areas are at least 10 feet from any structure.
- B. Embankment fill shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be obtained for each layer before any material for a succeeding layer is placed thereon. Compaction shall be obtained using the hauling and leveling equipment, and in addition, tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment required to produce the desired results.

### 3.09 CONCRETE FILL

- A. In areas where there is inadequate room for compaction equipment and in other areas as shown or specified, Class X concrete or flowable fill shall be used as fill material.

### 3.10 PIPE BEDDING AND COVER

- A. Immediately prior to placing the pipe, the trench bottom shall be shaped by hand to fit the entire bottom quadrant of the pipe. If pipe is of the bell and spigot type; bell holes shall be provided to prevent the bell from supporting the backfill load. Bell holes shall be large enough to permit proper making of the joint, but not larger than necessary to make the joint. All adjustments to line and grade must be done by scraping away or filling in bedding material under the body of the pipe. Any fill used must be bedding material. If necessary to obtain uniform contact of the pipe with the subgrade, a template shall be used to shape the bedding material. All pipe shall be placed on bedding material at least 4 inches thick. See Drawing 01-975-43A. Bedding material shall then be placed and tamped into place up alongside the pipe in maximum 6-inch layers shovel slicing the bedding material under the

haunches to provide firm contact with the pipe. CONTRACTOR shall perform all necessary excavation and shall furnish all necessary material to provide this bedding.

- B. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.

### 3.11 TRENCH BACKFILL CONSOLIDATION

- A. All trenches shall be consolidated as specified in this section for the entire depth and width of the trench.
- B. Consolidation shall be achieved by use of smooth surface vibratory compactors or backhoe operated hydraulic compactors for granular materials and rotating sheepsfoot type mechanisms for loam/clay soils. The lift height shall not exceed 8 inches for walk behind, hand operated, vibratory compactors and sheepsfoot. Lift height shall not exceed 24 inches for self-propelled vibratory drum or backhoe operated hydraulic compactors. Smaller lift heights shall be provided as necessary to achieve the degree of compaction specified.
- C. Unless specified otherwise, backfill material beneath paved areas or future paved areas and within 5 feet of paved areas or future paved areas shall be consolidated as follows: Within 3 feet of the surface 95% of maximum dry density, below 3 feet from the surface to 1 foot above the pipe 90% of maximum dry density, as determined by the modified Proctor Test (ASTM D1557).
- D. Unless otherwise specified, backfill material placed in all other areas shall be compacted to the point where no additional consolidation can be observed from the compaction and backfill equipment being used.
- E. Backfill material not meeting the compaction specification shall be recompacted by CONTRACTOR at no cost to OWNER. Cost for additional testing on recompacted material shall be at CONTRACTOR's expense.

### 3.12 GRADING

- A. CONTRACTOR shall perform all rough and finish grading required to attain the elevations shown on the Drawings.
- B. Grading Tolerances:
  - 1. Rough Grade: Buildings, parking areas, and sidewalks— $\pm 0.1$  feet.
  - 2. Finish Grade: Granular cushion or crushed stone mat under concrete slabs— $\pm 0.03$  feet.
  - 3. Lawn areas away from buildings, parking areas, and sidewalks— $\pm 0.25$  feet.

### 3.13 MAINTENANCE OF SURFACE

- A. CONTRACTOR shall maintain all backfilling, resurfacing, repaving, and other surface improvements constructed under this Contract. CONTRACTOR shall, upon proper notice from OWNER, make all repairs in surfaces of trenches and excavations. All expenses incurred by OWNER and/or CONTRACTOR in making repairs and all expenses in maintaining trench and excavation surfaces shall be at the expense of CONTRACTOR regardless of the material used in backfilling trench excavations. OWNER reserves the right

to make all emergency repairs necessary to make safe all streets and walks at the expense of CONTRACTOR regardless of the material used in backfilling trench excavations. A maintenance guarantee fund, if specified, will be withheld from the final amount due CONTRACTOR for a period of 6 months, after acceptance of the Work, to provide such maintenance.

- B. CONTRACTOR shall be responsible for controlling dust dispersion during utility and street construction. Remedial actions required as a result of inadequate dust control shall be CONTRACTOR's responsibility. To control dust, CONTRACTOR shall apply calcium chloride or ammonium lignin sulfonate in 12 to 14% solution or other dust control palliative acceptable to OWNER. Prior to application of dust palliative, the street shall be graded smooth.

#### 3.14 COMPACTION TESTING

- A. Compaction tests shall be done by the SPECIAL INSPECTOR. Location and frequency of the tests shall be as recommended by the Kentucky Building Code and paid for by OWNER.

END OF SECTION

## SECTION 31 23 19

### DEWATERING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Removal of groundwater to allow belowgrade construction.
  - 2. Site grading to prevent surface water from entering the excavation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment:
  - 1. The expense for making all extra excavations necessary to prevent water from interfering with the proper construction of the work and for forming all dams or diversions, digging of sumps or pump wells, bailing, and installation and pumping of wells shall be borne by CONTRACTOR.
  - 2. The cost for removal of groundwater and surface water shall be included in the prices bid for the work. No separate payment will be made for dewatering whether accomplished by use of sumps and pumps, well point systems, deep wells, or any other method.
  - 3. Any permits necessary for the dewatering operations shall be obtained and paid for by CONTRACTOR.

##### 1.02 REFERENCES

- A. See Division 01, Section 01 41 00–Regulatory Requirements, for permit requirements and water, erosion, and sediment control.

##### 1.03 SYSTEM REQUIREMENTS

- A. CONTRACTOR shall, at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or under water. Unless otherwise approved, no water shall flow over the work until the joints are complete or the concrete has set.
- B. Wherever necessary, CONTRACTOR shall excavate in advance of the completed work, lead the water into sumps or pump wells, and provide erosion control measures to prevent water or sediment damage.
- C. CONTRACTOR's dewatering system shall perform so that the soils within the trench will not be destabilized by hydrostatic uplift pressures from adjacent groundwater. If conditions warrant, CONTRACTOR shall furnish and install well point systems or deep wells.
- D. Dewatering shall be sufficient to lower the piezometric level to at least 2 feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.



- E. In areas where rock is encountered, the water level shall be kept at or below top of rock but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.
- F. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented.
- G. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

#### 1.04 QUALITY ASSURANCE

- A. All dewatering shall be done in accordance with applicable federal, state, and local code requirements.

### PART 2-PRODUCTS

NOT APPLICABLE

### PART 3-EXECUTION

#### 3.01 DEWATERING

- A. Dewatering shall be started, and the water level shall be lowered as specified herein prior to beginning excavation and shall be continued until structure, main, or appurtenance has been completed and fill has been placed and compacted to final grade.
- B. CONTRACTOR shall provide all necessary materials and equipment to keep the excavation free from water during construction. CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages and shall have available at all times competent workers for the operation of the pumping equipment. The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during the work stoppages.
- C. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill, and prevent floatation or movement of all structures and pipelines.

#### 3.02 PROTECTION

- A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding, or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner.
- B. In areas where continuous operation of dewatering pumps is required, CONTRACTOR shall avoid noise disturbance to nearby residences and businesses to the greatest extent possible

by using electric-driven pumps, intake and exhaust silencers, or housing to minimize noise from engine-driven generators or engine-driven pumps.

END OF SECTION

## SECTION 32 31 13

### CHAIN LINK FENCE

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes providing all chain link fencing and gates complete, as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A121–Zinc-Coated (Galvanized) Steel Barbed Wire.
- B. ASTM A121–Metallic Coated Steel Barbed Wire.
- C. ASTM A392–Zinc-Coated Steel Chain-Link Fence Fabric.
- D. ASTM A428–Weight of Coating on Aluminum-Coated Iron or Steel Articles.
- E. ASTM A491–Aluminum-Coated Steel Chain Link Fence Fabric.
- F. ASTM A1011–Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- G. ASTM F567–Installation of Chain-Link Fence.
- H. ASTM F626–Fence Fittings.
- I. ASTM F900–Industrial and Commercial Swing Gates.
- J. ASTM F1043–Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
- K. Chain Link Fence Manufacturers’ Institute (CLFMI)–Product Manual.

#### PART 2–PRODUCTS

##### 2.01 POSTS, RAILS, AND BRACES

- A. Construction:
  - 1. All posts and rails shall be either tubular pipe conforming to ASTM F1043 Group 1A, Schedule 40 with a Type A zinc coating, or Group 1C cold-formed and welded pipe with a Type B zinc coating.
  - 2. Post sizes shall be in accordance with the following:

## LINE POSTS (MAXIMUM 10 FEET SPACING)

Height and Fence Type	Post Type	O.D. (IN.)	Weight (PLF)
6 feet or less	Group 1A	1.90	2.72

3. Rails shall be 1 5/8 inch OD Group 1A 2.27 pound per foot or Group 1C 1.84 pounds per foot pipe.

B. Required Arms and Rails: Provide top rail and intermediate rail.

### 2.02 FABRIC

A. Construction:

1. Fabric to be No. 9 gauge steel aluminum-coated steel wire woven in a 2-inch mesh; top selvage to have knuckled finish, bottom selvage to be knuckled.
2. Fabric height shall be as noted on the Drawings.

### 2.03 ACCESSORIES

A. General: All accessories, except tie wires, shall be galvanized to comply with ASTM F626.

B. Post Tops:

1. Material shall be pressed steel or malleable iron.
2. Top shall be weathertight.
3. Top shall permit passage of top rail.

C. Stretcher Bars:

1. Stretcher bars required for tubular end, corner, pull, or gate posts.
2. Bars shall be one-piece lengths equal to full height of fabric with minimum cross section of 3/16 inch by 3/4 inch.
3. Provide one stretcher bar for each gate and end post and two stretcher bars for each corner and pull post.

D. Stretcher Bar Bands:

1. Material shall be heavy pressed steel.
2. Spacing shall be 15 inches maximum o.c. to secure stretcher bar to tubular end, corner, pull, and gate post.

## PART 3-EXECUTION

### 3.01 POSTS AND BRACES

- A. Set posts in a vertical position at the required location and alignment. Set tops at the required elevation to provide a smooth profile at the top rail or tension wire without abrupt changes and in conformity with the general contour.

### 3.02 STRETCHER BARS

- A. Provide one stretcher bar for each gate and end post and two for each corner and pull post, except roll form posts with integral loops. Attach to posts with heavy-duty pressed steel or malleable iron bands spaced at 15 inches o.c.

### 3.03 FABRIC

- A. Install top and intermediate rails at proper locations.
- B. Attach the end of the fabric to the end, corner, gate, or brace posts (except roll form posts with integral loops) by means of a stretcher bar threaded through the end loops of the fabric and stretched to remove all slack with proper stretching equipment. Secure the stretched fabric to posts, and rails with specified fabric fasteners. Install fabric fasteners on all posts at not greater than 14 inches o.c. and on rails and bottom tension wires at not more than 24 inches o.c.
- C. Repeat stretching operations at approximately every 100 feet for each run of fence.
- D. Make splices in fabric by interweaving a wire picket through each end loop of each piece of fabric. Each splice shall be subject to ENGINEER's review.

### 3.04 CLEANUP

- A. After chain link fence construction is completed, clean up all storage and work areas. Replace or repair, as required, all landscape features damaged or disturbed under this Contract.

END OF SECTION

## SECTION 33 00 10

### BURIED PIPING AND APPURTENANCES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All underground piping, valves, and appurtenances of every description.
  - 2. Excavation, dewatering, and backfilling for all work under this section unless otherwise noted.
  - 3. Concrete foundations and anchor bolts for all equipment furnished under this section.
  - 4. Underground piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Measurement and Payment: Payment for all work, including materials, equipment, and miscellaneous items necessary to complete the installation, will be made at the Unit Price Bid or Lump Sum Bid for buried piping and appurtenances.

##### 1.02 SUBMITTALS

- A. Shop Drawings: General arrangement drawings of 3 inches or larger exterior (belowground) ductile iron, piping shall be submitted to ENGINEER for approval. Drawings shall include proposed materials, length, location, and elevation of pipe, fittings, pipe restraint, valves, and appurtenances.

#### PART 2—PRODUCTS

##### 2.01 MATERIALS OF CONSTRUCTION

- A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials in contact with water to be used for potable water supplies shall be National Sanitation Foundation (NSF)-approved.
- B. Size and Type:
  - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.
  - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be standard selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Materials provided shall be suitable for the conditions in which they are being installed and used. CONTRACTOR shall review installation requirements of the Contract with material

suppliers and incorporate any additional installation requirements necessary to meet the required use within the price bid for the Work.

- D. All pipe and materials used in performance of the Work shall be clearly marked as to strength, class, or grade. Pipe and materials not so marked shall be subject to rejection.
- E. When requested by ENGINEER, material suppliers shall furnish certificates of compliance indicating that all tests required by various Standards have been conducted and that the test results comply with the Standards.
- F. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be selected by CONTRACTOR and submitted for review by ENGINEER.

## 2.02 MANHOLES

- A. General: All other provisions shown in the Drawings, except those contrary to provisions delineated herein or on the Drawings shall apply to manholes.
- B. Unless otherwise specified or shown on the Drawings for special manholes, all manholes shall be reinforced concrete precast manholes. Reinforced concrete manhole base sections, riser sections, cones, and flat slabs shall conform to the requirements of ASTM C478. Solid precast manhole bottoms shall be provided except where shown on the Drawings. Manholes shall be provided with minimum diameters as shown on the Drawings.
- C. A concrete water proofing admixture with red dye shall be added to each manhole during the concrete batching process and shall be Xypex Admix C-1000 Red dosed at 20 pounds per cubic yard of concrete, Krypton KIM-HS (K301) dosed at 2% by weight of cementitious materials, including fly ash, Penetron Admix RP dosed at the rate of one 6.6 pound soluble bag per cubic yard of concrete, or equal.
- D. Manhole top sections shall be precast reinforced concentric cones unless precast reinforced flat slabs are specifically required or shown on the Drawings or are necessary because of shallow depth. Flat slabs shall have opening offset unless otherwise required or shown. Flat slabs shall be designed for HS20 loadings.
- E. Concrete Manhole Chimney Adjusting Rings:
  - 1. Provide concrete manhole adjusting rings as shown in Drawing 01-975-43A.
  - 2. Precast concrete adjusting rings for standard manholes shall have an inside diameter of 26 inches, be not less than 2 inches nor more than 6 inches high, and shall have a wall thickness of 6 inches unless otherwise specified. The rings shall contain a minimum of one No. 2 reinforcing rod centered within the ring. The joints between rings and between rings and castings shall be sealed with preformed flexible joint sealant as specified herein.
  - 3. CONTRACTOR shall supply ring materials, adhesive, labor, and equipment to permanently install the rings in strict accordance to manufacturer's recommendations. Manhole casting rims shall be set flush with constructed road surface. Ring inside diameter shall be 24-inch nominal, or larger to match frame.
- F. Frames and Covers:
  - 1. Covers shall be Bilco, Nystrom, or equal, aluminum covers. The covers shall include a positive hold open arm with release handle and a tubular compression spring operator.

Provide covers with slam lock with inside handle and removable key wrench. All aluminum surfaces in contact with concrete shall be painted with bitumastic coating. Hardware shall be stainless steel throughout.

2. Covers shall be reinforced for minimum 300 pounds per square foot live load for HS20 loading. Provide stainless steel or fiberglass unistruts as necessary attached to covers to mount accessories, guides, etc.
3. Covers shall be Neenah R-6662 or R-6663 heavy duty covers with Type T hinges, Type G handles, and Type J locking devices. Provide stainless steel or fiberglass unistruts as necessary, attached to covers to mount accessories, guides, etc.

G. Manhole Chimney Seals:

1. External manhole chimney seals shall be provided for all new manholes. Chimney seal shall be Cretex X-85, or equal, from the top of the cone to the manhole casting frame.
2. Existing manholes exposed during the construction period shall have the adjustment rings replaced and a new chimney seal installed. Existing castings shall be reused.

H. Precast Reinforced Concrete Manholes:

1. Lengths of manhole riser (barrel) shall be furnished in such combinations as to conveniently make up the depth of the manhole. A maximum of two handling holes per length of riser will be permitted.
2. Drop entrances to sanitary sewer manholes shall be installed where indicated on the Drawings. Drop entrances shall be of the same diameter as the sewer main from sizes 8 inches through 18 inches. For larger diameters, the drop shall be 18 inches unless otherwise shown on the Drawings. Drop entrances for storm sewer manholes are not required.
3. The interior bottom of sanitary sewer and storm sewer manholes shall be constructed of concrete benches which shall be precast or poured in place in the field. Benches shall be constructed, at a minimum, to the spring line of pipe for diameters less than 15 inches and to 3/4-pipe-diameter for pipe diameters between 15 and 24 inches. Benches shall extend to the top of each pipe that is greater than 24 inches in diameter. Flow lines shall be made smooth with uniform curves to promote flow through the manhole.
4. All joints between manhole pipe sections and top shall be tongue and groove conforming to ASTM C443. Manhole joints for sanitary sewers shall use circular O rings. Manhole joints for storm sewers shall be sealed with circular O ring or preformed flexible joint sealant that shall be Ram-nek, Kent-Seal, Mas-stik, or equal.
5. Manhole connections for sanitary sewer mains shall be made using flexible, watertight connections, PSX Press Seal, Kor N Seal, or equal, for sewers up through 18-inch diameter. All other sanitary sewer manhole connections shall be made with A Lok, PSX Press Seal, Kor N Seal, or equal. The joint shall provide a flexible, watertight connection between pipe and manhole. Manhole connections for storm sewer mains and leads may be made with cast-in-place concrete during completion of manhole interior in lieu of above.
6. Manhole bottoms for sanitary sewer shall be monolithically precast with the bottom section for manholes up through 6-foot diameter. Bottoms for larger diameter manholes shall be precast but need not be monolithically cast with the bottom section. All other manhole bottoms shall be either poured in place or precast concrete.
7. Manholes shall be furnished of minimum diameters as shown on the Drawings. Manholes shall be furnished large enough to provide a minimum distance, between adjacent pipe, measured tangentially along the inside face of the manhole, equal to one half the outside diameter of the intersecting sewer pipe. In any event, manholes



shall be furnished in the diameter necessary to accommodate intersecting sewer pipe and the pipe to manhole connection as proposed for use.

8. Precast reinforced concrete manhole risers and tops shall be tested in accordance with ASTM C497. Precast reinforced concrete manhole risers and tops meeting the strength requirements will be considered acceptable and shall be stamped with an appropriate monogram. When requested, copies of test reports shall be submitted to ENGINEER before the manhole sections are installed in the Project. Final acceptance will be made after field inspection upon delivery to the jobsite.
9. Precast reinforced concrete manhole sections shall be subject to rejection for failure to conform to any of the requirements of the Standard Specifications. In addition, individual sections of manhole risers and tops may be rejected because of any of the following reasons:
  - a. Fracture or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.
  - b. Defects that indicate imperfect proportioning, mixing, and molding.
  - c. Surface defects indicating honey combed or open texture.
  - d. Damaged ends, where such damage would prevent making a satisfactory joint.
  - e. Noticeable infiltration into manhole.
  - f. Variation in diameter of the manhole section of more than 1% from the nominal diameter.
  - g. Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more regardless of position in the section wall.
- I. Each precast reinforced concrete manhole riser and top section shall be clearly marked with the name or trademark of the manufacturer and the date of manufacture. This marking shall be indented into the manhole section or shall be painted thereon with waterproof paint.
- J. Manhole and Inlet Castings: All manhole and inlet castings shall be gray iron and meet the requirements of ASTM A48. Unless otherwise shown on the Drawings, standard manhole castings shall be Neenah R1550 with machined frame, Type B solid lid, concealed pick holes and self-sealing gaskets, East Jordan Iron Works, or equal. Floodproof castings shall be Neenah R1916 C with machined frame, type B solid lid, concealed pick holes and self-sealing gaskets, East Jordan Iron Works, or equal.
- K. Mortar: Mortar shall meet the requirements of ASTM C270. Mortar shall be one part Portland cement and 2 1/4 parts washed mortar sand.
- L. Preformed Flexible Joint Sealant: Preformed flexible joint sealant shall be EZ Stik, Kent Seal, Ram Nek, or equal, meeting the requirements of ASTM C990.
- M. O-Rings: O-rings shall meet the requirements of ASTM C443.

## 2.03 BURIED PIPING

- A. Ductile Iron Piping and Fittings:
  1. Unless otherwise shown or specified, all underground piping 3 inches in diameter or larger shall be ductile iron conforming to AWWA C151/A21.51 with mechanical joints or push-on joints. Pipe wall thickness shall be furnished as required by AWWA C150 for buried piping with the depth of cover as shown on the Drawings for laying condition 4, minimum Special Thickness Class or Pressure Class as listed below, unless otherwise shown or specified.

Pipe Size (Inches)	Special Thickness (Class)	Pressure Class
3	53	---
4	53	---
6	53	---
8	53	---
10	53	---
12	53	---
14	52	---
16	52	---
18	52	---
20	---	250
24	---	250
30	---	250
36	---	250
42	---	250
48	---	250
54	---	250
60	---	250
64	---	250

2. Each pipe and fitting shall have the class or nominal thickness, country where cast, casting period, manufacturer's mark, the year in which the pipe was produced, and the letters DI or DUCTILE cast or stamped thereon. Improper or incomplete marking will be cause for rejection of the pipe or fitting.
3. CONTRACTOR shall furnish certification data representing each class of pipe or fitting furnished. The certification report shall clearly state that all pipe and fittings furnished meet the appropriate AWWA specification. Ductile iron pipe shall consist of pipe centrifugally cast in metal or sand-lined molds. Pipe wall shall be homogeneous from inside to outside and shall be completely free of laminations, blisters, or other imperfections. Defects may be removed at the factory only.
4. Except as otherwise specified, underground pipe shall have mechanical joints or push-on joints conforming to AWWA C110 and C111, as well as AWWA C153 (compact), with vulcanized styrene butadiene rubber gaskets conforming to AWWA C111 and ANSI A21.11. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe and provide joint restraint are not acceptable. Bolts on mechanical joints shall be high-strength low-alloy steel (Corten, or equal), conforming to ASTM A242. Certificate to that effect shall be provided.
5. For ductile iron pipe systems requiring pressure testing, restrained joints shall be provided in accordance with Part 3—Execution. Mechanical joints shall be restrained with MEGALUG® Series 1100 or 1100 SD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1400 by Ford Meter Box Co., Inc., or equal, restraint. Push-on joints for ductile iron piping shall be restrained with MEGALUG® Series 1700 or 1100 HD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1450 by Ford Meter Box Co., Inc., Flex-Ring or Lok-Ring by American Cast Iron Pipe Company, TR Flex by U.S. Pipe Company, TR Flex by McWane, or equal.
  - a. Pipe restraint fittings shall be provided as follows:
    - (1) For ductile iron pipe with ductile iron mechanical joints MEGALUG® Series 1100 or 1100SD by EBAA Iron Sales, Inc.; Series D SLDE or SSLD by Sigma; Series 3000 or 3000S by Star Pipe Products; or equal.

- (2) For ductile iron pipe with ductile iron push on joints MEGALUG® Series 1100HD or 1700 by EBAA Iron Sales, Inc; Series SLDEH or SSLDH by Sigma; Series 3100P or 3100S by Star Pipe Products; Flex Ring or Lok Ring by American Cast Iron Pipe Company; TR Flex by U.S. Pipe Company; or equal.
  - (3) For PVC pipe with ductile iron mechanical joint fittings–MEGALUG® Series 2000 PV, 1100SV, or 2000SV by EBBA Iron Sales, Inc.; Series D SLCE or PVM by Sigma; Series 1000C or 4000 by Star Pipe Products; or equal.
  - (4) For PVC pipe with PVC push on joints (not solvent welded)–MEGALUG® Series 1100HV, 1900, or 2800 by EBAA Iron Sales, Inc.; Series SLCEH, PWP (greater than 12-inch only), or D PWP (12 inches or less) by Sigma; Series 4100P by Star Pipe Products; or equal.
- b. Gland body, wedges, and wedge actuating components shall be ductile iron conforming to ASTM A536 Grade 65 45 12. Bolts and tie rods shall be high strength low alloy steel conforming to AWWA C111.
  - c. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe to provide joint restraint are not acceptable.
6. Joint restraint is not required for gravity sewers, drains, and those pipes designated in Paragraph 3.02.G.1. Infiltration/Exfiltration Tests.
  7. Underground pipe shall have mechanical joint ductile iron fittings conforming to AWWA C110 and C111 with a minimum rated working pressure of 150 psi. Gaskets for fittings shall be as specified for underground piping.
  8. Unless otherwise specified, all exterior ductile iron piping and fittings shall be cement-mortar lined and asphaltic-coated inside. Cement-mortar lining shall be in accordance with AWWA C104. Unless otherwise specified, underground piping and fittings shall be shop primed or asphaltic-coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
  9. Piping and fittings for installation in manholes, wet wells or other such structures, and elsewhere exterior as shown on the Drawings or specified shall be flanged and provided as specified in Section 40 05 00–Piping and Appurtenances.
  10. Drainage Piping: All process drain piping and all underground piping designated as drain (D) shall be ductile iron. All underground drainage piping more than 2 feet from building walls shall be ductile iron as specified. Connections to drainage piping from buildings shall be made within 2 feet from the building wall and shall be made with a Fernco, or equal, flexible coupling.
  11. Tapping and Bonding: In cases where corporation stops are to be tapped into mains, pipe wall thickness shall be furnished as specified in AWWA C151 to provide four threads or pipe saddles shall be furnished as approved by manufacturer.
  12. Cutting in and Repair Tees and Sleeves and Tapping Tees: Cutting-in and repair tees and sleeves and tapping tees shall be of ductile or cast iron with the same rated working pressure of the pipe in which they are installed but no less than 150 psi.
  13. Exterior Joints, Fittings, and Gaskets: Joints, fittings, and gaskets shall have the same rated working pressure of the pipe in which they are installed but no less than a minimum rated working pressure of 150 psi.
- B. PVC Piping–Chemical Feed Solution Piping:
1. PVC Pipe (Schedule Pipe)–Less Than 4 Inches: PVC Schedule pipe less than 4 inches in diameter shall conform to the requirements of ASTM D1785 for Schedules 40, 80, or 120. Pipe shall be solvent weld type conforming to ASTM D2855 with bell conforming to ASTM D2672. Pressure rating for pipe supplied shall be

minimum 150 psi. PVC pipe diameter shall conform to galvanized iron or steel pipe sizes (IPS).

2. Provide tracer wire as specified.

C. CPVC Piping:

1. Chemical piping shall be CPVC.
2. CPVC pipe shall be as specified in Section 40 05 00—Piping and Appurtenances.
3. Provide tracer wire as specified.

D. Miscellaneous Pipe:

1. Piping needed for repair or reconstruction of existing utilities and appurtenances shall be of the same type and strength as the existing. The type of jointing used in repair and reconstruction shall be reviewed by ENGINEER. Special fittings shall be furnished and installed as necessary for repair, reconstruction, or connection of existing facilities.
2. All special fittings on or for connection to utilities shall be specifically built for the type of gasket used. Special fittings shall have joints of the same type as the utility to which the connection is being made.

E. Tracer Wire:

1. Provide minimum 10-gauge solid insulated copper tracer wire with buried thermoplastic pressurized pipe. Wire shall be continuous, terminate, and be accessible at valve boxes, manholes, fire hydrants, or at test stations as specified below. Tracer wire shall be located 12 inches above the top of the pipe. Any splices in copper wire shall be made with a 3M™ DBR/Y-6 splice kit, or equal.
2. Tracer wire test stations shall be SnakePit magnetized tracer boxes by Copperhead Industries, or equal. Tracer box shall be corrosion-resistant brass wire lugs and wax pad to cover wire connection. Cover shall be color-coded according to APWA standards for fluid conveyed. Provide SnakePit Lite Duty Box in unpaved areas and Roadway Box in paved areas. Provide Rhino Triview Marker Posts, or equal, at all test stations. Provide custom decals to identify fluid in piping. The tracer wire shall be accessible at a minimum of every 500 feet along the pipeline and at horizontal bends in piping. The tracer wire shall run into and up the sides of all manholes and be secured near the casting. Test stations shall be placed as required between manholes to comply with the minimum 500-foot tracer wire accessibility requirement.
3. CONTRACTOR shall perform continuity testing of all tracer wire in the presence of OWNER ENGINEER.

## 2.04 VALVES (VALVES FOR UNDERGROUND SERVICE ARE SPECIFIED IN DIVISION 40)

- A. Valves shall conform to Section 40 05 00—Piping and Appurtenances.
- B. Gate Valves: Shutoff valves ductile iron lines containing wastewater and shutoff valves in potable and non-potable water lines 4-inch diameter and larger shall be AWWA C515, ductile iron, resilient seat, nonrising stem, OS&Y (rising stem) for wastewater applications, 150 psi working pressure with O-ring packing box, Kennedy, American, American AVK, or equal.

## 2.05 FIRE HYDRANTS

- A. Hydrants shall have permanent markings identifying the manufacturer by name, initials, insignia, or abbreviations in common usage, and designating the size of the main valve

opening and the year of manufacture. Markings shall be so placed as to be readily discernible and legible after hydrants have been installed.

- B. CONTRACTOR shall furnish certification to ENGINEER that the hydrant and all material used in its construction conform to the applicable requirements of AWWA C502 and the supplementary requirements thereto.
- C. Yard Hydrants:
  - 1. Yard hydrants shall be #2 Eclipse Post Hydrant as manufactured by Kupferle Foundry, St. Louis, Missouri, or equal, with one 2 1/2-inch hose nozzle. Inlet connection shall be 4-inch mechanical joint. Yard hydrant shall have a maximum working pressure of 150 psig. Provide one operating wrench for each hydrant. Provide all yard hydrants with 1 1/2-inch hose adaptor from 2 1/2-inch hose nozzle and four adaptors to 3/4-inch hose from 1 1/2-inch hose nozzle. Hydrant cover depths of 3 feet shall be provided.
  - 2. Yard hydrants shall be installed as shown on the Drawings and in accordance with manufacturer's recommendations.
- D. Yard hydrants shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the pressure relief valves and yard hydrants once assembled. Cleaned surfaces shall then be factory shop primed. Factory shop prime with one coat of Tnemec N69 or N140, Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all valves, hydrants, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

## 2.06 CONCRETE

- A. All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 03.

## 2.07 AGGREGATE SLURRY (FLOWABLE) BACKFILL

- A. Aggregate slurry (flowable) backfill shall consist of fine and coarse aggregate conforming to ASTM C33. Coarse aggregate shall be size number 67 and fine aggregate shall be size number 4. The material shall be mixed with water to provide an approximate 3-inch slump. The mix shall be deposited in the trench from ready-mix concrete transit mix trucks and shall be consolidated using concrete vibrators or vibratory plate compactors.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Underground Piping:
  - 1. Utility lines shall be laid and installed to the lines and grades specified with valves, fittings, manholes, and other appurtenances at the specified locations; spigots centered in bells; and all manholes and riser pipes plumb. Gravity sewer mains and laterals shall maintain a minimum 3 feet of cover but shall be deep enough to provide

service to buildings. Service lines shown on the Drawings are approximate. Staking shall be completed in conformance with Division 01.

2. Deviations Occasioned by Underground Facilities: Wherever significant obstructions not shown on the Drawings are encountered during the progress of the Work, CONTRACTOR shall proceed in accordance with the General Conditions to notify owners and protect the facilities. Existing items unnecessarily damaged during the performance of the Work shall be repaired and replaced at the expense of CONTRACTOR.
3. Prior to commencing pipe laying, CONTRACTOR shall notify ENGINEER of the intended date for starting Work. ENGINEER may request at CONTRACTOR's expense the removal and relaying of pipe which was installed prior to notification of ENGINEER.
  - a. Proper implements, tools, and facilities shall be provided and used by CONTRACTOR for the safe and convenient prosecution of the Work. All pipe, fittings, and appurtenances shall be carefully lowered into the trench piece by piece with a crane, rope, or other suitable tools or equipment, in such manner as to prevent damage to materials. Under no circumstance shall pipe be dropped or rolled into the trench.
  - b. Materials shall be as shown on the Drawings or as specified herein.
4. Material Inspection: CONTRACTOR shall inspect the pipe, fittings, and appurtenances for defects when delivered to the jobsite and prior to lowering into the trench. Defective material shall be removed from the jobsite. All material shall be clean and free of deleterious substances prior to use in the Work.
5. Except where noted or specified, all ductile iron underground piping shall be laid in accordance with AWWA C600 with the conditions that (a) blocking shall not be used to support pipe and (b) all bends and fittings shall be restrained as specified below, and pipe joints shall be restrained in all directions from all bends and fittings to the length as specified below.
6. Pipe Length:
  - a. The minimum length of pipe to be restrained shall be as shown in the following table.
  - b. This table assumes horizontal orientation of fittings, 150 psi test pressure plus a 100 psi water hammer allowance, ductile iron pipe, and a 3-foot bury. Lengths shall be adjusted for other conditions and fittings. For other fittings and for more specific requirements, see the Drawings:

#### REQUIRED LENGTH OF RESTRAINED PIPE BEYOND FITTING IN FEET

Fitting	Minimum Length-Ft
90 Degree Bend ( $\leq$ 6 inches)	36
90 Degree Bend (8 inches to 10 inches)	54
90 Degree Bend (12 inches to 14 inches)	72
90 Degree Bend (16 inches)	84
45 Degree Bend ( $\leq$ 8 inches)	18
45 Degree Bend (10 inches to 16 inches)	36
22 1/2 Degree Bend $\leq$ 16 inches	18
11 1/4 Degree Bend $\leq$ 16 inches	9
Fire Hydrant Leads	All Joints
Tees ( $\leq$ 4 inches)*	18 (Along Branch)
Tees (6 inches to 8 inches)*	36 (Along Branch)
Tees (10 inches to 12 inches)*	54 (Along Branch)
Tees (14 inches to 16 inches)*	72 (Along Branch)

\*Restrained run length on tees assumed 18 feet on each side of fitting.

7. PVC sewer and plant drain piping shall be installed in accordance with ASTM D2321. Except where noted or specified, PVC or other thermoplastic pressure piping shall be installed in accordance with ASTM D2774.
8. CONTRACTOR shall lay all gravity pipe to the line and grade shown on the Drawings with bell ends uphill wherever possible. If not possible, CONTRACTOR shall lay pipe to the line and grade shown on the Drawings with bell ends in the direction of laying. Water piping and chemical solution piping shall have a minimum of 3 feet of cover. Unless shown otherwise, drainage piping shall clear floor slabs or footings by a minimum of 6 inches.
9. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used. Pipe must be kept clean of mortar, cement, clay, sand, or other material. When PVC piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.
10. At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. Acceptable plugs include Foreman Nite Caps by APS, mechanical joint cap or plug, bladder plug, or test plug. All foreign material shall be removed from the pipe prior to acceptance.
11. The locations and elevations of existing piping and manholes are approximate. Where necessary, existing piping shall be exposed by CONTRACTOR to confirm location and elevation before installing new piping. Any changes in pipe location or elevation shall be approved by OWNER.
12. General Excavation:
  - a. Pipe Laying:
    - (1) All pipe shall be laid accurately to the line and grade as designated. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be joined or of the factory made jointing material shall be clean and dry. Lubricants, primers, adhesives, and other joint material shall be used and installed as recommended by the pipe or joint manufacturer's specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined, and adjusted in such a workmanlike manner as to obtain the degree of watertightness specified. Pertinent specifications from the joint and pipe manufacturer which outline procedures to be followed in making the joint shall be furnished to ENGINEER.
    - (2) Wyes, tees, and special fittings shall be installed as called for on the Drawings, or as requested by ENGINEER. Wyes, tees, and special fittings, shall, in general, be jointed with the same type of joint as used in the pipe.
    - (3) In joining two dissimilar types of pipe, manufactured adapters and fittings shall be used. Adapters and fittings shall be configured to maintain invert elevations at same level.
    - (4) Joint deflections shall not exceed the limits established by the pipe manufacturer for the pipe and joint being used.
    - (5) Joints that are damaged because of carelessness, improper handling, or failure to prevent imperfections in manufacture shall be subject to rejection and gaskets shall be subject to rejection whenever they show surface cracking, tears, or splice separation.
    - (6) At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. All foreign material shall be removed from the pipe prior to acceptance.

- (7) After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with specified backfill material tamped around it except at the bells.
- (8) Pipe shall be brought home by using a cross member and levers or jacks. It will not be permissible to push pipe home with motor powered excavation equipment.
- b. Abandoning Utilities: Utilities to be abandoned shall, unless otherwise noted on the Drawings, be abandoned in place. Open ends of pipes shall be plugged with 12 inches of concrete. Manhole barrels, valve boxes and other such structures shall be removed to a point 3 feet below existing or final ground surface, whichever is lower, and shall then be filled with backfill material compacted to that of the trench backfill. An approximate 9-inch-diameter opening shall be made in the bottom of the structure to allow for groundwater movement.
- c. Connections to and Modifications of Structures and Mains:
  - (1) Unless otherwise noted on the Drawings, openings in existing structures to allow for connection of mains shall be core drilled, and the mains themselves shall be connected by use of watertight connections as specified in the Standard Specifications. Flow channels in the bottoms of existing structures shall be modified as necessary to provide smooth transition for incoming flow and/or orientation of mains. These modifications may include breaking out and reforming flow channels.
  - (2) Where mains, new and existing, are to intersect, dog house manholes shall be provided to facilitate connection and to gain access to the intersecting mains. Manholes shall be provided at the manufacturing plant with arched openings in lower barrel section to span each of the intersecting mains. Reinforcing shall be cut and bent back. In the field, manhole shall be set on concrete blocks, with reinforcing provided according to Drawing 01-975-43A for the bottom slab. Concrete shall be poured under and around the manhole to seal all openings, cover and adhere to the slab and bent reinforcement, and provide for benches or fillets in the manhole. Sanitary and storm sewer mains shall be kept intact until the bench or fillet is poured. Then the top of pipe to springline shall be removed to provide access.
- 13. Valve Boxes: The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.

### 3.02 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all televising, testing, cleaning, and disinfection in the price bid.
- B. Work shall be tested as specified in this section. Unless indicated in writing before testing begins, tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.
- C. New piping shall be tested. Prior to conducting the pressure and leakage test, CONTRACTOR shall backfill the trench for its full depth. All bends and special connections to the main shall be adequately blocked and tied prior to the test. Any damage caused to



the main or its appurtenances during performance of these tests shall be corrected by CONTRACTOR at its expense. Should underground piping fail test, CONTRACTOR shall be responsible for removal and replacement of backfill, and relay new pipe if necessary, to repair the defective pipe. Under no circumstances shall defects be sealed from the interior of the pipe, and only where specifically allowed by ENGINEER, shall defects be sealed from the exterior of the pipe. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint. Piping and appurtenances shall be watertight or airtight and free from visible leaks. Manholes and precast reinforced concrete wet wells and appurtenances shall be free of any visible leaks. Any leakage shall be sealed by methods acceptable to OWNER, from the exterior of the manhole or structure. Precast reinforced concrete manhole risers and tops shall be tested in accordance with ASTM C497.

- D. Piping shall be flushed or blown out after installation prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Pressure Tests:
1. Pressure tests shall be performed as required by AWWA C600, unless otherwise noted herein.
  2. When test medium for piping is water, all air shall be removed from piping by flushing, opening vents, loosening flanges, utilizing equipment vents and/or installation of corporations at high points in system. Test pumping equipment used shall be centrifugal pumps or other pumping equipment that will not place shock pressures on the main. Power plunger pumps will not be permitted for use on closed pipe systems. Pumps shall be disconnected during test periods. Presence or absence of air will be determined during pressurization of the piping system.
  3. The test pressure in all lines shall be held for two hours, during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids shall be tested at the higher test pressure.
  4. During performance of the hydrostatic pressure test, water main shall be subjected to a minimum pressure of at least 50% above normal working pressure with a minimum pressure 125 psi. Force main shall be tested to 200% of normal operating pressure in the main, but to no more than the pressure rating of the pipe.
  5. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results.
  6. Where connections are made to existing mains, it shall be the responsibility of CONTRACTOR to provide the necessary hydrostatic tests on all new mains installed. This may necessitate, but is not limited to, the installation of temporary valves and restraint to isolate the new system from the existing system. All materials, Work, and equipment necessary for this Work shall be furnished by CONTRACTOR at its expense.
  7. All testing of pipelines shall proceed concurrently with installation. CONTRACTOR is encouraged to conduct daily preliminary testing of its Work.
  8. Water from disinfection testing shall not be discharged to a stream, creek, river, storm sewer tributary thereto, or to a navigable water without first neutralizing the chlorine residual in the water and complying with local, state, and federal laws thereto.

9. Gauges used for testing shall have increments as follows:
  - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
  - b. Tests requiring a pressure of greater than 10 psi by less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
  - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
CLS, SHS	150	Water	"A" <sup>(1)</sup>
SCM (Gravity Flow)	10	Water	"A"

<sup>(1)</sup> Leakage allowance designation "A" shall mean not more than 0.002 gallons per hour per inch diameter per 100 feet of buried pipe for all piping except buried mechanical joint pipe. Buried mechanical joint pipe shall meet the leakage specifications of AWWA C600.

- F. Prior to making final connection between new and existing piping, new piping shall be tested as specified above.

G. Infiltration/Exfiltration Tests—Leakage Testing:

1. All sanitary sewer gravity mains, drains, and those pipes designated as D shall be tested for leakage after installation of laterals and placement of backfill. Leakage testing of thermoplastic and iron sanitary sewer gravity mains shall be conducted in accordance with ASTM F1417. Testing of clay sanitary sewer mains shall be in accordance with ASTM C828. Testing for concrete sanitary sewer mains shall be in accordance with ASTM C1214. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results.
2. Sewers 18 inches and larger may be tested for leakage by infiltration or exfiltration in lieu of vacuum testing. Concrete pipe shall be tested per ASTM C969 except as modified herein. If groundwater is 2 feet or more above the sewer, measurements will be taken to determine the rate of infiltration into the sewer. If groundwater is below 2 feet above the sewer, the stretch of sewer shall be plugged at its downstream end and water shall be placed inside the sewer to provide a minimum of 4 feet of head above the upstream end.
3. Measurements will then be taken to determine the rate of leakage out of the sewer. CONTRACTOR shall furnish all labor and materials necessary for making the tests. The allowable leakage shall be as indicated below for final acceptance.
4. At the conclusion of construction and before final acceptance of the Work, the downstream end of all sanitary sewer will be measured for infiltration. Allowable infiltration shall not exceed 100 gallons/inch of pipe diameter/mile/day for that portion of the Work under groundwater. If infiltration is exceeded, the leak or leaks shall be located and repaired.
5. CONTRACTOR shall prepare all pipeline for testing and shall furnish all equipment, materials, tools, and labor necessary for performance of the tests. Equipment for the low pressure air test of gravity mains shall be equal in all operational aspects to that as furnished by Cherne Industries, Inc., United Survey, or equal.
6. Test apparatus and gauges shall be located such that ENGINEER or OWNER do not have to enter a confined space to verify readings.

7. Air and leakage testing of storm sewers will not be required.

### 3.03 CLEANING AND DISINFECTION

- A. All equipment and materials shall be clean before installation.
- B. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- C. All waste disposal areas and all areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off, cleaned up, and returned to condition that existed prior to construction.
- D. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.

### 3.04 CLEANUP

- A. Upon completion of the work, all improvements disturbed by CONTRACTOR's operations shall be repaired or replaced. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- B. All areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off and cleaned up. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.
- C. All pipes and manholes shall be flushed until clean, and all debris and mud shall be removed.

### 3.05 DEMOLITION

- A. All exterior piping removals, including manholes and appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Where necessary, existing piping shall be exposed before installing new piping. Any changes in pipe location or elevation shall be reviewed by ENGINEER.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal. Unless otherwise shown or specified, piping shown or specified to be abandoned shall have each end plugged with concrete or nonshrink grout. Nonshrink grout shall be as specified in Division 03. Wherever excavations cross piping to be abandoned, piping shall be removed to the limits of the excavation and the ends shall be filled as specified above.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.

- D. It is the responsibility of CONTRACTOR to remove the items listed below, including piping and appurtenances, as specified, and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner. All costs shall be included in the Lump Sum Bid.

END OF SECTION

## SECTION 33 52 16

### FUEL GAS DISTRIBUTION UTILITIES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. This section contains specifications for all fuel utility distribution systems for this project.  
Work included:
  - 1. Natural gas, aboveground.
  - 2. Buried natural gas piping.
  - 3. Vents and relief valves.
  - 4. Unions and flanges.

##### 1.02 CODES AND STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. NFPA 54–National Fuel Gas Code (Current Edition).
  - 2. Polyethylene gas distribution piping shall be installed in accordance with CFR 49, Part 192, Subpart G (mains), Subpart H (service lines), applicable codes and regulations, and ASTM D2774.

##### 1.03 WELDER QUALIFICATIONS

- A. Before any polyethylene fusion welding is performed, CONTRACTOR to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- B. OWNER reserves the right to test the work of any welder employed on the project, at CONTRACTOR's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

##### 1.04 NATURAL GAS SERVICE

- A. The Utility Company is Columbia Gas. The natural gas utility provider contact information obtained during design is Columbia Gas. CONTRACTOR is responsible to verify this information as well as installing and coordinating all aspects of the natural gas service.

#### PART 2–PRODUCTS

##### 2.01 NATURAL GAS–ABOVEGROUND

- A. See Section 23 11 23–Facility Fuel Gas Piping for specifications.

## 2.02 BURIED NATURAL GAS PIPING

- A. Manufacturers: Performance Pipe, a division of Chevron Phillips Chemical Company LP, JM Eagle, or equal.
- B. Buried natural gas pipe tubing, fittings, and joints shall be PE 2708 (PE 2406) polyethylene, SDR-11 or less, ASTM D2513 and D3350 pipe and fittings. Provide butt-weld fittings conforming to ASTM D3261 or socket-type fittings conforming to ASTM D2683.
- C. Polyethylene pipe tubing, fitting, and joint materials shall be compatible and by same manufacturer. Fabricated fittings shall not be used. Match fittings to service rating of pipe.
- D. Provide an anodeless riser connection between buried plastic gas service piping and metallic riser in accordance with the local codes. Provide a metallic riser consisting of HDPE fused coating on steel pipe for connection to aboveground building distribution piping. Underground horizontal metallic portion of riser shall be at least 24 inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser. Provide Elster, George Fischer Central Plastics, or equal.
- E. Gas Transition Fittings: Provide manufactured steel transition fittings approved for joining steel and polyethylene pipe, conforming to AGA XR0603 requirements for transition fittings. Transition fittings shall be manufactured by Continental, Elster, George Fischer Central Plastics, or equal.
- F. Underground installation of piping shall conform with ASTM D2774.
- G. Provide tracer wire as specified.

## 2.03 VENTS AND RELIEF VALVES

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

## 2.04 UNIONS AND FLANGES

- A. See Section 23 11 23–Facility Fuel Gas Piping for aboveground system specifications.
- B. Do not use flanges for underground gas or oil systems. Use fittings that are solvent-welded or fusion-bonded joints only.

# PART 3–EXECUTION

## 3.01 INSTALLATION

- A. Gas piping shall be installed in accordance with state, local, and utility codes and the National Fuel Gas Code, NFPA No. 54. All natural gas piping shall be tested in accordance with all state, local, and utility codes pertaining to natural gas service or service requirements. CONTRACTOR shall arrange for natural gas service and shall coordinate

service size and location and shall furnish and install all shutoff valves and pressure reduction as required.

- B. CONTRACTOR shall excavate and lay all pipe to the line and grade shown on the Drawings. Grade stakes will be required for all lines.
- C. Where piping is laid in native soil, the width of trench below the top of the pipe shall not exceed the nominal diameter of the pipe plus 2 feet for all pipelines. Where the maximum trench width is exceeded, the pipe shall be placed in a concrete cradle or a stronger pipe used. If the maximum trench width is exceeded for any reason other than as otherwise specified, the concrete cradle or the stronger pipe shall be placed at CONTRACTOR's expense, unless CONTRACTOR can demonstrate that the pipe to be used is compatible with the resulting load applied.
- D. Thermoplastic pressure piping may be bedded in compacted sand. CONTRACTOR shall perform all necessary excavation and shall provide all required materials to provide this bedding. Bedding material shall conform to the requirements of ASTM C33. The material shall be hard, tough, and durable and shall meet the following gradation requirements.

#### PERCENTAGE BY WEIGHT PASSING

	Bedding Sand
1 inch	---
3/4 inch	---
1/2 inch	---
3/8 inch	100
No. 4	95 to 100
No. 8	80 to 100
No. 30	25 to 60
No. 100	5 to 20
Passing No. 200	2 to 10

- E. No materials native to the trench shall be used as bedding material unless they meet the above specifications.
- F. When piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.
- G. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.
- H. Material that is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified, (a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable for cover material, (c) no stones larger than 3/4 inch in their greatest dimension shall be allowed in the cover material, and (d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be sand. Cover material for PVC pressure or other thermoplastic piping may be sand.

- I. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously. Cover material shall be placed over the top of the pipe to the height as shown on the Drawings for Class "B" (minimum 12 inches) or Class "C" (minimum 6 inches) Bedding. This backfill shall be placed by hand in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers. If bedding material conforming to any of the above three crushed stone or crushed gravel gradations is used as cover material, it need not be tamped. The remaining 6 inches to make up the required 1 foot of select cover material for Class "C" Bedding shall be granular material specified previously with no stones larger than 3/4 inch.
- J. All cover material shall be placed in maximum 6-inch layers and compacted by hand tamping. Compaction shall be equivalent to that described under "Compacted Fill and Backfill" as specified in Section 31 23 00–Excavation, Fill, Backfill, and Grading.
- K. Except as otherwise specified, all backfill above 1 foot above the pipe shall be "Compacted Fill and Backfill" as specified in Section 31 23 00–Excavation, Fill, Backfill, and Grading.
- L. The locations and elevations of existing piping is approximate. Where necessary, existing piping shall be exposed by CONTRACTOR to confirm location and elevation before installing new piping. Any changes in pipe location or elevation shall be approved by OWNER.
- M. Install an electrically conductive 10 gauge copper wire with yellow insulation with buried natural gas piping. The tracer wire shall be installed at a distance of 4 inches to 6 inches adjacent to the pipe. The wire and all of its connections shall be insulated to prevent corrosion.
- N. Do not install natural gas piping in same trench with other utilities. Minimum horizontal clearance between gas pipe and parallel utility pipe shall be 2 feet. Natural gas pipe shall not be installed through catch basins, vaults, manholes or similar underground structures.
- O. Natural gas entrances into buildings shall be above grade.
- P. Protection Against Shear and Bending Loads: In accordance with ASTM D2774, natural gas connections shall be protected where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle, or tapping tee on a main pipe, and where pipes enter or exit casings or walls. The area surrounding the connection shall be embedded in properly placed, compacted backfill, preferably in combination with a protective sleeve or other mechanical structural support to protect the polyethylene pipe against shear and bending loads.
- Q. Butt, socket, and saddle fusion joints in polyethylene natural gas piping shall be made using procedures that have been qualified and approved by the Operator in accordance with Title 49, CFR, and Part 192.283.
- R. In accordance with CFR. 49, part 192, Section 192.285, the Operator shall review that all persons making heat fusion joints have been qualified to make joints in accordance with the Operator's Approved Qualified Fusion Procedures. The Operator shall maintain records of qualified personnel, and shall certify that qualification training was received not more than 12 months before commencing construction. CONTRACTOR shall review that all persons making heat fusion joints are qualified in accordance with this section.



- S. Butt fusion of unlike wall thickness: Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR. Transitions between unlike wall thickness greater than one SDR shall be made with a transition nipple or by mechanical means or electrofusion.
- T. Polyethylene natural gas pipe and fittings may be joined together or to other materials by transition fittings, fully restrained mechanical couplings, or electrofusion. These devices shall be designed for joining polyethylene to another material and shall be approved by ENGINEER for use in natural gas distribution system.
- U. When mechanical OD compression couplings are used, polyethylene natural gas pipe shall be reinforced with a stiffener in the pipe bore. Stiffeners shall be properly sized for the diameter and wall thickness of polyethylene pipe being joined. For service pipe connections, the stiffener length shall match the pipe end penetration depth into the coupling.
- V. General Excavation:
  - 1. CONTRACTOR shall do all excavation, undercutting, dewatering, and backfilling necessary for work under this contract unless otherwise noted. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.
  - 2. Work shall conform to other sections of Division 31, except where modified by this section.
  - 3. Pipe shall be placed only on dry foundations. No extra payment will be made to CONTRACTOR for dewatering.
  - 4. Excavation shall include all necessary clearing of excavated areas, tree removal, all grubbing, all wet, dry, fill, and rock excavation, the removal of pavement, filling, and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling. All above work shall be included in the Lump Sum Bid.
  - 5. CONTRACTOR shall excavate whatever materials are encountered as required to place at the elevations shown, all pipe and other work as required to complete the project as shown. The bottom of the excavation shall be leveled off, all loose and disturbed soil shall be removed, and it shall be hand-tamped prior to pipe, manhole, etc., installation. Where requested by ENGINEER, original material below the excavation necessary for construction according to grades shown or specified shall be removed and replaced in accordance with Section 31 23 00—Excavation, Fill, Backfill, and Grading.
  - 6. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present underground services shown on the Drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.
  - 7. Excavated native material that is unsuitable or not required for filling shall be removed from the site. Materials to be used for fill and suitable for this purpose shall be deposited where required except that no fill shall be placed where trenches for sewers, water lines, or other services will be located until after the trench work is completed.
  - 8. CONTRACTOR shall provide adequate shoring, sheet piling, and bracing to prevent earth from caving or washing into the excavation and shall do all shoring and underpinning necessary to properly support adjacent or adjoining structures. All shoring, sheet piling, and underpinning must be maintained until permanent support is provided.

9. Any water, drainage, gas, sewer, or electric lines encountered in the excavation that are not to be disturbed shall be properly underpinned and supported. Any service connections encountered that are to be removed shall be cut off at limits of the excavation and capped in accordance with the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.
- W. Gas lines shall not be installed under buildings, structures, or in crawl spaces.
- X. A Schedule 40 steel sleeve shall be installed on all natural gas risers passing through asphalt or concrete slabs. Allow at least 1 inch of radial clearance between sleeve and riser. Void shall be filled with pea gravel.
- Y. Natural gas piping shall be buried a minimum depth of 36 inches, unless noted otherwise.
- Z. Install all valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.
- AA. Pitch horizontal piping down 1-inch in 60 feet in the direction of flow to dirt leg that is to be located in building for accessibility. When installing mains and branches, cap gas-tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- BB. Do not install gas pipe below a building or its foundation or in a ventilation air plenum.
- CC. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least 5 feet above grade.
- DD. All joints in underground polyethylene gas pipe must be made by qualified personnel proficient in the joining methods of ASTM D2513 thermoplastic gas pressure pipe and polyethylene fittings. Do not install polyethylene gas pipe inside buildings.
- EE. Install shut off valves as shown on Drawings. Provide valve box and valve operator per NFPA and AGA standards.
- FF. Blow compressed air into gas piping system as a part of commissioning system, before placing into service, to clean piping until target cloth is clean and free of debris.
- GG. Use for all underground metallic piping or underground metallic gas conduit.
- HH. Remove all dirt and other foreign material from exterior of pipe. Apply primer as recommended by the manufacturer. Use a spiral wrap process for applying tape to the pipe. Repair any breaks in the tape coating caused by the installation process.
- II. Concealed or underground unions or flanges are not acceptable.

### 3.02 FIELD QUALITY CONTROL

- A. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.

- B. Provide all piping, fittings, blind flanges, and equipment to perform the testing.
- C. Conduct pressure test with test medium of air unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Division's representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- D. Do not backfill pipe until it has been successfully tested.
- E. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.
- F. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

System	Pressure	Medium	Duration
Natural gas	30 psig	Air	24 hr

- G. On piping that cannot be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

END OF SECTION

## SECTION 40 05 00

### PIPING AND APPURTENANCES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All piping, valves, and appurtenances of every description except for pipe as specified in Divisions 33, 43, and 46.
  - 2. Concrete foundations and anchor bolts for all equipment furnished under this section.
  - 3. Piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Applicable provisions of Section 01 33 00—Submittals cover requirements for shop drawings and Operation and Maintenance Manuals.

#### PART 2—PRODUCTS

##### 2.01 MATERIALS OF CONSTRUCTION

- A. Materials of Construction: All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. Products used in potable water systems shall be UL classified in accordance with ANSI/NSF-61 for potable water service and shall meet the low-lead requirements of NSF-372.
- B. Size and Type:
  - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.
  - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER. All grooved joint couplings and fittings shall be of the same manufacturer.

##### 2.02 PIPE AND PIPE FITTINGS

- A. Ductile Iron Piping and Fittings:
  - 1. Unless otherwise shown or specified, all interior piping 4 inches in diameter or larger shall be ductile iron conforming to AWWA C151.

2. Interior piping shall be minimum Special Class 53 with a minimum rated working pressure of 250 psi.
3. Except where shown, interior pipe joints shall be flanged. Flanged joints shall conform to applicable flanged joint sections of AWWA C110, C111, and C115 and shall be compatible with ANSI B16.1 Class 125. Flanges shall be ductile iron.
4. Gaps between flanges and all locations where a gap exists at flange hub/pipe intersection shall be caulked prior to finish painting with Sonneborn NP-1 by Sonneborn-Chem Rex, Inc., Sika FLEX 1-A, or equal. CONTRACTOR shall verify compatibility of caulk with finish painting system specified in Division 09. Caulking shall be completed following installation and testing. Trim back excess edge of rubber gasket between flanges as necessary to achieve a uniform and flush caulk joint, but no more than 1/8-inch from outside edge of flange. Caulking shall be done and fully cured as required prior to painting of piping.
5. Flanged gaskets shall be minimum 1/8-inch-thick, styrene butadiene rubber (SBR), full-face, Toruseal, Flange-Tyte, Maloney, or equal, gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerance. All aeration piping shall have FKM gaskets designed for a minimum of 300°F service.
6. Flanged bolts and nuts installed in wet wells, digesters, and other submerged locations shall be 316 stainless steel.
7. Flanged fittings shall be of ductile iron with ductile iron flanges. Flanged fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
8. Unless otherwise specified, all ductile iron piping and fittings shall be cement mortar lined and asphaltic-coated inside. Cement mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Exterior exposed, submerged, and interior piping shall be furnished with outside surfaces prepared by abrasive blasting in accordance with NAPF 500C-03. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all piping, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.
9. Unless otherwise specified, piping and fittings in manholes and wet wells shall be asphaltic-coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.

**B. Copper Piping:**

1. Copper piping shall conform to the requirements of ASTM B88.
2. Shutoff valves shall be placed on each branch for all underground, aboveground, or interior piping.
3. Pump vent and drain lines, seal water supply and other small-diameter interior piping from the PW or NPW source, and manometer lines shall be rigid, Type K hard copper. An ample number of unions shall be provided for disassembling. Pump vents shall be valved.

**C. Stainless Steel Air Piping:**

1. Air piping where shown on the Drawings as being "SS" shall be 304L stainless steel with a 2D finish conforming to AISI 304L and ASTM A240, minimum gauges as follows:
  - a. Up to and including 12-inch diameter: 12 gauge.

- b. 14-inch up to and including 18-inch diameter: 11 gauge.
  - c. 20-inch diameter: 10 gauge.
  - d. Greater than 20-inch diameter: 8 gauge.
2. Piping 3 inches in diameter or larger shall conform to ASTM A778 (welded fittings shall conform to ASTM A774) or shall conform to ASTM A312 (welded fittings shall conform to ASTM A403).
  3. Bolts, washers, and follower flanges shall be made of Type 304 stainless steel. The nuts shall be low silicon bronze per QQ-C-591, Alloy 651. All anchor bolts shall be Type 304 stainless steel. Follower flanges on interior piping may be galvanized ductile iron.
  4. Connections between sections of pipe shall be by special flanged joints. These joints shall be designed so that individual pipe sections can be rotated independently of adjacent sections for alignment purposes. Flanged joints shall be of the face ring follower flange type with through bolts. Gaskets shall be EPDM, full face. Expansion joints shall be provided where necessary. Where connections are made to ductile iron or PVC piping, flanges shall be compatible with the mating pipe.
  5. All 304L material shall conform to the chemical requirements of ASTM A240 and AISI 304L. The maximum carbon content shall be limited to 0.030%.
  6. Flanges shall be shop-welded to the pipe. All welding shall be by the gas tungsten arc welding (GTAW), or gas metal arc welding (GMAW) method. Filler wire shall be added to all welds to provide for a cross section of weld metal equal to, or greater than, the parent metal. Butt welds shall have full penetration to the interior surface, and gas shielding shall be provided to the interior and exterior of the joint.
  7. Interior weld beads shall be smooth and evenly distributed with an interior projection not exceeding 1/16 inch beyond the pipe I.D. The outside weld area shall be wire brushed. Brushes shall be of stainless steel and used only on stainless steel. All discoloration and deposits left by welding shall be removed by pickling. If welding is performed on site, piping shall be immersed in acid solution and acid-washed for manufacturer-determined temperature and period of time. In lieu of full immersion for on-site welds, field welds may be treated as described in the following Paragraph 2.02.C.10.
  8. After manufacture of pipe and fittings, all stainless steel shall be passivated by immersion in a pickling solution of from 5% to 25% of nitric acid (65% strength) and 1% to 3% hydrofluoric acid (60% strength), both by volume, in water at a bath temperature of 120°F to 140°F for a minimum of 10 to 15 minutes, as determined by test. Scrubbing shall be completed as required. Immediate final thorough rinsing shall be completed in clean hot water followed by drying. Parts shall be free of iron particles or other foreign material.
  9. The exterior finished weld and heat-affected zone on stainless fabrications shall be cleaned using a pickle paste solution. All interior welds, where accessible, shall be cleaned with Scotch Brite EXL, or equal, deburring wheel. All weld spatter on the entire fabrication shall be removed.
  10. All field welding of stainless steel pipe shall be minimized and subject to the review of ENGINEER. Field welding shall be shielded metal arc welding (SMAW) or GTAW for piping 8 inches and smaller. All field welding shall be accomplished by certified welders and using qualified procedures in accordance with ASME Section IX. Acceptance criteria to ASME B31.9. All field welds shall be wire-brushed after completion, and grinding shall be provided as required. All field welds shall be passivated with Oakite 33, or equal solution. Upon request, QW 484 forms shall be submitted to ENGINEER.
- D. CPVC Piping:
1. Sodium Hypochlorite (SH), chemical feed, chemical solution, chemical piping shall be CPVC.

2. CPVC material used in manufacturing piping and fittings shall conform to ASTM D1784, Class 23447.
3. CPVC piping shall be CPVC 4120, Schedule 80, high-impact conforming to ASTM F441. Piping and fittings shall be approved for use by the National Sanitation Foundation. All pipe delivered to the jobsite shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided as required. In general, all joints shall be solvent weld, except where flanges are shown on the Drawings. All piping shall be supported at spacing not exceeding that recommended by the manufacturer.
4. Solvent cement for CPVC piping shall be specifically designed for piping systems receiving chemical resistance. Cement shall be Oatey EP42, IPS Weld-On ZZ724, or equal.
5. CPVC Schedule 80 pressure fittings shall meet requirements of ASTM F437 (threaded type) and ASTM F439 (solvent weld socket type). All internal threads shall be machine-taped to the requirements of ANSI/ASME B1.20.1. The quick burst strength of the fittings shall be equal to or greater than the burst strength of the equivalent Schedule 80 CPVC pipe. Fittings shall be made of CPVC 23447-B, or better.
6. All exterior or CPVC piping in open tanks shall be formulated with sufficient ultraviolet light screeners to provide for long-term outdoor exposure with no deleterious effects.

E. Double Wall PVC Piping:

1. Piping system for chemical piping outside of chemical containment areas, including underground, but interior to the building, shall be double wall as manufactured by GUARDIAN, New Baltimore, Michigan, or equal. Piping system shall include all piping, fittings, valves, and supports. Piping system shall consist of a Schedule 80 PVC interior pipe and Schedule 40 PVC exterior pipe suitable for carrying 15% sodium hypochlorite. Pipe system shall be provided with suitable drains, vents, and termination fittings and be designed to provide complete drainage of both primary and secondary containment to a low area where visual leak detection is located. A minimum of 1 visual leak detection systems consisting of a tee, a clear PVC sump, and a drain valve shall be provided per 50 linear feet of piping and fittings. Primary containment shall be supported within the annular space using interstitial support devices. All prefabricated pressure fittings shall be pretested by the manufacturer. All installation, cleaning, and testing procedures shall be according to the manufacturer's specific recommendation. Piping system shall be designed to allow for temperature and pressure consideration.
2. Leak detection system for WWTP SH piping shall be as manufactured by GUARDIAN, New Baltimore, Michigan, or equal. System shall include one sensor for each pipe line, 5-zone panel in a NEMA 4 enclosure, and audible and visual signals. Panel shall be located in the new Chemical Building. Signal for SH piping shall be indicated in the SCADA System and shall automatically shut down the SH pumps. See Division 26 and Division 46 for additional control and pump information.

F. Flexible PVC Piping:

1. Flexible hose connections between chemical totes and rigid chemical feed piping shall be Series K3280 Reinforced PVC Flexible Connection Hose, as manufactured by Kuriyama of America, Inc., or equal.
2. PVC hose shall have a maximum working pressure of 125 psi at 150°F.
3. Hose shall be clear and compatible with chemicals being used.
4. All hoses shall be provided with suitable fittings and connectors to connect hose to tanks and rigid piping. Fittings and connectors shall be compatible with chemicals being used.
5. Hose shall be certified under NSF/ANSI Standard 61.

## 2.03 VALVES

### A. Gate Valves:

1. Shutoff valves in ductile iron lines containing wastewater and shutoff valves in potable and non-potable water lines 4-inch diameter and larger shall be AWWA C515, ductile iron, resilient seat, nonrising stem, OS&Y (rising stem) for wastewater applications, 150 psi working pressure with O-ring packing box, Kennedy, American, American AVK, or equal.
2. Where shown or specified, gate valves in lines 4 inches in diameter or larger shall be AWWA C500 iron body, bronze-mounted, nonrising stem, double-disc, parallel seat, Class 150, O-ring stem seals.
3. Shutoff valves in non-potable water lines, grit flush water lines, pump vent and drain lines 1-inch diameter through 3-inch diameter shall be gate valves, Class 150, bronze or iron body bronze-mounted, solid wedge disc, threaded, rising stem, Nibco T-131, Milwaukee Valve 1150, or equal. Provide unions for ease of valve removal.
4. Underground valves shall have extended stem, cast iron telescopic valve box, and key. Exposed valves not in reach of the floor (7 feet to centerline, or greater) shall have chain wheel operator. All other valves shall have handwheels. Right angle operators shall be provided, if required, because of valve position.
5. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated (prime and finish coats) as specified in Division 09. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

### B. Plug Valves:

1. Shutoff valves in ductile iron lines containing wastewater and all scum lines and drainage lines shall be DeZURIK Series PEC or PEF 100% port Eccentric, or equal.
2. Eccentric-type valves shall be nonlubricated rectangular-ported with resilient faced plugs and end connections as shown on the Drawings. The plug profile shall be of a cylindrical eccentric shape so that the vertical face of the plug is straight and the horizontal face is eccentrically curved in relation to the plug shafts. Segmented ball valves with spherical plugs shall not be acceptable. Port areas shall be at least 100% (PEF) or 80% (PEC) through 20 inches and 70% (PEC) for 24 inches and above of full pipe area. Valve bodies shall be of ASTM A126, Class B cast iron. Valve bonnets shall be of the same material as the body. Resilient plug facings shall be chloroprene or Buna-N, suitable for use with wastewater. The valve shall be oriented with the shaft horizontal, seat upstream, and plug above flow stream when open.
3. Valves shall be furnished with corrosion-resistant seats, replaceable oil-impregnated permanently lubricated 316 stainless steel sleeve-type bearings and grit shaft seals on both upper and lower bearing journals that comply with the latest edition of AWWA C507



and C504. All valves except for valves in buried or digester gas service shall include grease fittings on upper and lower journals. Bodies of 3-inch and larger valves shall be furnished with a minimum 1/8-inch-thick machined smooth-welded overlay seat of not less than 90% nickel. Seat area shall be raised surface completely covered with weld so that the plug face contacts only nickel. Sprayed or screwed-in seats are not acceptable. Valve shaft seals for valves 4 inches and larger shall be of the type using a stuffing box and pull-down packing gland. Shaft seals shall be designed for replacement with the line pressurized at design pressure with the plug in both the open and closed position. For submerged service, or in valve manholes, valve vaults, or underground utility structures, valves shall have stainless steel bolts.

4. The design of the valve and stuffing box assembly shall be such that the packing can be adjusted or completely replaced without disturbing any part of the valve or operator assembly except the packing gland follower. Stuffing boxes shall have a depth sufficient to accept at least four rings of Buna-N vee-type packing. Valve seating adjustment shall be accomplished without removing the valve from the pipe line and with pressure in the line. For lever-operated valves, the plug position retention friction device shall consist of an adjustable phenolic cone that clamps on the plug shaft or a moly sheath. Metal-to-metal friction devices shall not be acceptable.
5. Valve working pressure ratings shall be 175 psi for valves through 12 inches and 150 psi for valves 14 inches through 24 inches. Valves shall provide drip-tight shutoff up to the full pressure rating.
6. All plug valves for buried service, all plug valves 8 inches in diameter or larger, all plug valves with direct pressure greater than 75 psi or reverse differential pressure greater than 25 psi, and all plug valves for any gas or digester gas service 4 inches in diameter or larger shall have worm gear actuators. All gearing shall be enclosed in a semi steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall indicate valve position. Buried or submerged valves and valves in manholes shall be supplied with actuators suitable for direct burial or submergence, shall be mounted on a gasketed and totally enclosed actuator mounting bracket, and shall have a totally enclosed and gasketed cover. All other valves shall be furnished with lever actuators. Supply one lever for every four valves of like size furnished. All valves 3 inches and smaller shall have individual levers. Valves not in reach of the floor (7 feet to centerline or greater) shall have chain wheel worm gear actuators. Right angle actuators shall be furnished, if required, because of valve position. Supply sufficient galvanized or electroplated chain with chain wheel so loop through chain wheel is within 3 feet of floor. All underground valves shall be equipped with cast iron telescopic adjustable valve boxes and covers. Buried or submerged service valves shall be supplied with 316 stainless steel bolts and hardware for both valve and actuator.
7. Extension stems and other accessories shall be provided as shown on the Drawings and as required to allow easy access for operation of valves within reach from walkways or other access points. Extend operators to at least 24 inches above walkways. Extension stems for quarter-turn plug valves shall be fabricated from 2-inch pipe, and extensions stems for gear-operated valves shall be fabricated from steel or stainless steel rod. Extension stems, stem guides, and related hardware and accessories for submerged valves shall be stainless steel. Stems shall be provided with 2-inch operating nut or other mechanism as shown on the Drawings. Stem guides shall be provided as recommended by the manufacturer. Maximum unsupported length of stem shall be limited to an l/r ratio of 200.
8. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated as specified in Division 09.

Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valves once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Except as noted below, valve interior shall be shop-primed and finish painted with epoxy painting system or fusion-bonded epoxy system as specified above. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

C. Check Valves:

1. Except where noted, check valves in ductile iron lines carrying liquid shall be GA Industries Figure 230-DS, Apco Model 250 LS by DeZURIK, (outside lever and spring), GA Industries Figure 220-DS, Apco Model 250 LW by DeZURIK, (lever and weight), or equal, 150 psi, ductile iron or iron body, bronze or stainless trimmed, swing check. Two levers and springs, heavier springs and/or additional weights shall be used if necessary to stop slamming.
2. Small Check Valves: Check valves in other than cast iron lines shall be Milwaukee Valve UP509, Nibco T-413-Y-LF, screwed-end bronze swing-check for water and air. Provide unions to allow for ease of removal.
3. Asphaltic varnish and coal tar coating are not allowed on check valves. Exterior of cast iron or steel valve body shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

D. Butterfly Valves:

1. Except as otherwise specified, shutoff valves in air lines 3 inches or larger shall be DeZURIK BOS-US, or equal, 150 psi, ASTM A536, ductile iron body, EPDM-resilient seat suitable for air at a temperature of 250°F, wafer butterfly valves. Valves 6 inches and smaller shall have ten-position levers.
2. Where shown on the Drawings, for non-potable water service, butterfly valves shall be AWWA Class 150 double offset butterfly valve with gear and handwheel operator. Valves shall be EKN as manufactured by VAG, or equal. Valves shall be installed such that the valve shaft is horizontal to prevent particulate matter from accumulating at the 6 o'clock position. Valves shall be provided with rotary manual handwheel operator.

Valves not in reach of the floor (7 feet to centerline or greater) shall have chain wheel operators. Right angle operators shall be provided, if required, because of valve position.

3. Extension stems and other accessories shall be provided as shown on the Drawings and as required to allow easy access for operation of valves within reach from walkways or other access points. Extend operators to at least 24 inches above walkways. Extension stems for ten-position lever butterfly valves shall be fabricated from 2-inch pipe, and extensions stems for gear-operated valves shall be fabricated from steel or stainless steel rod. Extension stems, stem guides, and related hardware and accessories for submerged valves shall be stainless steel. Stems shall be provided with 2-inch operating nut or other mechanism as shown on the Drawings. Stem guides shall be provided as recommended by the manufacturer. Maximum unsupported length of stem shall be limited to an l/r ratio of 200.
4. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be epoxy-coated. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valves once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

E. Miscellaneous Valves, Strainers, Hose Bibs, and Valve Boxes:

1. Shutoff valves in non-potable water lines smaller than 2 1/2 inches shall be Nibco T-585 (threaded), Nibco S-585 (solder joint), or equal, full port ball valves. Provide extended stems for valve operators installed with insulated pipe.
2. Shutoff valves in PVC piping shall be hand-operated 150 psi union-type PVC ball valves, Chemtrol TU Series Tru-bloc, Walworth Series 8927, or equal. Valves and all components including O-rings shall be compatible with chemicals in piping. PVC valves and union shall not be painted. Valves in sodium hypochlorite piping shall be fitted with a relief hole from center port to high pressure side of valve.
3. Y-strainers in potable, non-potable, and service water piping shall have cast iron bodies, stainless steel 20 mesh screens, Watts, LF777 or LFS777, or equal. Y-strainers in chemical lines shall be transparent PVC, Asahi, or equal, True Union strainer. Provide 20 mesh PVC mesh screens. Strainers used for hypochlorite service shall have Teflon O-rings.
4. Pressure Relief Valves in Tanks:
  - a. The flange drilling shall conform to ANSI B16.1 Class 125 standards. The valve shall be furnished with stainless steel backup rings and bolts for installation.
  - b. Manufacturer must have available flow test data from an accredited hydraulics laboratory to confirm pressure drop data. Company name, plant location, valve size, and serial number shall be bonded to the check valve. Valves shall be manufactured in the USA.
  - c. When line pressure inside valve exceeds the backpressure outside the valve by 2 inches, the line pressure shall force the bills of the valve open allowing flow to

- pass. When backpressure exceeds the line pressure by the same amount, the bills of the valve shall be forced closed.
- d. Valve shall be installed as shown on the Drawings and in accordance with manufacturer's written installation and operation manual and approved submittals.
  - e. Manufacturer's authorized representative shall be available for customer service during installation and start-up and to train personnel in the operation, maintenance, and troubleshooting of the valve.
5. Valves in NPW piping used for fluid control as shown on the Drawings shall be Nibco, or equal, globe valves rated for 200 psi WOG. Valves shall be bronze with TFE disc.
  6. Valve Boxes:
    - a. Valve boxes shall be provided for all buried valves.
    - b. Valve boxes shall be made of cast iron conforming to ASTM A48, Class 20. Valve boxes shall consist of a base section, tubular mid and top sections, both with cast threads by which one can be telescoped on the other, extension sections if required, and a circular drop cover. The castings shall be free from blowholes, porosity, hard spots, shrinkage defects or cracks, or other injurious defects and shall have a normal smooth casting finish. The castings shall be thoroughly coated with a 1 mil minimum thickness bituminous coating. Valve boxes shall be 5 1/4 inches in diameter. Valve boxes shall have a maximum length of 7 feet when extended without extension sections. Extensions shall be provided for deeper mains.
    - c. The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.
    - d. Valve box alignment devices: All valves shall be supplied with a gate valve adaptor as manufactured by Adaptor, Inc., or equal. All adaptors shall have a metal frame and be supplied with a 3/4-inch rubber gasket. All adaptors shall be sized to fit the brand of valve being supplied.
  7. Water Air Release Valve:
    - a. The air release valve shall be 1-inch APCO Model No. 50, Val-Matic No. 15A, or equal.
    - b. The valve assembly shall be installed as shown on Drawings.
    - c. CONTRACTOR shall run 1/2-inch pipe from the top of the valve as shown. Screen end of pipe.
  8. Corporation stop and nozzle shall be 3/4-inch bronze corporation stop, USA Blue Book, Item Number 6114, or equal.
  9. Flap valve for 8-inch stormwater outlet and 6-inch drain in RAS wet well shall be Neenah R-5004, or equal, flanged and iron body, brass hinge pin bronze-seat mount. Flap valve for 12-inch sewer at West Hickman shall be cast iron with stainless steel hinge and bronze seat by Troy Valve, or equal.
- F. Non-Potable Water Strainer:
1. Non-potable water strainer shall be automatic, self-cleaning, furnished with controls and ancillary equipment to provide a complete functioning system. Automatic strainer shall be Amiad Water Systems, Filter Model EBS 10000, or equal.
  2. Filter:
    - a. The filter unit shall be an automatic, self-cleaning type. The body of the filter shall be carbon steel (ST 37-2). The inside and outside of the body shall be coated per the FINISHES section. The body shall contain two raised face flange connections drilled with dimensions conforming to 150-pound ANSI. The cover shall be removable to facilitate maintenance. The maximum operating pressure of the filter

- body shall be 150 PSI and the maximum operating temperature shall be 140°F. Minimum operating pressure during the cleaning cycle shall be 30 PSI.
- b. Inlet and outlet flange connections shall be 12 inches in diameter.
  - c. The filter system shall have a clean-screen pressure drop of no greater than 3 PSI at a flow rate of 1200 GPM.
  - d. Cleaning shall be accomplished by an IEC frame, TEFC electric motor driven rotating cleaning element made of Type 316L stainless steel that simultaneously moves linearly as a result of a threaded-shaft/fixed-threaded-bearing mechanism. This linear movement shall be limited by two normally closed limit switches and monitored by the PLC in the control panel. The cleaning element, called a "suction scanner," shall have six radially oriented nozzles of circular cross section, each of which shall have a thread mounted polyacetal nozzle cap with a circular orifice for sacrificial wear. The sum of the cross sectional areas of the four nozzle orifices shall not exceed 1.43 square inches. The velocity created at the nozzle head shall be 49 feet per second. The motor drive for the rotating cleaning element shall turn the cleaning element at no more than 24-rpm, shall be suitable for operation with 480-volt, 3-phase, 60-hertz current and shall be minimum 1/2-horsepower. The cleaning cycle shall last for no more than 30 seconds.
  - e. The filter shall have a removable cylindrical four-layer filtration element made entirely of Type 316L stainless steel weave-wire screen with a 200 micron filtration degree. First, against the dirty liquid, shall be a square-weave woven-wire layer. Next shall be the fine weave-wire layer providing the solids removal. A second square-weave woven-wire layer shall make up the third layer. The fourth layer surrounding the entire cylinder is a welded wedge-wire grid providing structural strength. The total effective filtration area of the cylindrical filtration element shall be 1550 square inches. Filtration elements with filtration degrees ranging from 500-microns to 10-microns shall be interchangeable in the same filter body.
  - f. The cleaning system for the filter shall include a 3-inch hydraulic diaphragm valve operated by the pressurized liquid on the upstream side of the cleaning element. The body of this valve shall be polyester coated cast iron.
3. Pressure Differential Switch: The nonadjustable differential pressure switch shall be preset at 7-psi and enclosed in a NEMA 4X enclosure and shall be suitable for up to 240V AC/DC. The differential pressure switch shall have an easy to read "pointer & dial" gauge and shall be the fully automatic diaphragm type differential pressure switch.
  4. Flush Valve: The flush valve shall be a globe style Bermad 400 series valve for on/off service and controlled by an ASCO solenoid. The valve body and cover shall be cast iron, flanged per ANSI B16.41. The diaphragm assembly shall be natural rubber with a glass fiber infused polyamide with a vulcanized radial seal disk. The spring shall be stainless steel 302. External bolts shall be zinc coating plated steel. Coating shall be polyester. The valve is rated for operating between 7-232 PSI and for temperatures up to 140°F.
  5. Automatic Controls: A control panel shall be provided with the strainer. The enclosure shall be NEMA 4X and contain a main disconnect and all associated controls.

## 2.04 PIPING APPURTENANCES AND MISCELLANEOUS MATERIALS

- A. General: Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER.
- B. Non-Potable Water Caution Signs: Place non-potable water signs permanently mounted at every hose bib, hydrant, or faucet on the non-potable water system. Sign shall include as a minimum the wording "CAUTION, NON-POTABLE WATER, DO NOT DRINK" or similar

standard language. Signs shall be Brady Safety sign, or equal, minimum size 7 inches by 10 inches, constructed of fiberglass. Mount signs on building wall or structures with stainless steel screws or fasteners. At yard hydrant, provide post-mounted signs on steel U-channel posts.

- C. Aeration Piping Couplings: Except as otherwise specified or shown on the Drawings, couplings on exterior exposed aeration piping shall be Dresser Style 38, Smith Blair 411, or equal. The couplings shall have Viton gaskets and shall allow a minimum of 1/4-inch expansion. If two or more couplings are used to provide expansion compensation, provide a harness welded to each side of the couplings, and distribute the expansion evenly over the couplings.
- D. Tension Ties: All tension ties and rod ties shall be provided to resist a minimum 150 psi pressure in the pipe line. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary. Rods shall be provided with nuts and washers on both sides of tie ears. All nuts, washers, and rods shall be Type 304 stainless steel. Rods shall be Type 304 stainless steel at a minimum. Tie rods shall be equally spaced around pipe. The following table lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

Pipe Size (inches)	150 psi Pressure		250 psi Pressure	
	Minimum Number	Minimum Size (inches)	Minimum Number	Minimum Size (inches)
4-10	4	5/8	4	5/8
12	4	5/8	4	3/4
14	4	3/4	4	7/8
16	4	3/4	4	1
18	4	7/8	4	1 1/8
20	4	1	4	1 1/4
24	4	1 1/8	4	1 1/2
30	4	1 3/8	7	1 3/8
36	8	1 1/4	8	1 1/2
42	12	1 1/8	12	1 1/2
48	11	1 3/8	22	1 1/4
54	11	1 1/2	22	1 3/8

- E. Floor Boxes: Provide floor boxes in concrete floors or slabs and as shown on the Drawings. Floor boxes shall be Neenah R-7506-B, or equal. CONTRACTOR shall verify that all floor boxes are large enough to accommodate all operating nuts and wrenches. Provide one "Tee" valve key operator for each valve manhole and one for each tank with tank or channel drain.
- F. Mechanical Seals: Mechanical seals shall be 316 stainless steel Link Seal, Innerlynx by APS, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners. Sleeve diameter shall be provided and mechanical seals installed as recommended by the manufacturer.
- G. Pressure Gauges: Provide a pressure gauge on each new pump discharge piping (total of two) in the valve pit at suction and discharge of all centrifugal pumps. Pressure gauges shall

be Ashcroft, or equal, and shall have scale in psi with a maximum range equal to twice the normal operating pressure indicated in the submersible pump equipment specifications. Gauges shall have 4-inch minimum diameter stainless steel case, shall be connected to a mineral-oil filled diaphragm housing to separate the gauge from liquid in discharge line, and shall have accuracy of  $\pm 1\%$ . Provide isolation valve and union at connection to pipe to allow the gauges to be removed while the line is under pressure. Gauges shall be mounted to permit pressure readings from above without entering the valve pit.

- H. Safety Spray Shields: Provide safety spray shields at pipe joints, expansion joints, and valves in areas noted on the Drawings. Spray shields shall be PTFE coated glass cloth, clear PTFE, polypropylene, clear PVC, PVC, or polyethylene as manufactured by Advance Products and Systems (APS), Inc. of Lafayette, Louisiana, or equal. Provide replaceable pH patch on each shield for indication of acid leak. Shields shall be easily installed by one person without need for any tools by means of a hook and loop fastener and drawstrings. Shields shall be designed to fit flanges for designated piping.

### PART 3-EXECUTION

#### 3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, start-up, and operator training.

#### 3.02 INSTALLATION

- A. Interior or Exposed Piping:
  - 1. Provide pipe supports for all piping. Pipe support spacing and type shall, at a minimum, conform to manufacturer's recommendations unless more restrictive requirements are specified or shown on the Drawings. All interior or exposed pipelines shall be securely supported by adjustable saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile. Strap hangers, tin clips, or U-hooks will not be acceptable. Piping shall be supported, even though not shown on the Drawings, using base fittings and concrete pads to 6 inches above the floor, Anvil 264, B-line, or equal, adjustable pipe saddle stand with floor flange to 6 feet above the floor, and supporting clamps or inserts more than 6 feet above the floor. In general, the maximum spacing of supports shall not exceed 10 feet on centers. Except as specified for plumbing system, all PVC piping shall be supported using galvanized supports for flexible piping except as indicated. Piping in chemical feed rooms shall be supported with a plastic support system, Aickinstrut, or equal. Type 316 stainless steel supports and fasteners shall be used in submerged locations, tanks, wet wells, or as indicated. Piping shall be adequately supported and braced to resist thrust at bends, rubber expansion joints, and joints. Insulation saddles shall be used at supports of insulated piping. CONTRACTOR shall furnish and place hangers, supports, wall pipes, and sleeves in the forms before concrete is poured where needed or shown on the Drawings.
  - 2. All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete, or rod ties. The weight of the piping shall be supported independently of connected equipment.
  - 3. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers

shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Where vertical movement up to 1/8 inch is anticipated, a precompressed variable spring support shall be used. Rigid hangers shall be provided with a means of vertical adjustment after erection. Where horizontal piping movements are greater than 1/2 inch, or where the hanger rod angularity from vertical is greater than 4 degrees from hot to cold position of the pipe, the hanger pipe and structural attachments shall be offset in a manner that the rod is vertical in the hot position. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so stress will not be transferred to them.

4. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
5. All carbon steel parts shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation of all carbon steel parts shall be performed at such time during the assembly process as to preclude damage to the equipment once installed and assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.
6. The following maximum spacings shall be provided for supports:

#### MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING

Nominal Pipe or Tube Size	Copper Tubing		Ductile Iron (See Note 1) ft	PVC/CPVC Pipe (See Note 2) ft
	Water Service ft	Vapor or Air Service ft		
1/4	5	5		
3/8	5	6		Continuous
1/2	5	6		Continuous
3/4	5	7		Continuous
1	6	8		4
1 1/4	7	9		4
1 1/2	8	10		4
2	8	10		4
2 1/2	9	10		4
3	10	10		4
4	10	10	10	4
5	10	10	10	4
6	10	10	10	9
8	10	10	10	9
10	10	10	10	10
12	10	10	10	10
14			10	10
16			10	10



	Copper Tubing			
Nominal Pipe or Tube Size	Water Service ft	Vapor or Air Service ft	Ductile Iron (See Note 1) ft	PVC/CPVC Pipe (See Note 2) ft
18			10	10
20			10	
24			10	
30			10	
36			10	
42			10	

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

Note 2: Spacing is based on Schedule 80 at 100°F. For Schedule 40 or higher temperatures, provide shorter span. Consult local plumbing code and manufacturer's recommendations as required. Minimum spacing requirements shall govern.

7. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
8. Spacing for stainless steel air piping supports shall be a maximum of 16 feet for 6-inch diameter and above piping. Pipe slides, Anvil Figure 257, Type 3, B-line, or equal, in stainless steel shall be used on pipe support brackets where movement due to pipe expansion is anticipated. Expansion joints shall be used to prevent excessive pipe stress. Clamps or supports in contact with the stainless steel piping or as indicated shall be stainless steel.
9. Anchored supports shall include a stainless steel U-bolt and nuts bolted to the wall bracket.
10. Aeration piping in tanks or channels shall be supported by stainless steel brackets. The brackets shall be Anvil Figure 199 No. 3, B-line, or equal, and shall have a load rating of 3,000 pounds minimum. Provide stainless steel anchor bolts.
11. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings, and floors to permit access for covering of pipe and painting work. Care shall be taken in laying out piping so that there is no interference with the proper location of piping for other purposes or other equipment and shall be run with regard to the requirements of each service.
12. Piping shall not interfere with headroom or clear floor space. Unless otherwise shown, piping shall run exposed in buildings, except in finished areas. Unless otherwise shown, small water piping in finished areas shall be concealed in interior walls, above suspended ceilings, or under floors where possible. Water piping shall not be installed in exterior walls, unless otherwise shown or noted on the Drawings. Joints shall not be used under floor slabs. Unless otherwise shown, piping under floor slabs shall clear floor slabs or footings by a minimum of 6 inches. Pipes under floors shall have a minimum of 6 inches of sand cover. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings constructed of materials other than poured

concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.

13. Except for flanged piping, an ample number of standard weight ground joint unions and a shutoff valve shall be provided in all pipelines and at all equipment. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.
14. All PVC, and stainless steel aeration piping shall be protected from dust and debris deposits on the inside of the pipe during storage and installation. Protection shall be by plastic film or coated paper banded over the pipe ends to be removed just prior to installation. Any foreign matter shall be removed from the pipe interior at the time of installation.
15. The locations and elevations of existing piping are approximate. Any changes in the pipe location or elevation shall be reviewed by ENGINEER.
16. CONTRACTOR shall submit shop drawings showing new pipe routing and existing pipe removal. CONTRACTOR shall be responsible for final pipe routing and shall route new piping as required to minimize conflicts. Piping shown on the Drawings is approximate only. Not all existing piping, conduit, equipment, etc., are shown on the Drawings. CONTRACTOR shall field-verify locations. CONTRACTOR shall reroute existing piping, conduit, etc., as indicated or as required to install new piping or equipment. CONTRACTOR shall remove and relocate existing pipe supports as required to install new piping. CONTRACTOR shall provide all piping, fittings, flange fillers, and other appurtenances as required to provide functional system at no additional cost to OWNER.
17. All connections of pipes and fittings that contain hazardous or corrosive chemicals, except those adjacent to storage or feeder areas, shall have guards that will direct any leakage away from space occupied by workers.
18. Exposed pipes in all areas containing hazardous or corrosive chemicals that are located above shoulder level shall be provided with continuous drip collection trays and coupling guards that will eliminate the spraying or dripping of these chemicals onto workers.

B. Wall and Other Pipe Penetrations:

1. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the Drawings.
2. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping, unless otherwise shown on the Drawings. The sleeve diameter shall not exceed the pipe o.d. plus 2 inches (or the pipe flange o.d. plus 1 inch, as applicable), unless otherwise shown on Drawings. If the concrete members are to be watertight, the annular space around the pipe shall be sealed with a mechanical seal. Sleeves shall be steel unless noted otherwise and shall include minimum 1-inch waterstop. Steel sleeves shall be prepared, primed, and painted in accordance with Division 09 prior to placement in between concrete forms. Steel sleeves shall receive touch-up paint prior to placing forms.
3. Where plain wall pipes are shown or indicated on the Drawings, CONTRACTOR may substitute a flanged end wall pipe, if desired, for the purposes of pressure testing specified herein.
4. Where pipe passes through nonwatertight walls, the annular space shall be grouted full. Where pipes pass through nonwatertight floors, the sleeve shall extend 1 inch above the finished floor elevation. The annular space shall remain open, except the annular space between a rated space (example—Class I, Division 1, Group D hazardous location) and a nonrated space shall be sealed with a mechanical seal.

5. Where new pipes go through existing watertight concrete members, CONTRACTOR shall core a hole through the member, unless otherwise shown on the Drawings. The annular space between the concrete and pipe shall be sealed with a mechanical seal. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and annular space between the concrete and the pipe shall be grouted full (walls or floors at rated spaces) or remain open (floors at nonrated spaces). Prior to any coring, CONTRACTOR shall locate reinforcing steel in the member and shall consult with ENGINEER to determine optimal location for the core. Plug abandoned pipes and wall pipes, after pipe and fittings removal flush to the concrete surface, with nonshrink grout, to achieve a watertight seal.
  6. Where pipes pass through fire-rated walls, floors, ceilings, or other assemblies, the required firestopping materials shall be provided. Refer to Section 07 84 00—Firestopping for requirements.
  7. Nonshrink grout shall be as specified in Division 03.
  8. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the Drawings or specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case where such cutting or core drilling is necessary shall reinforcing rods be cut or disturbed without notifying ENGINEER. All openings for pipe work shall be neatly patched in a workmanlike manner.
- C. Cleaning and Disinfection: All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the potable water system before it is put online. Water main shall be disinfected according to AWWA C651.

### 3.03 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price Bid.
- B. Work shall be tested as specified in this section. Unless indicated by ENGINEER in writing before testing begins, tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.
- C. New piping shall be tested. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint or before caulking of any gaps at flanges of ductile iron piping. Piping and appurtenances shall be watertight or airtight and free from visible leaks.
- D. Piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Gauges used for testing shall have increments as follows:
  1. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
  2. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
  3. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.

- F. Pressure Tests: The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids, such as SCM/WAS, shall be tested at the higher test pressure.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
A	25	Air	"B" <sup>(2)</sup>
SH	150	Water	"A" <sup>(1)</sup>
SCM	10	Water	"A"
NPW	150	Water	"A"

<sup>(1)</sup> Leakage allowance Designation "A" shall mean zero leakage.

<sup>(2)</sup> Leakage allowance Designation "B" shall mean a loss of pressure of not more than 5% during the test period.

### 3.04 DEMOLITION

- A. All interior piping removals, including appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Any change in pipe location or elevation shall be reviewed by ENGINEER.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.
- D. It is the responsibility of CONTRACTOR to remove the following, including piping and appurtenances, as specified and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner. All costs shall be included in the Lump Sum Bid.

END OF SECTION

## SECTION 40 05 59.20

### SLUICE GATES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation sluice gates as described below and as indicated on the Drawings. Sluice gates shall be complete with gate, guides, wall thimble or wall pipe, framing, operator, and other components required to make a complete sluice gate system. The sluice gates and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
  - 1. The gate frame and slide shall be designed for the maximum head with a minimum factor of safety of 5 with regard to the ultimate tensile, compressive, and sheer strength.
  - 2. Sluice gates shall be provided as non-rising stem type with 2-inch operating nut.
- B. Performance Requirements:
  - 1. Sluice gates shall be suitable for use in wastewater.
  - 2. Leakage shall not exceed 0.05 gpm per foot of perimeter for seating and unseating heads of 25 feet. Factory leakage test results shall be submitted for each gate.

##### 1.03 SUBMITTALS

- A. Gate manufacturer shall submit shop test reports to confirm leakage as specified herein in accordance with AWWA C561 Section 5.2.2.

##### 1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC12.6, as modified in the Supplementary Conditions, or Substantial Completion of the project.

#### PART 2—PRODUCTS

##### 2.01 MANUFACTURERS

- A. Sluice gates shall be Series 900 as manufactured by Whipps, Inc. of Athol, Massachusetts, Model RW 1000-S as manufactured by RW Gate Company of Troy, New York, Series 20 as manufactured by Fontaine-Aquanox of Quebec, Canada, or equal.

## 2.02 GATE CONSTRUCTION

- A. The sluice gates shown on the Drawings and listed in the specifications shall conform to the latest edition of the AWWA Standard for Sluice Gates, AWWA C561 as modified herein, and to the following detailed specifications.
- B. The sluice gates shall consist of a frame and guides with a moveable side or disc. Resilient seals or self-adjusting UHMWPE seals between the movable disc and the frame shall be used to maintain leakage at or below the rate required by these specifications. All structural components of the frame and slide shall be fabricated of stainless steel having a minimum thickness of 1/4-inch and shall have adequate strength to prevent distortion during normal handling, during installation, and while in service.
- C. The frame shall be drilled for wall mounting with anchor bolts and non-shrink grout or EPDM gaskets unless noted otherwise on the Drawings. If a wall pipe is shown or noted at a gate location, the frame shall be suitable for installation on a wall pipe as indicated on the Drawings. The mounting flange of the frame shall be machined and all attaching holes shall be drilled. The guides shall extend a sufficient distance above the opening to support the full disc in the open position. Self-adjusting UHMWPE seals shall be provided along both sides and across the top of the gate. The structural portion of the frame that incorporates the seat/seals shall be formed into a one-piece shape for rigidity. Gussets shall be provided as necessary to support the guide members in an unseating head condition. The gussets shall extend to support the outer portion of the guide assembly and shall be positioned so that the load is transferred to the anchor bolts or the wall thimble studs.
- D. A flush-bottom closure seal shall be attached to the frame along the invert of the opening. The seal shall be mounted to a stainless steel channel or angle using a stainless steel retainer plate and attaching screws. The top surface of the seal shall be flush with the opening of the gate.
- E. The disc shall be a flat plate with horizontal and vertical reinforcing ribs. The disc shall be designed so that deflection of any part of the disc with full head on the gate will be less than 1/720 of the gate span of 1/16-inch, whichever is less.
- F. Wall thimbles or wall pipes shall be furnished for sluice gates as shown on the Drawings. Wall thimbles and wall pipes shall be mechanical joint (for connecting of piping) by square or rounded flanged joint (for mounting of sluice gate). F-type wall thimbles shall be the same depth as the wall thickness, unless otherwise shown. F-type and E-type wall thimbles shall be constructed of Type 304 stainless steel. Mechanical joint wall thimbles shall be constructed of Type 304 stainless steel or ductile iron. The depth shall be as shown on the Drawings. Thimbles shall be one-piece construction, of adequate section to withstand all operational and reasonable installation stresses. Wall thimbles shall be internally braced during concrete placement. A center ring or water stop shall be cast around the periphery of the thimble. The front flange shall have tapped holes for the sluice gate attaching studs and metal-stamped vertical centerlines with the word "top" for correct alignment. Large rectangular wall thimbles shall be provided with holes in the invert to allow air escape during concrete placement beneath the thimble. A permanent gasket of uniform thickness or suitable mastic shall be provided between the sluice gate and wall thimble.
- G. Stems shall be Type 304 stainless steel conforming to ASTM A276 and shall have a minimum diameter of 1 1/2 inches. Stem threads shall be machine rolled or machine cut,

full depth Acme type with a minimum 16 micro-inch finish on the threaded portion, or stem threads shall be cut Acme type. Stems shall be designed to transmit in compression a minimum of two times the rated output of the hoist at 40 pounds effort on the operating nut. The L/r ratio of the unsupported stem shall not exceed 200. Stem guides where required to limit the unsupported stem length shall be UHMWPE bushed. All gates having widths greater than two times their height shall be provided with two lifting devices connected by a tandem shaft for simultaneous operation. Stems for non-rising stem gates shall engage the nut on the slide.

- H. Stem Covers: Rising stem gates shall be provided with clear polycarbonate stem covers to provide indication of gate position, to permit inspection of the stem threads, and to protect the stem from contamination. The stem cover shall be constructed of clear rigid polycarbonate, butyrate, or Lexan. Vent holes shall be provided to prevent condensation.
- I. Provide a horizontal member at 21 inches above the operating floor where handrailing is interrupted by a sluice gate.
- J. All sluice gates shall be shipped and delivered to the project site fully assembled unless CONTRACTOR requests other arrangements.

## 2.03 MATERIALS

- A. Wall thimble, frame, guide, and disc of sluice gate shall be Type 316L stainless steel, 1/4-inch minimum thickness. All welds shall be passivated at the factory. Wall pipes shall be ductile iron.
- B. Guide bar shall be Type 304L stainless steel with UHMWPE bearing surfaces.
- C. Frame seat shall be ASTM D4020 UHMWPE for self-adjusting seals.
- D. Disc seal and bottom closure seal shall be EPDM conforming to ASTM 1056 or double density EPDM seals conforming to ASTM D2000-01 BA910 and BA415.
- E. Fasteners and adjusting bolts shall be Type 304L stainless steel conforming to ASTM F593 and F594.

## 2.04 MANUAL OPERATORS

- A. Operation of the gate shall be by antifriction handwheel bench stand or by crank operation through right-angle bevel gears as shown on the Drawings. Maximum effort shall not exceed 40 pounds on handwheel or crank to raise gate under full operating head. The lift mechanism shall be capable of withstanding, without damage, a handwheel or crank effort of 200 pounds. Floor stand shall be minimum of 36 inches above operating floor. If the bench stand is provided to allow operation of the gate and is over 42 inches above the operating floor, the member shall meet OSHA strength requirements for guardrail.
- B. A suitable side-mount operator system shall be provided where the bench stand is located over 48 inches above the operating floor. System shall include right-angle bevel gear boxes, stainless steel shafting and flexible couplings or a chain and sprocket transmission system with stainless steel cover as required for operation 36 inches above the operating floor.

- C. The hoist nut shall be manganese bronze conforming to ASTM B584 C86500. The hoist nut shall be supported on roller bearings. The hoist shall be outfitted with a stainless steel pinion shaft and the pinion shaft shall be supported by roller or ball bearings. A 2-inch square nut shall be provided on the pinion shaft to allow operation by a portable electric operator. A lubricated fitting shall be provided for lubrication of the hoist bearings without disassembly of the hoist. Suitable seals shall be provided to prevent entry of foreign matter. The direction of handwheel or crank rotation to open the gate shall be clearly and permanently marked on the hoist. Where the actuators will be interconnected, it shall be by a flexible coupling and stainless steel shaft or extruded aluminum tubing with stainless steel hardware.

## 2.05 ACTUATORS

- A. Actuators and their accessories shall be the intelligent electric type, as indicated herein, and as specified in the Valve and Gate Actuator section. The actuators shall be provided with the capability to accept and provide control signals as shown on the Drawings.
- B. The electric actuator shall be furnished with a permanently side attached handwheel for emergency operation.
- C. The motor actuator shall be 460/3/60, 15 min. duty rated, 1800 RPM and NEMA 4 rated. The motor actuator shall have a 125% service factor.
- D. Intelligent electric actuators shall be capable of non-intrusive configuration without requiring removal of any actuator covers. Configuration of actuator functions shall be by use of a hand held infrared linked device, laptop or PDA with compatible wireless communication capability, or by local control switches and 32-character LCD display mounted on the actuator housing. The display language shall be English.
- E. Each intelligent electric actuator shall be furnished complete with a motor, gearing, handwheel, configurable output relays, torque sensors, lubricants, wiring, and terminals. Each actuator shall be constructed as a self-contained unit with a ductile iron or aluminum alloy housing, of a type as indicated in the valve and gate schedules, and shall be integrally assembled on the applicable valve or gate by the valve or gate manufacturer. Housings shall have two O-ring seals, one on the controls compartment and one on the terminal cover.
- F. The direction of rotation of the rotating scum pipe shall be into or out of the flow, and the worm gear shall permit revolving the scum pipe through a minimum arc of 75 degree.
- G. Actuators shall connect to the plant's fieldbus protocol using DeviceNET, ProfiBus, Modbus, etc.
- H. The electric actuator shall be manufactured by Limitorque (MX), or equal.

## 2.06 FINISHES

- A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near



white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop prime with one coat of Tnemec N69 or N140, Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Color of primer should be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. Motors and speed reducers shall be factory shop-primed and finish-painted using the manufacturer's standard paint system for the specified application.

- B. Provide mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale in the factory. All heat tint and slag from the welding process shall be passivated in accordance with ASTM A380. If bead blasting is used, the entire slide and frame shall be bead-blasted.

## 2.07 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training.
- B. A minimum of one trip and two days on site shall be provided for startup and training services.

END OF SECTION

## SECTION 40 05 59.23

### SLIDE GATES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation slide gates and weir gates as listed below and indicated. Slide gates and weir gates shall be complete with gate, guides, framing, operator, and other components as required to make a complete system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SYSTEM DESCRIPTION

- A. Application:
  - 1. Slide gates and weir gates shall be suitable for use in wastewater streams that, in addition, may contain iron salts, polymers, chlorine solution, or sulfur dioxide solutions.
  - 2. Weir gates shall be downward acting and shall form a sharp-crested weir. Weir gates shall be used in modulating service to control flow rates.

##### 1.03 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year in accordance with GC 12.6.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. Fabricated stainless steel slide gates shall be Whipps, Inc. of Athol, Massachusetts, RW Gate of Troy, New York, Fontaine-Aquanox of Quebec, Canada, or equal.

##### 2.02 GATE CONSTRUCTION

- A. The slide gates shown on the Drawings and listed in the specifications shall conform to the latest edition of the AWWA Standard for Slide Gates, AWWA C561, and to the following detailed specifications.
- B. Disc: The gate disc shall consist of a flat plate reinforced with structural or formed members welded to the plate. The disc shall be designed to limit the deflection of the gate to 1/360 of its span or 1/16 inch, whichever is less, under design head. The working design stresses shall not exceed the lesser of 40% of the yield strength or 25% of the ultimate strength of the material. All disc components shall have a minimum material thickness of 1/4 inch. Provide ultra-high molecular weight polymer bearing bars on each side of gate.

- C. Frame: The gate frame shall consist of guides, invert member, and operator yoke welded or bolted together to form a rigid one-piece frame. The guides shall conform to AWWA C561 requirements and shall have a minimum material thickness of 1/4 inch. The guide slot shall engage the disc plate a minimum of 1 inch. The invert member shall be an angle, channel, or formed shape welded to the bottom of the guide to form a flush surface and to meet with the disc seal. For self-contained gates, the yoke members shall be designed to limit the deflection to 1/360 of its span. The working stresses shall not exceed the lesser of 40% of the yield strength or 25% of the ultimate strength of the material and shall be arranged to permit removing the disc from the frame.
- D. Seals: Self-adjusting UHMW seals shall be attached to the frame if necessary so that leakage shall not exceed 0.05 gpm per foot of seal perimeter of the maximum head in the seating and unseating head condition.
- E. Stems: Stems shall be Type 304 stainless steel and shall have a minimum diameter of 1 1/2 inches. Stem threads shall be machine-rolled, full-depth Acme type. Stems shall be designed to transmit in compression a minimum of two times the rated output of the hoist at 40 pounds effort on the crank or handwheel. The L/r ratio of the unsupported stem shall not exceed 200. Stem guides, where required to limit the unsupported stem length, shall be bronze or UHMW bushed. All gates having widths greater than two times their height shall be provided with two lifting devices connected by a tandem shaft for simultaneous operation.
- F. Stem Covers: Rising stem gates shall be provided with clear butyrate or Lexan stem covers to provide indication of gate position, permit inspection of the stem threads, and to protect the stem from contamination. The stem cover shall be constructed of clear rigid butyrate or Lexan. Vent holes shall be provided to prevent condensation.
- G. Provide a horizontal member at 21 inches above the operating floor where handrailing is interrupted by the slide gate.
- H. All gates shall be shipped and delivered to the project site fully assembled unless CONTRACTOR requests other arrangements.
- I. All gates shall be provided with UHMW seats on the upstream and downstream sides of the disc to prevent metal-to-metal contact between the disc and the frame.

## 2.03 MATERIALS

- A. Slide or weir gate components shall be Type 304 stainless steel unless otherwise indicated. All welds and weld burn shall be passivated per ASTM A380 at the factory to provide a clean, uniform finish. If sandblasting is used, the entire slide and entire frame shall be sandblasted to provide a uniform finish. Self-adjusting UHMWPE seat/seals shall conform to ASTM D4020.

## 2.04 MANUAL OPERATORS

- A. Unless otherwise specified, operation of the gate shall be by an antifriction handwheel bench stand or by crank operation through right angle bevel gears as shown on the Drawings. Maximum effort shall not exceed 40 pounds on handwheel or crank to raise gate under full operating head. The lift mechanism shall be capable of withstanding, without damage, a handwheel or crank effort of 200 pounds. Bench stand shall be minimum of 36 inches above operating floor. Where possible, the bench stand shall be 42 inches above the operating

floor where the gate interrupts handrailing. If the bench stand must be higher to allow operation of the gate, provide a horizontal member across the yoke at 42 inches above the operating floor. The member shall meet OSHA strength requirements for guardrail.

- B. A suitable side mount operator system shall be provided where the bench stand is located over 48 inches above the operating floor. System shall include right angle bevel gear boxes, stainless steel shafting, and flexible couplings as required for operation 36 inches above the operating floor.
- C. The hoist nut shall be manganese bronze conforming to ASTM B584 C86500. The hoist nut shall be supported on roller bearings. The hoist shall be outfitted with a stainless steel pinion shaft and the pinion shaft shall be supported by roller or ball bearings. A 2 inch square nut shall be provided on the pinion shaft to allow operation by a portable electric operator. A lubrication fitting shall be provided for lubrication of the hoist bearings without disassembly of the hoist. Suitable seals shall be provided to prevent entry of foreign matter. The direction of handwheel or crank rotation to open the gate shall be clearly and permanently marked on the hoist. Where the actuators will be interconnected, it shall be by a flexible coupling and stainless steel shaft with stainless steel hardware.

## 2.05 FINISHES

- A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop prime with one coat of Tnemec N69 or N140, Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Color of primer should be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. Motors and speed reducers shall be factory shop-primed and finish-painted using the manufacturer's standard paint system for the specified application. Touch-up paint shall be provided by manufacturer.
- B. Provide mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale in the factory. All heat tint and slag from the welding process shall be passivated in accordance with ASTM A380. If bead blasting is used, the entire slide and frame shall be bead-blasted.

## 2.06 ANCHOR BOLTS

- A. CONTRACTOR shall provide anchor bolts necessary for equipment furnished. Anchor bolts shall be Type 316 stainless steel and shall be of ample strength for intended service. Provide anchor bolts in accordance with Section 05 56 00—Anchor Bolts and Post-Installed Anchors.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of one trip and one day on site shall be provided for startup and training services.

END OF SECTION

## SECTION 40 70 00

### CONTROLS AND INSTRUMENTATION EQUIPMENT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Controls and instrumentation equipment provided with equipment in Division 43 and Division 46.
- B. Related Sections and Divisions:
  - 1. Applicable provisions of Division 01 shall govern work in this section.
  - 2. Section 26 09 10—Controls and Instrumentation Drawings.

##### 1.02 QUALITY ASSURANCE

- A. UL labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures. Electrical equipment shall include, but not be limited to, control panels, power supplies, controllers, relays, wire, selector switches, pilot lights, overcurrent devices, and connectors. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels which have individual components which are UL labeled, but do not have UL approval as an assembled unit are not acceptable.
- B. NEMA/ANSI Compliance: Comply with National Electrical Manufacturer's Association, American National Standards Institute and other standards pertaining to material, construction and testing, where applicable.
- C. Code Compliance: Comply with the National Electrical Code (NFPA 70) and any and all local codes as applicable to construction of electrical wiring devices, material, and equipment herein specified.

##### 1.03 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- C. Provide product data on all equipment and devices specified herein, as well as wiring schematics for all systems.
- D. Provide load calculations showing battery runtimes and UPS sizing including all equipment specified herein.

##### 1.04 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 33 00—Submittals.

- B. Include spare parts data listing, source, and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

#### 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store in a clean dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to equipment components, enclosure, and finish.

#### 1.06 COORDINATION

- A. Wiring diagrams for all control panels shall be completed using electronic CAD software and shall be in accordance with the requirements specified in Section 26 09 10—Controls and Instrumentation Drawings.

### PART 2—PRODUCTS

#### 2.01 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 14 gauge steel with continuously-hinged doors. Enclosures equal to or smaller than 24 inches wide by 24 inches high shall be equipped with at least two quarter-turn latches. Enclosures larger than 24 inches in any dimension shall be equipped with a 3-point latch with top and bottom bolts actuated by one rotating, lockable handle on each door. Provide a door stop kit for each door, data pockets for wiring diagrams, and minimum 12-inch, bolt-on, LED light and door switch. Panels over 48 inches wide shall have two lights. Panels shall include nonfused main disconnect with interlock to prevent opening the panel with switch in "On" position. A defeater shall be provided to bypass this interlock, with handle lockable in "Off" position. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, white interior, and OWNER-selected exterior color. All doors and panels shall be gasketed, and panels installed outdoors or nonconditioned spaces shall be insulated. Enclosures shall be as manufactured by Hoffman or Saginaw. Enclosure rating shall be as follows, unless noted otherwise on the Drawings, or in the associated specification section.
  - 1. Indoor and/or dry locations: NEMA 12.
  - 2. Corrosive and/or damp locations, including chemical rooms, belowgrade nonconditioned spaces, and outdoor locations: NEMA 4X stainless steel.
  - 3. Hazardous locations: NEMA 7 cast iron.
- B. Where necessary for the installed conditions, including direct sunlight or high-temperature environments, control panels shall be provided with louvers and filtered forced-air cooling as required to maintain internal ambient air temperatures 10°F below the rated operating temperature of all internal control panel equipment. Where the installed cooling system does not adequately maintain ambient air temperatures inside the control panel, additional cooling equipment shall be provided by the supplier at no cost to OWNER.
- C. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's

recommendations. For outdoor panels, indicating and control devices shall be mounted on a swing-out inner door.

1. All wiring within control panels shall be insulation-type MTW, minimum size 16 AWG. Wiring within the enclosure shall be routed through plastic wiring troughs with removable covers. Maximum fill for wiring troughs shall be 60%. Terminal blocks located adjacent to wiring troughs shall have a minimum of 1 1/2 inches between terminal block and trough. All wiring in control panels not in wiring troughs shall be bound with continuous-type spiral windings.
  2. All I/O devices shall be wired to DIN rail-mounted terminal blocks.
  3. Field wiring in dry locations shall be insulation-type THHN, minimum size 14 AWG. Field wiring in damp or wet locations shall be insulation type XHHW-2, minimum size 14 AWG. Damp and wet locations shall include, but not be limited to, all NEMA 4X areas, structures and areas below grade, and exterior locations. All field wiring shall terminate on DIN rail-mounted terminal blocks. Field wiring terminals shall be clearly identified as to which I/O terminals they are wired. Wire markers shall be permanently attached heat-shrink-type. Wire numbering preprinted on the conductor or insulation, flag-type labels, and individual wraparound numbers are not acceptable.
  4. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer.
  5. All panels with DIN rail-mounted equipment shall include a minimum of 25% spare DIN rail space.
  6. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminals wired to terminal strips. Spare terminals shall be provided for all voltage sources within the panel (e.g., 120 V, 24 V).
- D. Tubing and instruments containing water shall be in separate compartments, located and constructed so that leakage or spray at 100 psi pressure cannot touch electrical conductors or devices. Leakage shall be conducted to the floor in duct or pipe.
- E. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal blocks shall be mounted either at the bottom or on the side of the enclosure, depending where the I/O conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. All wiring shall be labeled at each end with corresponding numbers matching the associated terminal block. This numbering shall be shown on the shop and Record Drawings.
- F. All door-mounted devices shall be furnished flush-mounted, and an exterior engraved phenolic nameplate with black background and white characters worded by the manufacturer and reviewed by OWNER (upon receipt of shop drawings), shall be provided for each component, device, light, etc. All components within the enclosures shall be identified with sticky-back adhesive, self-laminating, machine printed labels with white background and black text; minimum 12-point font. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.
- G. Enclosures that include motor controllers shall have a main disconnect for the enclosure.
- H. Manufacturer of Accessories:
1. Plastic wiring duct shall be Panduit Panduct, or equal.
  2. Terminal blocks shall meet the requirements of Section 26 05 19–Wire.



3. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be rail-mounted type, Square D, Class 9080, Type GCB-150, or equal.
4. Power supplies shall be Sola, DIN rail mount, SPD or SDN Series, or equal.
5. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.

## 2.02 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.
- B. All indicating and control devices mounted on control panel enclosure doors (e.g., meters, gauges, electronic indicators, pilot lights, selector switches, Operator Interface Panels [OIPs], etc.) shall be located at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device.
- C. Power supplies shall be protected against short circuits and contain their own overcurrent and overvoltage protection. Twelve and 24 VDC power supplies shall be provided and installed in the enclosures for powering all analog input signals where required.
- D. All motor control power shall be 120-volt with suitable circuit protection, fuses or breakers. Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- E. Devices powered at 120 volts from control panels shall be fused. This shall include, but not be limited to, solenoid valves, motor-operated valves, motorized ball valves, flow meters, scales, and transmitters.
- F. Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. Lightning protection shall be completely solid-state and self-healing and not require the use of fuses. Lightning protection shall be as manufactured by Citel, Model DS240, or equal. Surge protection shall be provided for all phases and neutral.
- G. Each panel shall have a GFI, duplex, 15-ampere, 120-volt receptacle.
- H. Control panels that include programmable or electronic controllers (e.g., Programmable Logic Controllers [PLCs]) shall be provided with a 120-volt AC true on-line UPS backup that will provide continuous operation for at least 30 minutes following a power failure.
  1. UPS power shall be provided, at a minimum, to the following equipment:
    - a. PLCs and I/O cards, controllers, and OIPs.
    - b. Network switches, signal converters, and other communication devices.
    - c. Power fail and communication indicating lights and alarm devices.
    - d. Power supplies for loop-powered instruments.
    - e. Intrinsic safety barriers.
  2. The UPS shall be plug connected inside the control panel with a dedicated receptacle and overcurrent protection device. All UPS-powered devices shall be continuously powered through the UPS under normal operating conditions. Provide UPS voltage monitoring relays to automatically bypass the UPS when the UPS output rises 110% above or falls 90% below the nominal supply voltage.
  3. Provide a stand or shelf within each control panel for the UPS so that the UPS does not sit on the bottom of the enclosure.
  4. Each UPS shall be provided with a dry contact output to the programmable or electronic controller to activate an alarm in the event that the UPS batteries need replacement.

5. UPS shall be APC with relay I/O module, Liebert GXT5 with relay card, or Eaton 9SX.
- I. Where PLCs or OIPs are installed in control panels, two copies of all programs and documentation files, with associated passwords, shall be turned over to OWNER at final completion. Copies shall be USB flash drives.
  - J. If enclosure and panel space is needed for future installation of devices, lights, etc., the enclosure and panel shall be constructed for such installation. Supports shall be provided for future equipment, and panel openings shall be made and covered with neat cover plates matching the panel.
  - K. Control panels that include PLCs shall have an exterior panel-mounted receptacle and programming port mounted to the front of the panel, as applicable to the installation. Receptacle and programming port shall be provided to allow for PLC programming via laptop without opening the panel door. Programming port shall match that of the network being installed (e.g., Ethernet, data highway, etc.).
  - L. CONTRACTOR shall furnish one complete extra set of fuses and similar parts which may need replacement in normal service and an identification list of all component parts and where they may be obtained for operating the system for 3 years from start-up.
  - M. Where a certain accuracy of sensing and transmitting levels or flows and controlling operations are called for, means must be provided to read or determine that the levels or flows are within the limits or accuracy specified of the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of levels is necessary to set operating points, an indicating device of accuracy consistent with the operation of the system is required.
  - N. All internal wiring shall be color-coded and numbered, and each wire shall be terminated on terminal blocks. Schematic and wiring layout drawings complying with Section 26 09 10—Controls and Instrumentation Drawings which show all connections to external devices, a complete bill of materials, interior and exterior panel layouts, and a detailed description of operation, shall be submitted for each control panel.
  - O. Each analog signal entering or leaving a control panel and leaving a building shall be provided with a surge protection device as manufactured by Citel, Model DLA-24D3, or equal. Each transmitter shall be provided with a surge protection device as manufactured by Citel, Model TSP15M on the output and Citel, Model No. DS240 on the power supply, or equal.
  - P. An anti-condensation heater shall be provided in all control panels located outdoors. The anti-condensation heater shall be as manufactured by Hoffman, Model D-AH, X000 Series, sized as required.
  - Q. Hard-wired Motor Controls:
    - 1. Equipment and wiring specified to be hardwired shall be physically wired independent of controllers, programmable relays, and communication systems to allow manual operation in the event of an emergency.
    - 2. Motor control wiring and logic shall be set up such that in the event of a power failure, equipment shall automatically restart if previously running, or remain off if previously off. A manual reset shall not be required to restart equipment following a power failure.

3. All hardwired local controls for VFDs shall be fully functional in the event of an Ethernet communication failure between the VFD and the PLC.

## 2.03 CONTROL PANEL DEVICES

- A. All control panel devices shall comply with Section 26 09 00—Controls and Instrumentation.
- B. Manual, magnetic, solid state motor starters, Variable Frequency Drives (VFDs), and motor control devices shall comply with Section 26 24 19—Motor Control.
- C. Overcurrent protection and disconnecting means for equipment shall be provided as specified in the specification section for the associated equipment. Molded case thermal magnetic circuit breakers shall include integral thermal and instantaneous magnetic trip in each pole. Motor controllers shall include molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Nonfusible switch assemblies shall consist of quick-make, quick-break load interrupter enclosed knife switch with externally operable handle.
- D. Pushbuttons: NEMA ICS 2; heavy-duty, oiltight (30 mm) as shown on the Drawings. Pushbuttons in hazardous locations shall be rated NEMA 7. Pushbuttons in exposed, outdoor locations shall be rated NEMA 4X.
- E. Indicating Lights: NEMA ICS 2; heavy-duty, oiltight (30 mm), LED, push-to-test type as shown on the Drawings. Indicating lights in hazardous locations shall be rated NEMA 7. Indicating lights in exposed, outdoor locations shall be rated NEMA 4X.
- F. Selector Switches: NEMA ICS 2; heavy-duty, oiltight, (30 mm) as shown on the Drawings. Selector switches in hazardous locations shall be rated NEMA 7. Selector switches in exposed, outdoor locations shall be rated NEMA 4X.
- G. Timing Relays: UL Listed with On and Timing Out LEDs.
- H. Contactors: All contactors for starters specified herein, including VFD and bypass starters, shall be NEMA rated. IEC contactors are not allowed. Contactors shall be Allen-Bradley, Bulletin 509, or equal.
- I. Elapsed Time Meters: Redington/Engler 722 series, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.
- J. Control Power Transformers: 240/120-volt secondary. Each motor controller shall have a dedicated control power transformer.
- K. Industrial control and power relays shall be installed in control panels where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, alarm lights, alarm horns, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays. Relays for monitoring the output voltage of uninterruptable power supplies shall be UPS voltage monitoring relays. Contactors for motor power control shall be industrial, electrically-held power contactors.
- L. Relays shall meet the following requirements:
  1. Interposing/isolation relays:

- a. Configuration: SPDT or DPDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC, or as required by System Supplier.
    - d. Contact rating: 8 A (DPDT), 16 A (SPDT).
    - e. Operating life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HK, or equal.
  - 2. General purpose relays:
    - a. Configuration: DPDT or 3PDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC.
    - d. Contact rating: 15 A, minimum; 3/4 hp.
    - e. Operating life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
  - 3. UPS voltage monitoring relays:
    - a. Configuration: SPDT.
    - b. Mounting: DIN rail.
    - c. Voltage: 120 VAC.
    - d. Contact rating: 15 A.
    - e. Operating life: 10 million cycles.
    - f. Over-voltage range: 80 to 150 VAC, adjustable.
    - g. Under-voltage range: 30 to 95% of pickup, adjustable.
    - h. Drop-out time delay: 0.1 to 10 seconds, adjustable.
    - i. UL listed.
    - j. Manufacturer: Macromatic, VWKE120A, or equal.
  - 4. Power contactors:
    - a. Configuration: Electrically-held, 3 poles.
    - b. Mounting: DIN rail.
    - c. Voltage: 120 VAC.
    - d. Minimum contact rating: 20 A continuous, 1 hp.
    - e. Operating life: 1.3 million cycles.
    - f. UL listed.
    - g. NEMA rated.
    - h. Manufacturer: Allen-Bradley, Bulletin 300, or equal.
- M. PLCs, Operator Interface Panels (OIPs), and network switches shall comply with Section 26 09 00—Controls and Instrumentation. PLCs shall be by the same manufacturer and match the communication protocol (e.g., Ethernet/IP) provided under Section 26 09 00—Controls and Instrumentation. Network switches shall be by the same manufacturer and be compatible with communication features (e.g., self-healing ring) provided under Section 26 09 00—Controls and Instrumentation. Coordinate requirements with the Section 26 09 00 System Supplier.

## 2.04 WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be permanently-attached, heat-shrink type labels.
  - 1. Sleeve: Permanent, PVC, white, with legible machine-printed black markings.
  - 2. Acceptable Manufacturers: Raychem Model D-SCE or ZH-SCE, Brady Model 3PS, or equal.

3. Grounding Conductor: Provide green wire marker; minimum 2 inches wide.
- B. Wire or cable numbering preprinted on the conductor or cable insulation, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

## PART 3—EXECUTION

### 3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, start-up, and operator training.

### 3.02 INSTALLATION

- A. All control panels and equipment enclosures shall be cleaned of debris and wires neatly arranged with surplus length cutoff. Spare wires shall be labeled as "spare" and where the wires terminate.
- B. Where louvers are provided in enclosures or control panels, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in enclosures or control panels, all filters shall be replaced with new at the time of final completion.
- C. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.
- D. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR. One can of touch-up paint shall be provided for each different color factory finish that is to be the final finished surface of the product.

### 3.03 WIRE IDENTIFICATION

- A. Conductors shall be grouped as to circuits and arranged in a neat manner. Phase identification shall be consistent throughout the system. All wiring labels shall be able to be read without removing wire management (i.e., wiring trough covers, spiral windings, etc.) or twisting the wire/cable.
- B. Power Conductor Insulation Color Code:
  1. 6 AWG and Larger: Provide general-purpose, flame-retardant, permanent tape at each termination.
  2. 8 AWG and Smaller: Provide conductors with color-coded insulation.
  3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
120/240 Volts Single-Phase, Three Wire	Grounded Neutral One Hot Leg Other Hot Leg	White* Black Red
120/208 Volts	Grounded Neutral	White*

System	Conductor	Color
Three-Phase, Four Wire	Phase A Phase B Phase C	Black Red Blue
277/480 Volts Three-Phase, Four Wire	Grounded Neutral Phase A Phase B Phase C	White* Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		
*When installed as part of a 120-volt or 277-volt branch circuit, provide a color-coded stripe on the white neutral conductor insulation matching the branch circuit insulation.		

C. Control Panel Control Conductor Insulation Color Code:

1. All conductors shall have color-coded insulation.
2. Colors:

System	Conductor	Color
Supply Voltage	Ungrounded Circuit Conductors Neutral	Black White
Discrete 120-volt AC Input/Output	Control Circuit Conductor Neutral	Red White
Discrete 12/24-volt DC Input/Output	Control Circuit Conductor Common	Blue White with Blue Stripe
Conductors energized when the main disconnect is in the "off" position (e.g. foreign supply voltages)	Control Circuit Conductor AC Neutral DC Common Ground	Orange White White with Blue Stripe Green
Intrinsically Safe	Control Circuit Conductor DC Common	Light Blue White with Two Light Blue Stripes

D. Circuit Identification:

1. Identify power, instrumentation, and control conductors at each termination.
2. Conductors fed from remote panelboard circuits shall identify circuit matching the circuit directory designations, including the neutral conductor.
3. Control conductor identification shall match the associated terminal block label.

E. Data/Voice Cable and Communication Equipment Identification: All communication cables shall be labeled on both ends.

F. Terminal Block Identification:

1. Terminal blocks shall be labeled on both sides of each terminal block. Terminal block numbering shall match the numbers shown on the project-specific wiring diagrams.
2. Fused terminal block labels shall be located on top of the terminal blocks and include the fuse voltage and amperage rating.

G. Labeling Font Requirements:

1. The font for all conductor, cable, and device labels shall be Arial with black characters on white background, and minimum font size 12.
2. The text for all conductor, cable, and device labels shall be machine printed. Handwritten labels are not acceptable.

### 3.04 SYSTEM START-UP AND SUPPORT SERVICES

- A. On-Site Functional Acceptance Testing:
1. After all equipment has been installed and is placed in full-time operation or after all equipment associated with the group of equipment scheduled for on-site functional acceptance testing has been installed and placed in full-time operation, CONTRACTOR and manufacturer shall demonstrate that all equipment and controls operate in compliance with the Contract Documents. For each piece of equipment being tested, all systems associated with the operation of the equipment (e.g., controls, supply/discharge piping, etc.) shall be installed and be in full operating condition so that all equipment functions are able to be completely tested without delay using real-time process I/O.
  2. All control wiring, hardwired interlocks, OIP screens, control programming, etc., shall be checked out and functionally tested by manufacturer prior to ENGINEER's on-site functional acceptance testing. All functional errors shall be corrected prior to ENGINEER's on-site functional acceptance testing.
  3. CONTRACTOR shall submit updated versions of all OIP screens provided by Division 46 to ENGINEER for review at least 1 month prior to the functional acceptance testing of equipment controlled through the associated OIP screens.
  4. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for ENGINEER's functional acceptance testing, CONTRACTOR and manufacturer shall be on-site during testing to adjust equipment, correct erroneous wiring, and make modifications to control system and OIP programming, as necessary.
  5. Manufacturer shall provide functional acceptance testing support through one or more on-site field service engineers and the project control system programmer. Time for the on-site field service engineers and programmer scheduled for functional acceptance testing shall be dedicated to the functional acceptance testing process and shall not be interrupted for other construction-related activities.
- B. Final acceptance and payment for panels that include programmable controllers will not be made until the system has operated satisfactorily for a minimum of 30 consecutive days. Manufacturer shall include in their Bid field follow-up to provide proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:
1. Satisfactory operation of I/O control loops.
  2. Satisfactory operation of software.
  3. Satisfactory operation of control program.
  4. Satisfactory operation of peripheral equipment.
  5. The necessary debugging programs have been performed.
  6. Data output is reliable.
  7. Control loops are operational.
  8. Checking and calibrating of systems have been completed.
- C. Manufacturer shall provide the following support services:
1. Field Service Engineer: Field Service Engineer shall be responsible for programming of system PLCs in the factory and at the site. Field Service Engineer shall be present for start-up of all systems and available throughout the entire construction process until final completion. Service technicians sent for system start-up will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
    - a. Commissioning, installation, start-up, and testing of equipment.
    - b. Revising or rewriting manuals to incorporate an installed and accepted system.

- c. On-site training.
  - d. Software modifications.
- 2. In-Factory support shall include consultation following the acceptance testing and shipment. Services shall include, but not be limited to:
  - a. Researching and answering questions related to the system operation, documentation, and system use and functions.
  - b. Program modifications.
  - c. Revising or rewriting manuals.
- 3. Post start-up support shall include follow-up services during the one-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. Enhancement hours and associated trips to the site shall be as specified in the individual specification sections.

END OF SECTION



## SECTION 41 22 23

### HOISTS AND CRANES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Hoists.
  - 2. Trolleys.
  - 3. Bridge cranes (under running).
  - 4. Conductor systems.
  - 5. Flat cable festoon systems.
  - 6. Cord reels.
  - 7. Electrical system controls.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. CMAA–Crane Manufacturers Association of America.
- B. MHI–Material Handling Institute, Inc.
- C. ANSI–American National Standard Institute.
- D. HMI–Hoist Manufacturers Institute.
- E. MMA–Monorail Manufacturers Association.

##### 1.03 SYSTEM DESCRIPTION

- A. Crane System: Under-running crane systems shall include items specified in this section as appropriate, and all other specified accessories necessary to provide a complete functioning system.
- B. Monorail System: Monorail system shall include monorail beam(s) furnished under Division 05 and items specified in this section (excluding bridge cranes and portable cranes) as appropriate, and all other specified accessories necessary to provide a complete functioning system.

##### 1.04 DESIGN REQUIREMENTS

- A. Crane systems shall be designed and manufactured in accordance with CMAA Specification No. 74, *Specifications for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist*.
- B. Under running crane and monorail systems shall be designed and manufactured in accordance with ANSI MH 27.1, *Monorail Manufacturers Association Specifications for*

*Underhung Cranes and Monorail Systems.* Where design standards of the CMAA and MMA conflict, the CMAA standards shall govern.

- C. Hoists shall be designed and manufactured in accordance with the standards of the Hoist Manufacturers Institute.

#### 1.05 PERFORMANCE REQUIREMENTS

- A. Crane and Monorail Systems: CONTRACTOR shall conduct start-up and testing of crane and monorail systems to demonstrate that load capacity and total system operation meet the requirements and intent of the Contract Documents.
- B. Portable Hoists: CONTRACTOR shall demonstrate that portable hoist operation meets the requirements and intent of the Contract Documents.

#### 1.06 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. Submit type, brand, and thickness of primer paint to be furnished on bridge cranes, runway beams, and monorails.

### PART 2–PRODUCTS

#### 2.01 BRIDGE CRANE

- A. Bridge crane shall consist of a single girder under running bridge supported on four-wheel end trucks at each end. End trucks shall run on two runway beams located where shown on the Drawings. End trucks shall be dual motor-driven with 460-volt, three-phase motors.
- B. Bridge crane manufacturer shall design and provide runway beams and supporting column and frame system.
- C. Acceptable manufacturers include the following, or equal:
  - 1. UESCO Cranes, Inc., Worth, Illinois.
  - 2. ACCO Chain and Lifting Products, York, Pennsylvania.
  - 3. Lift Crane and Conveyor.
- D. Crane schedule is as follows:

Structure	Load Capacity	End Truck Motor Size	Motor Speeds
West Hickman–UV Disinfection	1-ton	2/3 HP	1200 RPM

- E. Crane service classification shall be Class A–Standby Service, or better.

#### 2.02 HOISTS/TROLLEYS

- A. Hoists shall be Coffing, or equal, electric chain hoists. Motors shall be 460-volt, three-phase, 60 Hz. Provide chain container with hoists.

- B. Provide corrosion resistant features to include zinc plated chain and hook, stainless steel limit shaft and wheels, and epoxy paint system.
- C. Hoist schedule is as follows:

Structure	Model	Load Capacity	Motor Size	Speeds	Lift Height
Town Branch–UV Disinfection	ECMT-2016	1-ton	1/2-hp	16 ft/min (hoist) 35 ft/min (trolley)	23'-0"

## 2.03 CORD REELS

- A. Provide heavy duty stretch cord reels rated to supply 480-volt, three-phase power. Cables shall include copper phase and ground conductor quantities and sizes as scheduled above. Cord reels and cables shall be rated for horizontal stretch applications at maximum 6% sag for the entire length of allowable hoist travel. Cable reels shall be as manufactured by Gleason Reel, Series S, or equal.

## 2.04 ELECTRICAL SYSTEM CONTROLS

- A. Bridge crane systems, hoists, trolleys, conductor systems, and flat cable festoon systems for exterior locations shall be rated NEMA 4X.
- B. Bridge crane systems, hoists, and trolleys shall be controlled via a pushbutton pendant. Pushbutton pendant shall reach to within 3 feet 6 inches of the operating floor. Pushbutton pendant shall provide control of all system motions (up/down, forward/reverse, etc.) and shall have an emergency stop pushbutton.
- C. Bridge crane systems, hoists, and trolleys shall have a control power transformer for dedicated control power circuit.
- D. Bridge crane systems, hoists, and trolleys motion shall be controlled by magnetic motor contactors mounted on shockproof mountings.
- E. Bridge crane systems, hoists, and trolleys shall accept a single point power connection.
- F. Where hoists and trolleys are specified to be provided on the same mounting structure (i.e., monorail, etc.) the hoist and trolley shall be combined as one unit and shall be wired by manufacturer such that the hoist and trolley unit shall accept a single point power connection. Additional CONTRACTOR interconnection wiring between the hoist and trolley shall not be required.
- G. Local disconnect shall be provided by Division 26.

## 2.05 FINISHES

- A. Bridge crane runway beam and monorail beams shall be painted in accordance with Section 09 91 00–Painting requirements for steel, machinery, and equipment not submerged. Primer shall consist of one shop coat of Tnemec 69-1255 Hi-Build Epoxoline primer, 5.0 mils DFT. Load capacity shall be stenciled on the bridge and monorail beam after finish painting.

- B. Hoists and trolleys shall be factory-finished painted with the manufacturer's epoxy paint finish system.

### PART 3-EXECUTION

#### 3.01 EQUIPMENT INSTALLATION

- A. Install equipment as indicated and according to supplier's and manufacturer's instructions.
- B. CONTRACTOR shall inspect the units after delivery to the site for any damage to the units during shipping.

#### 3.02 FIELD QUALITY CONTROL AND DEMONSTRATION

- A. Provide manufacturer's services for the following:
  - 1. Start-up.
  - 2. Field Testing: Equipment manufacturer shall provide a written report covering checkout, testing, inspections and start-up, and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report.
  - 3. Operator training and final adjustment.
- B. Supervision and Start-Up: Installation of all equipment furnished under this Contract shall be supervised as required by a qualified representative of equipment manufacturer. All equipment shall be placed in operation, and the plant operator shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentation given by manufacturer's representatives.

#### 3.03 FINISHING

- A. CONTRACTOR shall provide finish paint as required by Section 09 91 00-Painting.

#### 3.04 ADJUSTING, CLEANING, AND PROTECTION

- A. CONTRACTOR shall provide final adjusting, cleaning, and protection in accordance with Division 01. CONTRACTOR shall make all final adjusting on equipment as required by manufacturer. CONTRACTOR shall leave equipment in a clean condition.

#### 3.05 LUBRICATION

- A. CONTRACTOR shall furnish a one-year supply of grease and oils for all items of equipment requiring lubrication. Lubricants for all items of equipment shall be the same brand, when available, as recommended by the manufacturer to meet both warm and cold weather requirements.

END OF SECTION

## SECTION 43 25 10

### SUBMERSIBLE PUMPS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation submersible pumps and appurtenances. The pumps and appurtenances shall be furnished by the same supplier. They are to include: Four non-potable water pumps NPW-01, NPW-02, NPW-03, and NPW-04.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

##### 1.02 SYSTEM DESCRIPTION

- A. Application: Pumps NPW-01, NPW-02, NPW-03, and NPW-04 shall be used to supply the plant non-potable water system utilizing water from the disinfection facility.
- B. Design Requirements:
1. The submersible pumps shall meet the following operating conditions:

OPERATING CONDITIONS							
		Head Conditions at Given Flows					
		Normal		Minimum		Maximum	
Pump	Location	GPM	TDH (ft)	GPM	TDH (ft)	GPM	TDH (ft)
NPW-01	NPW PS	400	240	100	250	600	230
NPW-02	NPW PS	400	240	100	250	600	230
NPW-03	NPW PS	400	240	100	250	600	230
NPW-04	NPW PS	400	240	100	250	600	230

2. The submersible pump motors shall meet the following operating conditions:

Pump	HP	Voltage	Phase	RPM	Minimum Pump Eff.*	Minimum Motor Eff.*
NPW-01	74	460	3	1780	49.4%	92.2%
NPW-02	74	460	3	1780	49.4%	92.2%
NPW-03	74	460	3	1780	49.4%	92.2%
NPW-04	74	460	3	1780	49.4%	92.2%

\*Minimum efficiency at normal operating conditions.

- C. Performance Requirements: CONTRACTOR shall supply pumps to meet the following requirements using constant speed operation:
1. Operate at the normal condition listed above following Hydraulic Institute (HI) Acceptance Grade 1U (operate at normal condition within +10% of rated flow and within

+6% of total head) noted in HI 14.6: Hydrodynamic Pumps for Hydraulic Performance Acceptance Tests.

2. While operating under suction head at the normal operating conditions, the pump design shall be such that the pump will operate satisfactorily without cavitation, excessive noise, or vibration when installed as shown on the Drawings and operating at the head specified.
3. Motor horsepower shown is the minimum requirement. The motor shall be large enough not to be overloaded at any point on the design curve for the pump chosen to meet the operating conditions.
4. The maximum and minimum head conditions are given as a guide to the shape of the head discharge curve. The pumps shall have a head discharge curve of the same shape or steeper within the guidelines previously specified.
5. Be designed to operate in submerged condition in the space allotted.
6. Be vertical, nonclog centrifugal wastewater pumps with integral motors designed and assembled by same manufacturer.
7. Be capable of handling 3-inch solids and long stringy materials found in raw unscreened wastewater.
8. With its appurtenances and cable, be capable of operation with continuous submergence without loss of watertight integrity to a depth of 65 feet.
9. Be capable of running continuously at full nameplate rated load while the pump is submerged, partially submerged or unsubmerged. The use of shower systems, secondary pumps, or cooling systems to cool the motor shall not be acceptable.
10. Be UL, CSA, or FM approved for Class I, Division 1, Groups C and D hazardous locations.

### 1.03 QUALITY ASSURANCE

- A. Materials of construction for the pumps and related equipment shall be suitable for the environment in which they are to be located.

### 1.04 WARRANTY

- A. The pump manufacturer shall warrant the units being supplied to OWNER against defects in workmanship and materials for a minimum period of 5 years or 10,000 hours under normal use, operation and service. The warranty shall be in printed form and apply to all similar units.

## PART 2-PRODUCTS

### 2.01 MANUFACTURER

- A. Submersible pumps shall be manufactured by KSB, or equal, meeting the following requirements:

Pump	Series	Model	Impeller	Diameter
NPW-01	KRT K	100-401	14.75-inch	4-inch
NPW-02	KRT K	100-401	14.75-inch	4-inch
NPW-03	KRT K	100-401	14.75-inch	4-inch
NPW-04	KRT K	100-401	14.75-inch	4-inch

- B. The Drawings and Specifications were prepared based on KSB. CONTRACTOR shall include in the Bid, and shall be responsible for, the cost of any changes to accommodate other equipment, including, but not limited to, structural, mechanical, and electrical Work. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

## 2.02 PUMP RETRIEVAL SYSTEM

- A. The design of the pumps shall be such that the pump unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection, permanently installed in the wet well. The pump shall be easily removable for inspection or service, requiring no bolts, nuts or other fasteners to be disconnected, or need for personnel to enter the wet well.
- B. A sliding guide bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron discharge connection, which when bolted to the floor of the wet well and discharge line, will receive the wet well discharge connecting flange without the need of adjustment, fasteners, clamps or similar devices.
- C. Alignment of the pump to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by no less than two stainless steel guide bars. Guide bars shall be of a diameter and wall thickness as recommended by the pump manufacturer. Provide stainless steel top guide bar brackets and intermediate guide bar brackets as required. Guide bars shall extend from access door to the discharge connection. No other motion of the pump unit, such as tilting or rotating, shall be required. Sealing of the pump to the discharge flange connection shall be by a machined metal-to-metal contact. As an alternative, provide a machined groove to hold a molded urethane sealing ring in place to provide a redundant leak-proof seal. No portion of the pump unit shall bear directly on the floor of the wet well. The entire weight of the pump shall be borne by the pump discharge elbow. There shall be no more than one 90° bend allowed between the volute discharge flange and station piping. Discharge connection to discharge pipe shall be an ANSI B16.1 Class 125 flange.
- D. Pumps shall be fitted with a stainless steel cable of adequate strength to permit raising and lowering of the pumps for inspection or removal. Hoist end of pump retrieval cable shall be fitted with a swaged ball to allow for connection to pump lifting equipment. All components shall be of adequate size, length, and strength for the pump being lifted and shall be provided so to allow cable to automatically be wound on cable drum.

## 2.03 PUMP CONSTRUCTION

- A. All major parts such as the stator casing, lubricant casing, sliding bracket, discharge connection, volute and impeller shall be of gray iron with smooth surfaces. All exposed bolts, screws and nuts shall be stainless steel construction. All metal surfaces coming in contact with the pumped liquid other than steel or brass shall be protected by a manufacturer-selected paint system.
- B. All mating surfaces of major parts shall be machined and fitted with O-rings where watertight sealing is required. Machining and fitting shall be such that sealing is accomplished by automatic compression in two planes and O-ring contact made on four surfaces without the requirement of specific torque limits to affect this. Rectangular cross-sectioned gaskets

requiring specific torque limits to achieve compression shall not be considered adequate or equal. Tolerances of all parts shall be such that allows replacement of any part without additional machining required to provide sealing as described above. No secondary sealing compounds, greases, or other devices shall be used.

#### 2.04 PUMP VOLUTE

- A. Pump volute shall be single-piece, cast iron, nonconcentric design with smooth passages large enough to pass any solids that may enter the impeller.

#### 2.05 PUMP MOTOR

- A. The pump motor shall be housed in an air-filled watertight chamber and shall have moisture-resistant Class H insulation. The pump motor shall be NEMA Design B designed for continuous duty. Motor shall be capable of sustaining at least 15 evenly spaced starts per hour.
- B. The combined service factor (combined effect of voltage, frequency, and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of  $\pm 10\%$ . The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. Motor shall meet the requirements of NEMA MG-1 part 31 and be suitable for VFD operation.
- C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
- D. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

#### 2.06 PUMP PROTECTION

- A. The motor stator shall incorporate three thermal switches in series to monitor the temperature of each phase winding. At a temperature preset to protect the motor the thermal switches shall stop the motor and be capable of activating an alarm.
- B. A float-type leakage sensor (FLS) shall be provided to detect fluid in the stator. When activated, the sensor shall be capable of stopping the motor and activating an alarm or indicator. The thermal switches and sensor shall be connected to a monitoring unit which shall be designed to be mounted in the control panel.

#### 2.07 PUMP SHAFT

- A. Pump and motor shaft shall be one unit. Couplings are not acceptable. The shaft shall be made of stainless steel. The shaft shall rotate on two permanently lubricated bearings with a L-10 bearing life of 50,000 hours when pump is operating at or near best efficiency point. Bearings shall compensate for axial thrust and radial forces.



## 2.08 PUMP MECHANICAL SEALS

- A. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces. The lower primary seal unit between the pump and lubricant chamber shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper secondary seal unit between the lubricant chamber and the motor housing shall contain one stationary and one positively driven rotating tungsten carbide seal ring. Each interface shall be held in contact by its own spring system and not require being supplemented by external liquid pressures. Both seals shall be mounted on the shaft. The lower seal shall not be mounted on the impeller hub. The seals shall require neither maintenance nor adjustment, nor depend on direction of rotation for sealing. Shaft seals without positively driven rotating members or conventional double mechanical seals with a common single or double spring acting between the upper and lower units, requiring a pressure differential to offset external pressure and effect sealing shall not be considered acceptable, nor equal to, the dual independent seal system specified.
- B. The pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive antileak seal shall be easily accessible from the outside. No seal damage shall result from operating the pump in an unsubmerged condition. The seal system shall not rely on the pumped media for lubrication.

## 2.09 PUMP IMPELLER

- A. The impeller shall be wear resistant and made of high chromium cast iron with at least 24% chrome against sand and grit which is expected to enter the pump station with the wastewater or stormwater. Impellers that have surface hardening (by thermal coating, etc.) will not be allowed.

## 2.10 PUMP MOTOR CABLE

- A. The pump motor cable shall be suitable for submersible pump applications. This shall be indicated by a code or legend permanently printed on the cable. Cable size shall conform to NEC and ICEA Standards and shall be of adequate size to allow motor voltage conversion without replacing the cable. Provide a stainless steel Kellum grip strain relief on motor cable to support cable at manhole cover. Provide minimum 50 feet of cable for each pump, more as necessary. Cable shall be of sufficient length to provide continuous run from in-place pump to point of cable connection. All ends of pump cables shall be fitted with a rubber shrink-fit boot to protect cable prior to installation.

## 2.11 CABLE ENTRY SEAL

- A. A cable entry seal shall be provided where the pump cable enters the pump. The cable entry seal design shall preclude specific torque requirements to provide a watertight and submersible seal. The cable entry shall consist of cylindrical elastomeric grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain-relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by stator lead sealing gland or a terminal board which shall isolate

the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be required or used.

## 2.12 COOLING SYSTEM

- A. As required for air-filled motors, pump shall be provided with cooling system of thermal radiators integral to the stator housing, cast in one unit. Pump shall be capable of operating in a dry condition without damage to motor or pump.

## 2.13 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 26.

## 2.14 VARIABLE SPEED NON-POTABLE WATER PUMP CONTROLS

- A. Variable speed drives are specified in Division 26 of these specifications. Care shall be taken in sizing the drive to provide adequate starting torque for the non-potable water pumps. This information shall include, but not be limited to, motor full load amps and locked rotor amps, and shall be provided to the variable speed supplier specified in Division 26.
- B. Non-potable water pump controls are specified in Division 26, Section 26 09 00—Controls and Instrumentation of these specifications. The non-potable water pump manufacturer shall review these controls and coordinate with Division 26.
- C. The non-potable water pump manufacturer shall, on the job site, perform a vibration analysis and harmonics frequency test of the installed units to determine the actual field-defined range of VFD speeds that should be locked out and where the VFD should be ramped across (not operate) in this range to limit harmonic frequencies. This shall be performed and repeated at high submergence, zero submergence, and at low submergence.
- D. Equipment manufacturer shall furnish information regarding the minimum motor speed allowed in order to protect the motor and drive equipment to the variable speed drive supplier specified in Division 26. Minimum speed requirements shall be based on actual installed conditions and shall be furnished at or prior to equipment start-up. Calculations showing how minimum speed requirements were determined shall be furnished to ENGINEER for review.

## 2.15 ACCESS DOORS AND ACCESSORIES

- A. Provide aluminum single-leaf access doors as manufactured by Bilco, Nystrom, or equal, for the openings indicated on the Drawings. Doors shall be angle-frame design. The doors shall include a positive hold-open arm with release handle and a tubular stainless steel compression-spring operator. Provide doors with flush slam-lock with inside handle and removable key wrench. Aluminum doors shall be mill finish. All aluminum surfaces in contact with concrete shall be painted with bitumastic coating as prescribed by manufacturer. Door hardware shall be zinc plated and stainless steel throughout.
- B. Access cover shall be provided with fall-through protection consisting of aluminum grating designed to withstand live load of 300 pounds per square foot. Grating shall allow for visual inspection, limited maintenance, and float adjustment while the grate is in place. Grate shall be provided with a permanent hinging system which will lock grate in 90 degree position

once opened. A locking device to prevent unauthorized entry to the confined space below shall be provided. Aluminum grating shall be powder-coated safety orange.

- C. Doors shall be cast into top slab. CONTRACTOR shall coordinate location of door to provide proper clearance between door and pumps and to allow for proper placement of pumps.
- D. Doors shall be reinforced for minimum 300 pounds per square foot loading.
- E. Provide stainless steel or fiberglass unistruts, as necessary, attached to doors to mount accessories. Accessories (upper guide holder, cable holder, power and float cable holder, etc.) shall be stainless steel.

## 2.16 FINISHES

- A. It is the intent of these specifications that the submersible pumps be furnished shop-primed and factory-finished painted. Priming and finish painting shall be as recommended by manufacturer and shall be suitable for the uses described in these specifications. Touch-up paint shall be provided by manufacturer.
- B. The impeller shall be coated with manufacturer selected primer.

## 2.17 ANCHOR BOLTS

- A. CONTRACTOR shall provide anchor bolts necessary for equipment furnished. Anchor bolts shall be stainless steel and be of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

# PART 3—EXECUTION

## 3.01 INSTALLATION

- A. Refer to requirements specified in Division 01 for field installation, testing, quality assurance, and start-up.
- B. Install in accordance with manufacturer's directions as supplemented herein.
- C. CONTRACTOR shall coordinate the proper location of wet well cover casting in the wet well top slab, placement of the hoist socket, and all associated pump accessories to facilitate installation and removal of pumps. Locations shall be suitable to meet current design and future design conditions without interference.

## 3.02 PUMP TESTING

- A. Factory Test: Each pumping unit to be furnished shall be fully performance tested with water in the manufacturer's facility in accordance with the Standards of the Hydraulic Institute to determine compliance with the rated conditions. The pump tests shall be witnessed by OWNER at OWNER's option. Notify OWNER at least three weeks in advance regarding the proposed test dates and location. Certified test curves, test data, and computations shall be submitted for approval prior to shipment and shall include pump performance curves for each of the speeds needed to meet the specified operating conditions defined under

Paragraph 1.02.B. Each pump performance curve shall include at least four operating points and shall show:

1. Head versus discharge.
2. Pump efficiency.
3. Break horsepower.
4. NPSHr for maximum flow conditions.
5. Hydrostatic pressure test for casing at 75 psi.

B. Installed Test: Prior to startup at OWNER's facility, manufacturer's representative shall certify that equipment has been properly aligned and installed. During equipment startup, manufacturer's representative shall confirm each pump is operating properly as specified. Report shall be submitted verifying test. Pump shall be modified if specified conditions are not met.

C. Start-Up Tests: The pump manufacturer shall perform the following inspections and tests on each pump at start-up:

1. Impeller, motor rating, and electrical connections shall first be checked for compliance to the specifications.
2. A motor and cable insulation test for moisture content or insulation defects.
3. Verify correct rotation.
4. Verify proper voltage.
5. Verify proper current draw on each phase.
6. Verify thermal sensor trip will shut down motor in Hand and Auto mode.
7. A written certified test report giving the above information shall be supplied after start-up.

END OF SECTION

## SECTION 46 33 20

### LIQUID CHLORINATION EQUIPMENT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation nine chemical feed pumps (SHFP-TB-01 through SHFP-TB-05 at Town Branch WWTP, and SHFP-WH-01 through SHFP-WH-04 at West Hickman WWTP). The equipment and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Mobile Pump Skid 4 will be employed during construction to feed 38% Sodium Bisulfite solution (SBS) for dechlorination at West Hickman once the Sulfur Dioxide feed system is removed from service. Following temporary use for Sodium Bisulfite, skids and piping shall be cleaned thoroughly for use with 12.5% Sodium Hypochlorite Solution (SHS) according to the Manufacturer's instruction. CONTRACTOR shall provide temporary feed piping suitable for use with Sodium Bisulfite.

##### 1.02 REFERENCES

- A. NEMA—National Electrical Manufacturers Association Standard.

##### 1.03 SYSTEM DESCRIPTION

- A. Chemical feed pumps shall be used to pump chlorine solution to the temporary and permanent chlorination points, as shown on the Drawings.
- B. Design Requirements: Chemical feed pumps shall meet the following operating conditions:

	Skid No.	1	2	3	4
	LFUCG Treatment Plant	Town Branch	Town Branch	West Hickman	West Hickman
	Product Pumped	Sodium Hypochlorite	Sodium Hypochlorite	Sodium Hypochlorite	Sodium Hypochlorite
	Chemical Concentration (%)	12.5%	12.5%	12.5%	12.5%
	Skid Use (Permanent/Mobile)	Permanent	Mobile	Permanent	Mobile
	Skid Configuration (Floor/Wall)	Floor	Floor	Floor	Floor
	Total No. of Pumps Per Skid	3	2	2	2
	Pump Quantity of Each Model Per Skid	2 Duty / 1 Standby	1 Duty / 1 Standby	2	1 Duty / 1 Standby
	No. of Outlets Per Skid	2	2	2	2

	Skid No.	1	2	3	4
Flow Rate Per Pump (Rated)	GPH	1.85	9.25	9.25	9.25
Flow Rate Per Pump (Maximum)	GPH	5.3	11.1	11.1	11.1
Flow Rate Per Pump (Minimum)	GPH	0.8	0.8	0.8	0.8
Discharge Pressure (Max)	PSIG	145	145	145	145
Pump Model	Prominent	Sigma/1 Control Version B	Sigma/1 Control Version B	Sigma/1 Control Version B	Sigma/1 Control Version B
Required Features	Available Options				
Liquid End Wetted Material	PVDF 316SS	Degassing Head	Degassing Head	Degassing Head	Degassing Head
Speed Control	Manual + 4-20ma	Manual + 4-20ma	Manual + 4-20ma	Manual + 4-20ma	Manual + 4-20ma
On-Skid Controls	SCADA Interface Panel Or Terminal Box	CP3 3-Pump 120 VAC SCADA Interface Panel Mounted on Skid	None	CP3 3-Pump 120 VAC SCADA Interface Panel Mounted on Skid	None
Remote Pause	Dry Contact	Standard	Standard	Standard	Standard
Diaphragm Failure Indication	Local Only Remote	Remote	Local Only	Remote	Local Only
Output Relay	None Fault Fault + Pacing Fault + 4-20 ma	Fault + 4-20 ma	None	Fault + 4-20 ma	None

#### 1.04 SUBMITTALS

- A. Shop drawings showing system installation shall be submitted.
- B. Schematic diagram for installation must be reviewed by ENGINEER before approval of equipment will be made.

#### 1.05 WARRANTY

- A. Standard 1-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of 1 year from the earlier of either the date established for partial utilization in accordance with GC12.6, as modified in the Supplementary Conditions, or Substantial Completion of the project.

## PART 2–PRODUCTS

### 2.01 MANUFACTURERS

- A. Feed pumps SHFP-TB-01 through SHFP-TB-03 and SHFP-WH-01 shall be Prominent Sigma/1 Series Model 12017 SST, or equal.
- B. Feed pumps SHFP-TB-04 and SHFP-TB-05 as well as SHFP-WH-02 through SHFP-WH-05 shall be Prominent Sigma/1 Series Model 12035 PVT, or equal

### 2.02 DIAPHRAGM PUMPS

- A. The chemical metering pump(s) shall be microprocessor-controlled, motor-driven, reciprocating, mechanically actuated diaphragm type. The pump shall include integral motor, oil-lubricated or permanently greased bearings, gear reducer and cam-and-spring drive mounted on an aluminum housing. Such housing is to be sealed into an outer plastic housing for corrosion protection.
- B. All pumping functions shall be set by membrane switch keypad and click wheel and status shall be displayed on an illuminated LCD. The keypad shall allow for simple scrolling and display of programmed parameters.
- C. The pump shall be fully tested by the manufacturer prior to shipment to meet rated flow and pressure.
- D. The pump shall have a universal power supply that allows it to operate at a supply voltage in the range of 100-230 VAC  $\pm 10\%$ , 50-60Hz, single phase.
- E. The diaphragm shall be constructed of a solid core, vulcanized into nylon-reinforced EPDM, with a PTFE-faced fluid contact surface. The diaphragm shall have a convex design fitting into a concave liquid end to minimize dead volume and promote the flow of solids in suspension. The pump shall also have a diaphragm failure detector with a visible indicator of a diaphragm rupture. There shall also be an option for a fault indication or pump shut down in the case of a diaphragm rupture. Diaphragm options shall be supplied as specified in Paragraph 1.03.B.
- F. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the drive if the primary diaphragm fails.
- G. The liquid end shall be virgin PVDF. Pumps with PVDF liquid ends shall be NSF 61 Certified for use with standard water treatment chemicals. Liquid end material selection shall be based on the best compatibility with the chemicals listed in Paragraph 1.03.B. Chemical compatibility information should be made available at ENGINEER's request.
- H. Stroke length control shall be adjustable manually by means of a stroke length knob, in increments of 1%, from 0% to 100% of stroke length. Stroke length shall be determined by a sensor within the stroke adjustment knob that provides accurate feedback to the electronics of the pump for calibration and LCD display of stroke length. The digital display and optional analog output will calculate, display, and transmit the flow of the pump based on pump speed and stroke length settings.

- I. Stroke frequency control shall be done with an integral VFD and stepper motor pump controller. For the integral controller, the first 1/3 of the frequency in strokes per minute will operate with the stepper motor and frequencies greater than 1/3 of the maximum will operate with the internal VFD. When specified in Paragraph 1.03.B., control shall be switchable between manual or external control. In manual mode, stroke frequency control shall be manually adjusted by the touch keypad, with the set stroke rate displayed on the pump's LCD. In external mode, the pump shall be capable of receiving a 4-20 mA input via an optional external control cable. The metering pump shall be capable of remote ON-OFF operation using the PAUSE function via a voltage-free contact relay through an optional control cable. The pump shall include a TEFC, four-pole AC motor.
- J. It shall be possible to selectively slow the discharge or the suction stroke speed of the pump to accommodate application requirements and process fluid viscosity and off-gassing conditions.
- K. When specified in Paragraph 1.03.B., the pump shall be equipped with an output relay which shall be programmable for any of the following indications:
  - 1. Fault Indication.
  - 2. Fault Indication and Pacing Relay.
  - 3. mA Output: The current output signal indicates the pump's actual calculated metering volume.
- L. For simplified operator monitoring the pump shall be equipped with a three LED Display (Red, Yellow, and Green) to locally indicate normal operation, fault conditions, and warning conditions.
- M. Operating Modes: The pump shall have the following operating modes available:
  - 1. Manual operating mode permitting the operation of the pump stroke and speed controls manually.
  - 2. Contact operating mode providing the option of controlling the pump externally by means of potential-free contacts (e.g. by means of a contact water meter). The number of pump strokes per input contact can be scaled by a factor ranging from 0.01 to 99.99 to tailor the pump feed rate to the application.
  - 3. Batch operating mode providing the option of working with large factors (up to 99,999). Metering can be triggered either by pressing the Click wheel or by a pulse received via the "External control" terminal or through a contact or a semiconductor switching element. It is possible to pre-select a metering volume (batch) or a number of strokes using the Click wheel in the settings menu.
  - 4. The Analog operating mode allows the capacity and/or stroke rate to be controlled via an analog (4-20mA) current signal via the "External control" socket. The processing of the current signal can be preselected via the control unit.

## 2.03 SKID-MOUNTED FEED SYSTEM

- A. The skid mounting of the metering pumps shall conform to the following requirements:
  - 1. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. Components to be mounted on the skid are as indicated on the Drawings and shall include the metering pumps, calibration column, piping, valves, piping accessories (pulsation dampeners, strainers, back pressure valves, pressure relief valves, etc.), and wiring integral to the skid. The chemical



- metering pump manufacturer shall be responsible for providing all equipment, valves and piping within the skid boundary.
2. The skids shall be constructed of fusion welded black polypropylene sheets with adequate supports for all equipment and piping and a 1/2-inch drip lip. Forklift truck cut outs shall also be provided.
  3. All components of the skid-mounted system (pumps, piping and controls) shall be tested as described in Paragraph 1.03.B.
  4. Suction header shall be inverted with vent connection for flexible tubing back to bulk tank or tote.
- B. Skid-mounted accessories to include the following:
1. Calibration Chamber:
    - a. Provide one, clear plastic calibration chamber with vent for use in calibrating the metering pumps.
    - b. The chamber shall be sized to give adequate capacity for a minimum 30 second draw down test.
    - c. The scale shall give direct readings in mL and GPH without the need for calculations.
    - d. The calibration chamber shall be piped and valved so that each pump shall be able to utilize the calibration chamber without interfering with the operation of the other pumps.
    - e. The top of the chamber shall have a threaded fitting to allow for piping to a common vent.
  2. Pulsation Dampeners:
    - a. Shall be of the single diaphragm design, capable of arresting water hammer in the pump discharge lines created by the metering pumps.
    - b. Materials of construction of diaphragm and body shall be corrosion resistant to the chemical fluid pumped.
    - c. Provide one dampener on the discharge side of each metering pump.
    - d. Each pulsation dampener shall include an integral pressure gauge.
    - e. Pulsation dampeners shall be sized appropriately for each pump to remove a minimum of 95% of the pulsations. The manufacturer shall provide calculations to verify sizing if requested by ENGINEER.
  3. Backpressure and Pressure Relief Valves:
    - a. Adjustable diaphragm backpressure sustaining type valve installed on pump discharge header and set at location recommended by manufacturer. Materials to be suitable for rated chemical service.
    - b. Adjustable diaphragm pressure relief valve installed externally on pump discharge header and set at location recommended by manufacturer. PRV required for each pump mounted on feed system. Materials to be suitable for respective chemical service.
  4. Piping, Valves, and Appurtenances:
    - a. Skid piping shall be as specified in Part 1 herein. Cement shall be as recommended by the pipe manufacturer for the service outlined in this Section.
    - b. True-union ball valves shall be provided for isolation of major equipment. Seals shall be compatible with the chemical being pumped.
- C. SCADA Interface Panel for Permanent Skids:
1. Skid system shall be provided with dedicated local control panel. Control panel shall be provided with a local disconnect. Enclosures shall be NEMA 4X Polycarbonate Box or FRP.
  2. The pump control panel shall provide all functions and interfaces as shown on the specification P&ID's but not limited to the following features: L-O-R pump selector

switches, status lights, local speed control digital potentiometer, general alarm output and pump speed output.

3. Each pump shall have the following signals available for the plant SCADA/PLC via hard wire connection: Pump running status, pump alarm status, pump speed analog feedback (optional when provided), remote mode selected status.
4. Each pump shall accept the following signals from the plant SCADA/PLC via hard wire connection: Dry contact pump enable, Analog 4-20mA speed command.
5. All components shall be UL listed or Recognized, door mounted devices shall be NEMA 4x, 22mm, heavy duty, oil tight, and instrumentation shall also be NEMA 4X rated.

#### 2.04 ACCESSORIES

- A. Provide necessary tubing, hose pipe, couplings, fittings, and valves for complete installation.
- B. Include two 1/2-inch corporation cock with NPT threads, check valve, and solution tube for point of application at the West Hickman WWTP, as detailed in Section 40 05 00—Piping and Appurtenances.
- C. Provide injection nozzle equal to LMI Model 49287. Include 3/4-inch NPT injection check valve with corporation stop and nozzle assembly.

#### 2.05 FINISHES

- A. Provide factory-applied paint finish to all fabricated items; color to be selected by ENGINEER.
- B. Piping, insulation, valves, fittings, and other items which are not provided with a factory finish shall be coated per Division 09.

### PART 3—EXECUTION

#### 3.01 INSTALLATION

- A. Provide all necessary tubing, hose, couplings, fittings, and valves for a complete installation. Point of application for chemical shall be as shown on the Drawings.

#### 3.02 TESTING AND START-UP

- A. Provide manufacturer's services for the following:
  1. Start-up for each item of equipment at each plant.
  2. Field testing for each item of equipment at each plant.

END OF SECTION

## SECTION 46 43 21

### SCUM DECANT PIPE

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation six scum decant pipes (SDP-1 through SDP-4 at West Hickman WWTP and SDP-1 and SDP-2 at Town Branch WWTP). The piping and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- B. Submit shop drawings and operating and maintenance manuals in accordance with Division 01, and include the following: At ENGINEER's request, submit certification that the manufacturer has not less than ten years of experience in the application, design, and manufacturer of similarly specified sludge collecting equipment.

##### 1.03 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year in accordance with GC12.6.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. Decant pipes and appurtenances shall be as manufactured by Evoqua Water Technologies of Waukesha, Wisconsin, Jim Myers & Sons, Inc. (JMS) of Charlotte, North Carolina, or equal. This listed equipment is part of the Lump Sum Base Bid and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.

##### 2.02 SCUM DECANT PIPE

- A. SDP-1 through SDP-3 shall be used to span each 41-foot-wide tank while SDP-4 shall span one 39 foot at West Hickman WWTP. SDP-1 and SDP-2 shall each span one 19 1/2 foot-wide tank at Town Branch. Continuous travel of flotables through the series of pipes shall be 162 feet for SDP-1 through SDP-4 at West Hickman and 39 feet for SDP-1 and SDP-2 at Town Branch. CONTRACTOR to verify dimensions during shop drawing

review. Each mechanism shall be independently operated and shall be capable of minimum 75-degree rotation in either direction.

- B. Pipe shall be Type 304 stainless steel and be 12 inch-diameter with a minimum 0.25-inch wall thickness. A 60-degree wide, slotted opening shall be cut symmetrical about the vertical axis to provide a weir over which scum can flow into the pipe when rotated. Edges of the slot shall be parallel to the longitudinal axis of the pipe. Full periphery bands not less than 2 inches wide shall be left in the pipe at intervals not exceeding 2 feet to act as stiffeners. The pipe shall have a vertical deflection of no more than 1/4-inch over the entire length of the pipe.

## 2.03 BEARINGS

- A. The pipe shall be supported at each end in such a manner that a slight vertical or horizontal misalignment shall not interfere with the smooth operation of the pipe. The pipe shall be supported by and shall rotate in a Type 304 stainless steel end bearing assembly which shall be mounted to the basin wall. The end plate shall have a 360-degree, UHMW-PE bearing mounted on the inside of the end bearing support. The UHMW-PE bearing shall be inset within the bracket to allow for seals.
- B. A suitable seal shall be provided for the open end of each pipe. This seal shall be so constructed that it shall remain effective even with a slight misalignment of the pipe and end bearing support. The seal shall not be affected by grease, mild acids, or alkalis. The seal shall be readily removable without removing the pipe from the supporting brackets and shall not bind or impede the smooth action of the revolving pipe. The seal shall be held in place by an external stainless steel adjustable retainer ring.
- C. Each end bearing assembly to include up to 1/2-inch-thick stainless steel wall plate and a 1/2-inch-thick closed cell continuous wall gasket seal with excellent resistance to oil/grease and meeting all physical properties of ASTM D 1056-07 2A2, 2C2 & 2B2 and SAE J-18 APR2002 2A2, 2C2 & 2B2 shall be provided.

## 2.04 ELECTRIC ACTUATOR

- A. Actuators and their accessories shall be the intelligent electric type, as indicated herein, and as specified in the Valve and Gate Actuator section. The actuators shall be provided with the capability to accept and provide control signals as shown on the Drawings.
- B. The electric actuator shall be furnished with a permanently side attached handwheel for emergency operation.
- C. The motor actuator shall be 460/3/60, 15 min. duty rated, 1800 RPM and NEMA 4 rated. The motor actuator shall have a 125% service factor.
- D. Intelligent electric actuators shall be capable of non-intrusive configuration without requiring removal of any actuator covers. Configuration of actuator functions shall be by use of a hand held infrared linked device, laptop or PDA with compatible wireless communication capability, or by local control switches and 32-character LCD display mounted on the actuator housing. The display language shall be English.
- E. Each intelligent electric actuator shall be furnished complete with a motor, gearing, handwheel, configurable output relays, torque sensors, lubricants, wiring, and terminals.

Each actuator shall be constructed as a self-contained unit with a ductile iron or aluminum alloy housing, of a type as indicated in the valve and gate schedules, and shall be integrally assembled on the applicable valve or gate by the valve or gate manufacturer. Housings shall have two O-ring seals, one on the controls compartment and one on the terminal cover.

- F. The direction of rotation of the rotating scum pipe shall be into or out of the flow, and the worm gear shall permit revolving the scum pipe through a minimum arc of 75 degree.
- G. Actuators shall connect to the plant's fieldbus protocol using DeviceNET, ProfiBus, Modbus, etc.
- H. The electric actuator shall be manufactured by Limitorque (MX), or equal.

## 2.05 INTEGRAL ACTUATOR CONTROLS

- A. Each actuator shall have a control screen and control knobs mounted directly on the actuator itself.

## 2.06 ACTUATOR STAND

- A. The actuator stand assembly shall be manufactured from T-304 stainless steel and will be a minimum of 3 feet high.
- B. The actuator stand shall be designed and reinforced to withstand all loads, torsional and vertical, applied by rotating forces of the scum pipe equipment operating at full speed.

## 2.07 ROTATING STEM

- A. The rotating stem shall be T-304 stainless steel and keyed to mount to the output shaft of the electric actuator.

## 2.08 GEARING

- A. The skimmer pipe operating mechanism shall consist of a worm gear and rack assembly capable of rotating the skimmer pipe in both directions so that either lip of the slot can be positioned at least 1 inch below the water level.
- B. The gear assembly shall consist of a nylon worm gear and a UHMW-PE rack. The worm gear shall be connected to the rotating stem shaft, and the rack shall be bolted to the scum pipe.
- C. The scum pipe will rotate up to 75 degrees in both directions.

## 2.09 WALL SPOOL

- A. New T-304 stainless steel wall spools shall be provided where indicated on the drawings. New wall spools shall be fabricated from Schedule 40 minimum pipe. CONTRACTOR shall install all spools with CONTRACTOR provided mechanical seals. These new wall spools will be cast in place by the CONTRACTOR.

## 2.10 WALL MOUNTED MID-SPAN SUPPORTS

- A. Midspan supports shall be fully adjustable to allow alignment and leveling of the rotating trough and shall prevent nonessential movement of the rotating trough due to hydrostatic uplift forces, the weight of the trough, or other causes.
- B. A means of preventing movement in the rotating trough parallel to its axis shall be provided.
- C. The mid span supports shall be lined with UHMW.

## 2.11 MOTORS

- A. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL listed for the service specified.
- B. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
  - 1. Physical Construction:
    - a. Copper leads and windings. Motor leads shall have the same insulation class as the windings.
    - b. Rotor bars shall be aluminum.
    - c. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
  - 2. Mounting: Horizontal.
  - 3. Enclosure: TEFC Hazardous location meeting the requirements of Class I Division 2.
  - 4. Efficiency: Premium efficiency as noted in schedule below.
  - 5. Service Factor: 1.0.
  - 6. Power requirements: 60 Hz, Three phase, 230/460 volt, factory-wired for 460 volt connection,  $\pm 10\%$  voltage variation.
  - 7. Load type: Constant torque.
  - 8. NEMA Design: B.
  - 9. Insulation: Class F.
  - 10. Nominal operating speed: 1,800 rpm.
  - 11. If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Location	Equipment	Horsepower	Nominal Speed	Efficiency
West Hickman	SDP-1	1	1,800	75.5%
West Hickman	SDP-2	1	1,800	75.5%
West Hickman	SDP-3	1	1,800	75.5%
West Hickman	SDP-4	1	1,800	75.5%
Town Branch	SDP-1	1	1,800	75.5%
Town Branch	SDP-2	1	1,800	75.5%

## 2.12 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of

each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

## 2.13 FINISHES

- A. It is the intent of these specifications that equipment, support and accessories be furnished factory shop-primed and finish-painted. Equipment and appurtenances shall be prepared in accordance with commercial grade SSPC specifications No. 6. Priming and finish painting shall be as recommended by manufacturer and shall be suitable for describe if applicable (e.g., corrosive atmosphere, high temperature, outdoor operation). Touchup paint shall be provided by manufacturer.
- B. All stainless steel surfaces shall be brush blasted in accordance with SSPC-SP7 before shipment.

## 2.14 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of four trips and four days on site shall be provided for startup and training services.

END OF SECTION

## SECTION 46 51 46

### DIFFUSERS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation fine bubble membrane tube diffusers at the West Hickman WWTP. The diffusers, appurtenances, and equipment required for the successful relocation of diffusers, as shown on the Drawings, shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
  - 1. Disinfection Tank(s) will receive air supply from blowers feeding the air main and subsequently the drop legs. Drop leg will feed each aeration zone as shown on the Drawings.
  - 2. Air and mixing rates shall be variable over the range necessary for oxygen transfer and mixing.
  - 3. The maximum diffuser membrane flux rates shall be 4 SCFM/sq ft. Maximum spacing between diffuser rows shall not be more than 12 feet.
  - 4. 304 Stainless steel drop pipes.
  - 5. PVC manifold and lateral pipes.
  - 6. Diffuser assemblies consisting of EPDM membrane diffuser, ABS diffuser body, air flow control orifice, with mounting saddles assembled onto lateral pipes.
  - 7. Expansion joints and fixed joint.
  - 8. Type 304 stainless steel supports and anchor bolts.
- B. Performance Requirements:
  - 1. SWD: 5.45 feet.
  - 2. Maximum diffuser submergence: 5 feet.
  - 3. Airflow per tank: 240 SCFM.
  - 4. Number of diffusers per tank: 38 sets.
  - 5. DO Concentration: >7.0 mg/L.

##### 1.03 SUBMITTALS

- A. Submit shop drawings. Shop drawings shall include plan, elevation and appropriate cross sections and details of aeration equipment, support and anchor location.
- B. Submit headloss curves and complete headloss calculations for the aeration system to the manufacturer's point of responsibility.
- C. The manufacturer will supply oxygen transfer performance curves based on previous/historic SOTE tests by independent testing laboratory showing the capability of the aeration equipment to meet the specified oxygen transfer requirements.



1. Minimum lab oxygen transfer efficiency will be as offered at the specified side water depth and design airflow conditions.
2. This test data must include data from a depth similar to the design operating depth with similar diffuser density, or an appropriate interpolation may be made between test points and must be normalized to 1,000mg/l TDS. The test data should be developed in conformance with the general procedures set forth in the ASCE Clean Water Standards.

#### 1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC12.6, as modified in the Supplementary Conditions, or Substantial Completion of the project.

### PART 2-PRODUCTS

#### 2.01 MANUFACTURERS

- A. The diffusers shall be AFT-S2610-E fine bubble tube diffusers, manufactured by SSI Aeration of Poughkeepsie, New York, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

#### 2.02 GENERAL

- A. Furnish all materials and equipment for a fine bubble membrane tube aeration system, beginning with a Van Stone flange and a 90-degree stainless steel elbow, and including all pre-engineered and pre-fabricated stainless steel and PVC piping within the tank, all fine bubble diffusers and accessories required to connect diffusers to pipe, as well 304SS support stands, 304SS shell expansion joints, and a continuous purge system for each piping grid.

#### 2.03 STAINLESS STEEL MATERIALS AND FABRICATION

- A. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel. Fabricate non-welded parts and pieces from sheets and plates of 304 stainless steel.
- B. Pickle all stainless steel assemblies and parts after welding, fabrication and wire brushing by complete immersion in an acid solution as specified in ASTM A380-88. The acid shall be a nitric-hydrofluoric solution as defined in Table A2.1, Annex A2 of ASTM A380. Providing a final rinse using ordinary industrial or potable water and dry in conformance with Section 8.3

of ASTM A380. Corrosion protection techniques not employing full immersion methods are not acceptable.

- C. Perform all welding in the factory using MIG, TIG or plasma-arc welding inert gas processes. Field welding is not permitted.

#### 2.04 PVC MATERIALS AND FABRICATION

- A. Produce all PVC pipe and fittings from PVC compound with a minimum tensile strength of 7000 PSI.
- B. Provide lower drop pipes, manifold pipes with a minimum of Schedule 40 wall thickness and header pipes with minimum wall thickness of SDR 32.5. Header pipes to have a minimum outside diameter of 4 inches. Pipe must be produced from PVC Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784. Alternates are not acceptable.
- C. Factory solvent-weld all PVC joints. Field solvent welding is not permitted.
- D. Headers to terminate in removable end caps, to facilitate water flushing of the piping before installation of diffusers.

#### 2.05 MEMBRANE AERATION SYSTEM EQUIPMENT COMPONENTS—STAINLESS STEEL SUPPORT STANDS

- A. Provide 304 support stands, including hold-down: guide straps anchor bolts, and supporting structure. Each 20-foot length of pipe shall have a minimum of 3 support stands. Guide straps shall be a minimum of 1 1/2 inches wide, 8 inches and above size pipe supports shall have 2 inches wide. Supports shall have a mechanism for  $\pm 2$  inches vertical adjustment for the alignment of the manifold in the field. Supports shall be designed to allow for complete removal from the tank (less anchor bolt) to enable cleaning and maintenance of tank bottom. Minimum anchor bolt and threaded rod diameter shall be 3/8 inch. Anchor bolts shall be sized with a pull-out strength design safety factor of 4 or greater. Support systems using a single anchor bolt design will not be accepted.
- B. Guide supports to consist of a self-limiting hold down and sliding mechanism. Hold down and sliding mechanism shall provide a full circumferential minimum of 1 1/2 inches wide, 8 inches and above size pipe supports shall have 2-inch width. Contoured bearing surface with chamfered leading edges to minimize binding of the air distribution header. Sliding mechanism shall provide minimum resistance to movement of the air distribution header under full buoyant up-lit load. Mechanism to provide 1/8-inch clearance around header and be self-limiting if the mechanism is over-tightened. Worm gear clamps are not to be utilized for attaching header pipe to supports, and U-bolts are not acceptable.
- C. Fixed supports to consist of a self-limiting hold down and sliding mechanism. Hold down and sliding mechanism shall provide a full circumferential minimum of 1 1/2 inches wide, 8 inches and above size pipe supports shall have 2-inch width contoured bearing surface. Clamping device shall positively grip the air distribution header when tight and be self-limiting to prevent overstressing the header if the clamp is over tightened. Worm gear clamps are not to be utilized for attaching header pipe to supports, and U-bolts are not acceptable.

- D. Aligning and adjusting shall be infinitely adjustable within its limits to allow precise leveling of the air distribution headers and diffuser assemblies to within  $\pm 1/4$ -inch of a common horizontal plane without removing the header from the support.
- E. Attach supports to tank floor with a minimum of two stainless steel expansion type anchor bolts designed for embedment in 3,000 PSI concrete. Supports which utilize only one anchor bolt or one chemical anchor, or which are made of plastic are not acceptable.

## 2.06 DIFFUSER ASSEMBLIES

- A. Connect each diffuser holder to the header by means of mounting saddles. Glued mount connections will not be acceptable.
- B. Furnish Ø2.4-inch by 24-inch-long tube type diffusers with EPDM membrane. Other rubber shall not be acceptable.
- C. The diffuser to consist of EPDM membrane; single body support pipe and saddle mount with locking wedge, and an airflow control orifice with integral gasket. Diffusers with ceramic or plastic type diffusion media elements are not acceptable as alternatives to the membrane. Diffusers with taps on the side center lines of lateral air pipes are not acceptable.
- D. Membrane material to be premium quality EPDM membrane with low plasticizer. Coating to be grey stretchable dispersion, specifically designed for use with fine bubble diffusers. Manufacturers shall have a minimum of five years of experience manufacturing EPDM membranes.
- E. Design should permit air to exit through the entire periphery of the membrane. Membrane shall be designed to resist clogging.
- F. Characteristics Follow:
  - 1. Substrate Layer: EPDM.
  - 2. Tensile strength: 1,800 PSI.
  - 3. Extractable Plasticizer per ASTM <4%.
  - 4. Tear strength min 80 Lb/linear inch.
  - 5. Ozone resistance: Pass.
  - 6. UV resistance: Pass.
  - 7. Durometer: 60.
  - 8. Ultimate elongation: 692%.
  - 9. FOG resistant: Yes.
  - 10. Solvent resistant: Yes.
  - 11. Bio fouling resistant: Yes.
  - 12. Friction Coefficient: 0.09.
- G. Diffuser support pipe base to be constructed of ABS material with organic UV stabilizers and anti-bacterial agents to prevent bacterial buildup and ease future membrane replacement. Plastics that do not utilize UV protection shall not be acceptable. Characteristics follow:
  - 1. Specific Gravity: 0.905.
  - 2. Water absorption: 0.02%.
  - 3. Tensile Strength: 5,000 PSI.
  - 4. Coefficient of thermal expansion  $5 \times 10^{-5}$  in/in/°F.
  - 5. Maximum Temperature: 212°F.

- H. Sealing method of retaining device shall generate a minimum of 50 pounds per inch of circumference of the sealing gasket to provide a long-term positive seal and to prevent air escape.

## 2.07 EXPANSION JOINTS

- A. Design for expansion/contraction over a temperature range of 50°C without deforming any component. Utilize fixed supports to anchor the header against movement. Utilize intermediate supports to allow for longitudinal movement. Provide one fixed support for each straight pipe run.
- B. Provide fixed or expansion joints as required.
- C. Flanged joints shall be Van Stone with through bolts. The flanged joints shall transmit the longitudinal forces caused by expansion and contraction of the air distribution header. All flanged joints shall have 45 to 55 Durometer, Shore A, neoprene gaskets.

## 2.08 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

## 2.09 FINISHES

- A. It is the intent of these specifications that equipment, support and accessories be furnished factory shop-primed and finish-painted. Equipment and appurtenances shall be prepared in accordance with commercial grade SSPC specifications No. 6. Priming and finish painting shall be as recommended by manufacturer and shall be suitable. Touchup paint shall be provided by manufacturer.

## 2.10 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

# PART 3-EXECUTION

## 3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of two trips and two days on site shall be provided for startup and training services.

### 3.02 PREPARATION

- A. The equipment shall be packaged as follows for protection during shipment and site storage to minimize CONTRACTOR installation efforts and cost:
  - 1. All pipe with open ends and diffuser cutouts shall be covered to prevent dirt and debris from entering pipe.
  - 2. All pipe shall be properly crated and suitable for transport and lifting onsite.
  - 3. All equipment and pipe shall be clearly labeled for ease of installation and provided with installation drawings that reference equipment and parts with the same nomenclature.
  - 4. All boxed equipment shall be wrapped and protected from the element.

### 3.03 EQUIPMENT INSTALLATION AND COORDINATION

- A. Follow equipment manufacturer's recommendations for sequencing of equipment installation:
  - 1. Layout and install supports in accordance with instructions and anchor setting plan.
  - 2. Level aeration system such that all diffusers are plus or minus 1 inch of a common horizontal plane.
  - 3. The top surface of each diffuser shall be horizontal and level.
- B. Clean air header pipe, laterals, blowers, filters and dropleg prior to installing diffuser elements.
  - 1. Install diffuser elements on headers.
  - 2. Protect diffuser elements from unnecessary direct sunlight and excessive heat and cold.
- C. Carry out system tests for support stand integrity, pipe joint and diffuser mount leaks, and proper air distribution and mixing in accordance with manufacturers' recommendations.

### 3.04 FIELD QUALITY CONTROL AND DEMONSTRATION

- A. After the piping, headers, and diffusers for a tank are installed, introduce clear water into the tank until the diffusers are covered approximately 2 inches then release compressed air through the piping and check for leaks through joints, pipes etc. Repair all leaks. Repeat this test until the entire system is tight.
- B. By visual inspection, verify that air release is uniform for each diffuser and header section.
- C. CONTRACTOR shall make all modifications and repairs until the system passes all tests.

END OF SECTION

## SECTION 46 66 57

### ULTRAVIOLET DISINFECTION SYSTEM

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation two complete open channel, gravity flow, ultraviolet (UV) disinfection systems. One UV disinfection system will be installed at the Town Branch WWTP and the other system will be installed at the West Hickman WWTP. Each system shall be complete with UV banks, power distribution, system control, on-line UV transmission monitoring, automatic cleaning system, and all related components as shown on drawings and specified herein. The UV disinfection equipment and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section and Section 40 70 00—Controls and Instrumentation Equipment.

##### 1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
  - 1. The UV disinfection system shall be designed to disinfect wastewater plant effluent with the characteristics described herein.
  - 2. The system design shall provide full-length immersion of UV lamps in effluent flow with the use of fixed sharp-crested weirs for water level control installed downstream of the UV banks. The system design shall allow complete system shutdown or bypass and shall be capable of continuing disinfection while UV lamps, lamp sleeves, and ballasts are replaced and/or maintained.
  - 3. The UV system shall be “low-pressure, high-intensity” with a lamp rated output of 600 watts UV-C (254 nm) per lamp measured with lamps having operated for 100 hours.
  - 4. The system shall utilize active control based on the following dose parameters. Based on these parameters, the system shall automatically vary the UV lamp power proportionally to the dose requirement:
    - a. Lamp output intensity.
    - b. Quartz sleeve transmittance.
    - c. Water quality transmittance.
    - d. Water flow.
  - 5. The dose delivered by the UV system shall be linearly variable within a range of 30% to 100% of maximum power in both manual and automatic operating modes. If the range differs between modes, the automatic mode of operation shall be the sole mode considered.
  - 6. The system shall be capable of continuous disinfection while automatically cleaning the UV lamp sleeves without reducing or shadowing the output of the lamps.
- B. Performance Requirements (Town Branch UV):
  - 1. The Town Branch equipment provided shall disinfect a wastewater effluent with the following characteristics:
    - a. Current Peak Flow: 70 mgd.
    - b. Design Peak Hourly Flow: 64 mgd.
    - c. Design Average Flow: 30 mgd.

- d. Current Average Flow: 21 mgd.
  - e. Current Minimum flow: 5 mgd.
  - f. Total suspended solids: 20 mg/L, 30 Day Average grab samples.
  - g. Annual effluent temperature range: 33°F to 85°F.
  - h. Minimum UV transmittance @ 253.7 nm: 62.8%.
  - i. Disinfected Effluent Permit Standards: 130 E. coli/100 ml (monthly average by geometric mean) and 240 E. coli/100 ml (weekly average by geometric mean).
2. The West Hickman equipment provided shall disinfect a wastewater effluent with the following characteristics:
    - a. Current Peak Flow: 70 mgd.
    - b. Design Peak Hourly Flow: 64 mgd.
    - c. Design Average Flow: 33.8 mgd.
    - d. Current Average Flow: 20 mgd.
    - e. Current Minimum flow: 5 mgd.
    - f. Total suspended solids: 20 mg/L, 30 Day Average grab samples.
    - g. Annual effluent temperature range: 33°F to 85°F.
    - h. Minimum UV transmittance @ 253.7 nm: 65%.
    - i. Disinfected Effluent Permit Standards: 130 E.coli/100 ml (monthly average by geometric mean) and 240 E.coli/100 ml (weekly average by geometric mean).
  3. West Hickman System Requirements: The headloss through the UV system (not including head over fixed sharp-created weirs or through flow conditioner plates) shall not exceed 2.5 inches at daily maximum design flow of 70 mgd. This headloss includes UV modules, including lamps and any framework, and any other equipment or restrictions which may be provided with the system.
  4. Town Branch System Requirements: The headloss through the UV system (not including head over fixed sharp-created weirs or through flow conditioner plates) shall not exceed 10.3 inches at daily maximum design flow of 70 mgd. This headloss includes UV modules, including lamps and any framework, and any other equipment or restrictions which may be provided with the system.
  5. The West Hickman system shall be capable of handling flood waters (to approximately 890.0 elevation) above the top of the channel for a period of 24 hours without sustaining damage.
  6. Effluent Standards to be achieved by the system provided: Effluent E. coli limit of <130 CFU/100 mg L as a monthly geometric mean and <240 CFU/100 mg L as a weekly geometric mean.
  7. The UV system shall be designed to deliver a minimum MS2 RED of 30 mJ/cm<sup>2</sup> (T1 bio-assay) at peak flow, in effluent with a UV transmission of 65% at end of lamp life (EOLL) after reductions for quartz sleeve fouling. The basis for evaluating the RED delivered by the UV system shall be the independent third party bioassay, without exception. Bioassay validation methodology shall follow protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003, 2012) and applicable sections of the US EPA UV Disinfection Guidance Manual (2006).
  8. Independent certification of the lamp aging factor must be submitted if values other than the specified default values are being proposed. The lamp aging (or end-of-lamp-life) factor must be determined using the protocol described in the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (2003, 2012).
  9. Independent Certification of the fouling factor shall only be accepted if performed on the UV lamp and quartz sleeve combination equal to that being proposed by the UV manufacturer. The fouling factor must be conducted on municipal wastewater effluent using the protocol described in the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (2003, 2012).

### 1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provision of Section 01 33 00–Submittals.
- B. In addition to the general submittal requirements described in Division 01 (Section 01 33 00–Submittals), the equipment shop drawing submittal shall include, but not be limited to, the following:
  - 1. Complete manufacturer's specifications and data in sufficient detail to permit an item-by-item comparison with these specifications.
  - 2. General arrangement drawings showing plan and all elevations of the equipment and system components.
  - 3. Dimensions and installation requirements of equipment.
  - 4. Descriptive information including catalog cuts and manufacturers specifications for all components of the system.
  - 5. Details of the disinfection system including UV banks, power distribution, system control, UV detection system, automatic cleaning system, and all related components.
  - 6. Engineering reports stating UV dose calculations, head loss calculations, hydraulic profiles, and retention time. The submittal shall clearly state head loss through the channel with all restrictions, weirs, and flow controls factored in. All system components that contribute to head loss shall be itemized. This shall be provided for the design daily maximum flow conditions.
  - 7. Power consumption per lamp (including ballast loss) and the system peak power consumption (including ballast loss) for both new lamps and the end of lamp life.
  - 8. Project specific electrical schematics, point to point wiring diagrams, scaled enclosure drawings, process and instrumentation diagrams (PIDs), and any other electrical details and drawings for the complete system.
  - 9. A statement by the equipment manufacturer listing any deviations or exceptions taken to these specifications. Include specification reference and proposed alternative with reason for stated exception.
- C. CONTRACTOR shall submit any other certifications, instructions, reports, and other documentation as may be required following delivery, installation, or starting of the system as specified under Part 3 of this specification.
- D. Following performance testing, CONTRACTOR shall furnish to OWNER and ENGINEER a written report certifying that the UV system has achieved the required guaranteed performance based on field testing results as specified under Paragraph 1.04.B. below.

### 1.04 QUALITY ASSURANCE

- A. Provide evidence of previous performance by submitting the following information and samples to ENGINEER:
  - 1. Operational data from a minimum of two fully operational installations using technology identical in all aspects to that specified.
  - 2. These systems shall have been disinfecting at least 20 mgd of unfiltered secondary, wastewater effluent flow with similar characteristics to that specified herein for a minimum of 1 year. This documentation shall include 5 consecutive months of data from these installations demonstrating that the disinfected effluent quality was below effluent standards to be achieved as specified in Paragraph 1.02.B. at a UV dose less than, or equal to, that which shall be produced by the proposed system.
  - 3. These conditions shall be documented by a laboratory independent of the manufacturer.



- B. Provide process guarantee as outlined below:
1. The manufacturer shall guarantee that the UV disinfection system shall perform in accordance with the specifications when operated at the specified design conditions. A performance test shall be run at start-up. The 60-day test will occur over the duration of the first season of operation. Samples during the performance test shall be collected and delivered to a state-certified laboratory by OWNER. Laboratory costs shall be paid by OWNER. Tests will be run by OWNER. Tests will consist of OWNER's routine sample collection practices used for plant combined effluent to meet the effluent criteria as specified in Paragraph 1.02.B. at the UV dose produced by the installed system. Note: plant effluent is effluent that has passed through the UV channel.
    - a. Grab samples will be taken up to once per day. Samples will be taken from the UV channel in operation on the day samples are collected as deemed necessary by OWNER.
    - b. Samples will be analyzed by OWNER's laboratory for parameters including E. Coli (as measured in CFU/100 mL). Any combined effluent sampling that results in exceedance of an E. Coli daily maximum indicates the system does not meet the design conditions.
    - c. If any individual sample from the UV channel exceeds a daily maximum E. Coli 240 CFU/100 mL, the sampling protocol may be intensified at OWNER's discretion, up to seven days per week. CONTRACTOR and manufacturer will be notified of any daily sampling result that exceeds 240 CFU/100 mL within three business days of receipt and shall take corrective action within 15 days of notification such that the UV system consistently achieves results of 240 CFU/100 mL daily maximum or less following the corrective action.
    - d. No individual sample from an individual UV channel is to exceed the daily maximum E. Coli limit of 240 CFU/100 mL. A sample result above 240 CFU/100 mL during this time indicates the system does not meet the design conditions.
    - e. After day 60 of the UV disinfection demonstration, OWNER will inform CONTRACTOR and manufacturer of the results of sampling.
    - f. Sampling will continue through day 60 of the UV disinfection demonstration. Any results that exceed E. Coli 240 CFU/100 mL or other operational deficiencies that are identified must be corrected by CONTRACTOR or manufacturer within 15 days. If this corrective action occurs after day 30, then 30 additional continuous days of operation with a sample not exceeding E. Coli 240 CFU/100 mL is required to certify the system as acceptable.
  2. In the event the system does not meet the design conditions after day 60 of start-up the manufacturer shall make necessary corrections and remedy deficiencies within 90 days of notification and conduct performance testing. Performance testing shall be based on a representative composite sample basis tested in accordance with Standard Methods for Examination of Water and Wastewater, latest edition. Tests shall be performed by an independent laboratory and paid for by CONTRACTOR. If the system does not meet performance requirements, OWNER retains the option to require testing and evaluation of other manufacturer's trailer-mounted or pilot UV disinfection unit. OWNER will arrange for any trailer-mounted or pilot testing. Should these tests on trailer-mounted or pilot UV disinfection unit indicate the wastewater effluent is disinfected to a level that meets KPDES permit requirements and are in accordance with the design conditions, CONTRACTOR shall remove the installed UV disinfection system at no cost to the OWNER. CONTRACTOR shall then purchase, at no expense to OWNER, a system that meets the performance specifications and CONTRACTOR shall install the same at no increase in the Contract price. This shall include channel wall changes, electrical modifications, and start-up services for the new system.

## 1.05 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC12.6, as modified in the Supplementary Conditions, or Substantial Completion of the project.
- B. Lamps shall be warranted for a minimum of 15,000 operating hours, prorated after 9,000 hours.
- C. Lamp drivers shall be warranted for 10 years, prorated after 1 year.
- D. UV Intensity sensors shall be warranted for 5 years, prorated after 1 year.

## PART 2-PRODUCTS

### 2.01 MANUFACTURERS

- A. The UV disinfection systems shall be Trojan, UV Signa, as manufactured by Trojan, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.

### 2.02 GENERAL TOWN BRANCH UV

- A. The system shall minimally consist of five banks to be installed in each channel.
- B. The total connected system power consumption shall not exceed the values given below at the design conditions: Maximum installed: 289 kW at current design configuration 70.0 mgd daily maximum flow.
- C. Channel dimensions in the area of the UV modules shall be as follows. Layout and additional dimensions and tolerances shall be shown on the Drawings.
  - 1. Channel width: 5 feet 5 inches.
  - 2. Channel depth: 7 feet 9.6 inches.
  - 3. Channel length: 37 feet 6 inches.
- D. The UV lamps shall be arranged in an angle of 45 degrees in staggered rows to provide proper mixing and minimal channel depth.
- E. The system shall be designed for immersion in the effluent of the UV lamps within their protective quartz sleeve. UV lamp connectors shall be located above the effluent water level and shall be accessible without removing the UV module from the disinfection channel. UV lamps and sleeves shall be removable while the module is in the disinfection channel.
- F. The system shall be designed for complete submersion of all in-channel components under all flow conditions for 24 hours.
- G. The UV system shall be able to continue providing disinfection while replacing UV lamps, quartz sleeves, and ballasts and while cleaning the sleeves.

- H. To maximize performance and promote safety, bank light locks shall be used in each bank to prevent short circuiting over the top of the lamps.

## 2.03 GENERAL WEST HICKMAN UV

- A. The system shall consist of three banks to be installed in one channel.
- B. The total connected system power consumption shall not exceed the values given below at the design conditions: Maximum installed: 253 kW at current design configuration 70.0 mgd daily maximum flow.
- C. Channel dimensions in the area of the UV modules shall be as follows. Layout and additional dimensions and tolerances shall be shown on the Drawings.
  - 1. Channel width: 5 feet 4.8 inches.
  - 2. Channel depth: 7 feet 9.6 inches.
  - 3. Channel length: 41 feet.
- D. The UV lamps shall be arranged in an angle of 45 degrees in staggered rows to provide proper mixing and minimal channel depth.
- E. The system shall be designed for immersion in the effluent of the UV lamps within their protective quartz sleeve. UV lamp connectors shall be located above the effluent water level and shall be accessible without removing the UV module from the disinfection channel. UV lamps and sleeves shall be removable while the module is in the disinfection channel.
- F. The system shall be designed for complete submersion of all in-channel components under all flow conditions for 24 hours.
- G. The UV system shall be able to continue providing disinfection while replacing UV lamps, quartz sleeves, and ballasts and while cleaning the sleeves.
- H. To maximize performance and promote safety, bank light locks shall be used in each bank to prevent short circuiting over the top of the lamps.

## 2.04 EQUIPMENT COMPONENTS, MATERIALS, AND CONSTRUCTION

- A. All metal components in contact with the effluent shall be type 316 stainless steel. Aluminum wetted materials shall not be used.
- B. All metal components located in (not submerged) or directly on top of the channel shall be constructed of 304 stainless steel.
- C. All wiring exposed to UV light will be Teflon-coated or other suitable long-term resistant materials.
- D. All materials exposed to UV light shall be 316 stainless steel, quartz glass, Teflon, Viton, or other suitable long-term UV resistant materials.
- E. UV Bank:
  - 1. Each UV bank will consist of UV lamps, quartz sleeves and an automatic chemical/mechanical cleaning system mounted in a 316 stainless steel frame.

2. Each lamp shall be enclosed in its individual quartz sleeve, one end of which will be closed and the other end sealed by a lamp end seal.
3. The closed end of the quartz sleeve will be held in place by a retaining O-ring. The quartz sleeve will not come in contact with any steel in the frame.
4. Each UV bank shall contain a pre-formed 316 stainless steel wall on each side to prevent possible short-circuiting at the side walls of the reactor.
5. Each bank shall be rated for NEMA Type 6P.
6. To minimize maintenance, equipment must be provided by the UV manufacturer to enable lifting a complete bank of lamps from the channel at once for inspection and/or servicing. When the banks are lifted out of the channel, the maximum height of both the lifting device and the bank (at service position) shall not exceed 2 1/2 meters.
7. Lamps shall be removable with the quartz sleeve and wiper system remaining in place.
8. Electrical connections for the lamp shall consist of four pins at one end of the lamp only. Lamp wiring shall be Teflon- insulated strand wire.
9. Lamps without maintenance coating or that do not have four pins are considered instant-start and are not acceptable due to reduced reliability and increased maintenance and operating costs.
10. No UV light shall be emitted from the channel when the UV banks are installed and the lamps are energized.
11. The UV banks shall be designed so that operating personnel at the plant can change the lamps and quartz sleeves without requiring specialized tools.

F. UV Lamps:

1. Lamps shall be low-pressure mercury amalgam high-intensity type.
2. Medium Pressure or other lamp types with a polychromatic UV output requiring a higher connected electrical load than that specified to deliver the specified total UV-C (254 nm) output wattage shall not be acceptable.
3. Lamps shall be capable of producing a minimum new lamp (100 hrs.) output of 1,000 watts of UV-C energy at wavelength of 253.7 nm (254 nm)
4. UV output energy of the lamp shall be variable. The lamp shall be capable of maintaining a UV-C output proportional to the variable power settings from the ballast.
5. Lamp guarantee for UV lamps shall be provided in accordance with the following minimum requirements:
  - a. Lamp life shall be guaranteed to 15,000 operating hours. The useful lamp life shall be higher because of periodic switching and cycling of individual UV banks. The UV manufacturer shall guarantee 15,000 hours operating time for each lamp under normal operating conditions. Normal operating conditions include:
    - (1) On/off cycles average 4 per 24 operating hours.
    - (2) Voltage fluctuations according to DIN IEC 38 (230/400 V  $\pm 10\%$  relating to 480 V  $\pm 10\%$ ).
  - b. In case of premature lamp failure, OWNER will send the lamp back to the UV manufacturer together with the information of UV unit serial number, hours run and on/off cycles. The UV manufacturer shall then offer the following:
    - (1) Send a replacement lamp free of charge if the lamp failure is before 9,000 hours.
    - (2) Issue a credit proportional to the hours not used if lamp failure is after 9,000 hours.
6. The UV manufacturer shall provide disposal of returned lamps (old/used) at no cost to OWNER upon receipt of the returned lamps at the manufacturing headquarters.
7. UV lamps shall not require a long cool down period prior to restart should the power to the UV system fail or be interrupted for a short period of time. Systems or lamps that require long cooling periods, (e.g., 10 to 30 minutes) before restart are not acceptable.

8. The lamp output shall not fluctuate more than 3% because of the water temperature variations between 40°F and 100°F.
  9. The operating skin temperature of the UV lamp shall not exceed 130°C to minimize the possibility of quartz fouling.
  10. The lamp filaments shall be the clamped design, significantly rugged to withstand shock and vibration.
  11. Lamps shall be rated to produce zero levels of ozone.
  12. Lamps will be operated by electronic lamp drivers with variable output capabilities ranging from 30% to 100% of nominal power. The lamp assembly incorporates active filament heating to enable operation at optimum lamp efficiency across varying water temperatures and lamp power levels.
- G. Lamp Plugs:
1. Each lamp plug shall be accessible from the top of the UV bank to facilitate lamp removal without moving the UV banks or any other components.
  2. A light emitting diode (LED) visual indicator on the lamp plug shall continuously indicate on/off status for each lamp.
  3. An integral safety interlock in the lamp plug shall prevent removal of energized lamps.
  4. The lamp plug shall be rated Type 6P.
- H. Quartz Sleeves:
1. Quartz sleeves will be clear fused quartz circular tubing containing 99.9% silicon dioxide.
  2. Sleeves will have minimum UV transmittance at 254nm of 87% (2 1/2 mm wall thickness).
  3. Sleeves will be open at one end only and domed at the other end.
- I. Cleaning System:
1. Each UV bank shall be equipped with an automatic wiping system with field adjustable wiping frequency.
  2. The automatic wiping system for the UV banks in each channel shall be hydraulically powered from a single compact Hydraulic System Center (HSC) located near the UV banks for a total of two HSCs per channel.
  3. The cleaning system shall include both mechanical and chemical cleaning systems.
  4. The wiping sequence shall be automatically initiated with capability for manual override.
  5. The cleaning system shall be fully operational while UV lamps and modules are submerged in the effluent channel and energized.
  6. To minimize maintenance, UV System shall be designed such that cleaning solution replacement can be performed while the UV Bank and lamps are in place and operational in the channel.
  7. Cleaning system operation shall be remote auto (default) or remote manual.
  8. The wipers shall travel the full length of the UV lamp arc.
  9. Wiping interval, the time between wiping cycles, shall be factory preset for optimum effect and shall be 2 strokes per time interval and adjustable timer interval (1 to 24 hours).
  10. The useful life of the wiper brush or cleaning device in contact with the quartz sleeve shall be in excess of 2 years based on factory stroke and interval settings.
  11. The cleaning system shall maintain full efficiency throughout its life, with no deterioration in quality of cleaning.
  12. The cleaning system shall maintain full efficiency throughout its life, with no deterioration in quality of cleaning.

13. The wiper blade brush or other cleaning device in contact with the quartz sleeve shall be nonmetallic and shall not damage or scratch the quartz sleeve or sensor in any way.
  14. The cleaning system shall be provided with the required solutions necessary for initial equipment testing and start-up after the first 6 months of operation.
  15. The cleaning system shall also incorporate an integrated debris removal device to clear the quartz sleeves of any large solids or debris to maximize the life of the chemical/mechanical cleaning system.
  16. The wiper on the cleaning system shall be parked out of the effluent when not in use.
  17. The UV intensity sensor shall be cleaned utilizing the same chemical/mechanical cleaning method as that of the lamp quartz sleeves.
  18. To be considered as alternate, systems that use only mechanical wiping must have the ability to periodically be cleaned out of channel using a chemical bath. Out of channel cleaning will include lifting slings, removable banks, cleaning tanks, agitation system and air compressors, as required. The UV manufacturer will be responsible for supplying all equipment including any equipment not specifically listed required to perform out of channel chemical cleaning. CONTRACTOR will be responsible for installation.
- J. Effluent Level Controller–Level Control Weir:
1. The water level (depth of flow) through the UV banks shall be controlled by the use of a fixed sharp-crested weir system downstream of the UV banks. The effluent weir system shall be provided by CONTRACTOR and shall satisfy requirements of Section 05 50 00–Metal Fabrications. Manufacturer may review weir submittal if desired.
  2. Manufacturer shall confirm the elevation for the top of the weirs with respect to a known reference point on the UV system at peak design flow conditions specified, as shown on the hydraulic profile.
- K. Flow Conditioners:
1. Flow Conditioner plates shall be 304 stainless steel in the quantity per channel as shown on the Drawings.
  2. The plates shall be removable and inserted in stainless steel L-frames mounted to the channel walls.
  3. Maximum headloss per stilling plate is 0.35 feet at Town Branch and 0.06 at West Hickman and the overall system shall meet the total maximum headloss specified earlier in this section.
- L. Light Locks:
1. Light locks, two per bank, will be provided to force effluent through the UV treatment zone maximizing disinfection performance.
  2. The entire length of the lamp arc will remain submerged to maximize UV dose delivered to the effluent and to prevent any UV exposure above the water free surface.
- M. UV Intensity Sensors:
1. A submersible UV sensor shall continuously sense the UV intensity produced in each bank of UV lamps.
  2. The sensor shall measure only the germicidal portion of the light emitted by the UV lamps as measured at 254 nm. It shall have sensitivity at 254 nm of greater than 95%.
  3. The measured intensity shall be displayed on the operator interface as an absolute value in mW/cm<sup>2</sup>.
  4. The sensor shall be automatically cleaned at the same frequency as the lamp sleeves to prevent fouling of the sensor and false alarms for low intensity.
  5. The UV sensor shall be factory-calibrated to US National Institute for Standards and Technology (NIST). Sensors requiring field-calibration are not acceptable.

6. The sensor shall be digitally calibrated to provide calibration accuracy.
7. The sensor shall be accessible without shutting down the system, lifting a bank/module or removing lamps to provide continuous disinfection.
8. Sensors shall be designed to provide UV intensity data for dose monitoring and control functions. Dose pacing program shall enable use of measured UV intensity along with flow rate and UVT to determine the delivered dose during operation.
9. Sensors shall be designed such that reference sensor readings can be taken without interrupting disinfection and without removing UV lamps or sleeves.

N. UV Bank Lifting Device:

1. The lifting device for UV banks shall be supplied by the UV manufacturer.
2. An Automatic Raising Mechanism (ARM) shall be designed and supplied to facilitate lifting a UV bank from the channel without use of ancillary equipment.
3. The ARM shall be integrated into the UV bank for simple and seamless operation.
4. The UV bank shall be raised from the channel through a pivot point for easier access and maintenance.
5. The ARM design shall provide access to components without having to break electrical connections.

## 2.05 GENERAL ELECTRICAL REQUIREMENTS

- A. The UV disinfection system shall be provided with all required electrical sub-systems and connections. Each bank of UV lamps shall be powered from a Power Distribution Center (PDC) and each lamp shall be controlled through an interface with the Supervisory Control Center (SCC).
- B. The UV disinfection system manufacturer shall supply electrical termination points and cable from lamps to ballasts and ballasts to PDCs in accordance with ANSI and NEC requirements. All enclosures shall be UL listed as an assembled unit.
- C. All electrical cables and connectors exposed to UV light or installed in free-air shall be UV-resistant.
- D. All setpoints, alarms, timers, and status monitoring signals shall be available at the plant SCADA System. The UV disinfection system manufacturer shall be responsible for all coordination with the Section 26 09 00—Controls and Instrumentation System Supplier so that all signals specified herein are provided and are compatible with the existing SCADA System. Refer to the I/O listing following this section for all required I/O that shall interface with this system.
- E. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Section 40 70 00—Controls and Instrumentation Equipment.
- F. The manufacturer shall include follow-up services during the one-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include an allowance of 8 hours for work on-site at both Town Branch and West Hickman other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. It shall be assumed that, in addition to these 8 hours at each site, one trip to each site shall be included.

- G. All communication of system signals and status signals between SCC-UV for both plants and the plant SCADA System shall be via Ethernet/IP unless noted otherwise.

## 2.06 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 26 and Section 40 70 00–Controls and Instrumentation Equipment.
- B. Equipment manufacturer shall review electrical wiring and control diagrams prepared by the Division 26 contractor. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.
- C. Electrical controls and instrumentation for this equipment are specified under Section 26 09 00–Controls and Instrumentation and Section 26 24 19–Motor Control of these specifications.

## 2.07 CONTROLS AND INSTRUMENTATION

- A. UV System Supervisory Control Center (SCC-UV) For Both Plants:
  - 1. The UV disinfection system manufacturer shall provide a Programmable Logic Controller (PLC)-based control systems with operator interface panels for the UV disinfection system. All communication of system alarms and status signals between the SCC and the plant SCADA System shall be via Ethernet/IP.
  - 2. Provide a NEMA 12 freestanding enclosure including, but not be limited to, the following:
    - a. Main circuit breaker: 20-amp. Power to the SCC shall be 120-volts, single phase.
    - b. Programmable logic controller (PLC).
    - c. Operator interface panel with project-specific HMI screens.
    - d. Control power transformer.
    - e. Relays and control devices as required for controlling the UV disinfection system.
    - f. Managed network switch.
    - g. Twelve-port fiber patch panel.
    - h. Uninterruptible power supply (UPS).
    - i. White “Power On” indicating light on the front door.
  - 3. The OIP shall be programmed to allow the operator to enter all control and alarm setpoints associated with the UV disinfection system and shall be set up such that it prompts the operator for the setpoints to be entered. The OIP shall provide indication and operating functions for the system as follows:
    - a. A process overview of the UV disinfection system. Provide zoomed-view screens as required for additional details.
    - b. Hand-Off-Auto (H-O-A) control for each piece of equipment.
    - c. Adjustment for all system setpoints.
    - d. On, failed, open, and required (where applicable) for each piece of equipment.
    - e. Status of all equipment.
    - f. Indication of levels and intensities.
    - g. Indication of time remaining for each timed sequence.
    - h. Indication of all alarm conditions on an alarm summary screen. This screen shall show the last 10 alarms, indicate whether the alarm is active, unacknowledged, or returned to normal. The operator shall be able to acknowledge all or individual alarms from this screen. When an alarm is received, the OIP shall default to this screen to show the current alarm. The current alarm shall blink until acknowledged. Alarms shall be listed in chronological order and include time and date of the alarm.



4. The communication protocol between the SCC, PDCs, and HSCs shall be Modbus via RS485. The communication protocol between the SCC and plant SCADA System shall be Ethernet/IP.
  5. A Dose Pacing System shall control the On/Off cycling and lamp power of the UV banks based upon a dose pacing philosophy. The Dose Pacing System shall receive a selectable flow signal from the plant SCADA system and shall automatically adjust the received UV dose to maintain the required levels under all operation conditions.
- B. Power Distribution Centers (PDC):
1. The UV disinfection system manufacturer shall provide PDCs, each capable of powering three banks of UV lamps.
  2. Provide NEMA 4X, 304 stainless steel, freestanding enclosures including, but not be limited to, the following:
    - a. Main circuit breaker disconnect with door-interlocked, padlockable handle: Main breaker size based on PDC electrical load. Power to each PDC shall be 277/480-volts, three-phase, four-wire.
    - b. Circuit breaker for each UV bank powered from the PDC.
    - c. UV lamp ballasts and power distribution receptacles. Receptacles shall be environmentally sealed.
    - d. Thermostatically-controlled anti-condensation heater.
    - e. Data concentration circuit boards.
    - f. Three-position Local-Off-Remote selector switch on the front door.
- C. Hydraulic System Centers (HSC):
1. The UV disinfection system manufacturer shall provide HSCs, each capable of servicing four banks of UV lamps.
  2. Provide NEMA 4X, 304 stainless steel, freestanding enclosures including, but not be limited to, the following:
    - a. Main circuit breaker disconnect with door-interlocked, padlockable handle: 20-amp. Power to each HSC shall be 480-volts, three-phase, three-wire.
    - b. Thermostatically-controlled anti-condensation heater.
    - c. Control devices as required for the cleaning and lifting systems.
    - d. Hydraulic pump, fluid reservoir, manifolds, valves, and filters.
    - e. The following shall be provided on an angled top door:
      - (1) Three-position Wipe-(Blank)-Lift control mode selector switch.
      - (2) Three-position 1-2-3 bank to lift selector switch at West Hickman.
      - (3) Three-position 1-2-3-4-5 bank to lift selector switch at Town Branch.
      - (4) Three-position Up-Off-Down lift control selector switch.
      - (5) Three-position Local-Off-Remote wiper control selector switch for each UV bank.
      - (6) Three-position Retract-Extend-Sequence wiper local control selector switch.
- D. Lamp Drivers:
1. Each lamp driver shall independently power two UV lamps. Failure of one lamp shall not affect operation of the other lamp.
  2. The lamp driver shall have a power factor correction circuit to provide minimum 99% power factor and less than 5% total harmonic distortion (THD) current at the maximum power level and nominal input voltage.
  3. The lamp driver electrical conversion efficiency shall be minimum 95% at the maximum power level.
  4. The lamp driver shall be programmed-start type utilizing filament preheat followed by a high voltage pulse to ignite the lamp.

5. During lamp operation, variable filament heating current shall be provided according to a predetermined curve to maintain optimum filament temperature and amalgam temperature to provide maximum lamp life and optimum lamp efficiency across varying water temperatures and lamp power levels.
  6. A ground fault in the output circuit shall be detected and communicated as a warning to the SCC while the corresponding lamp operates undisturbed.
  7. Local visual diagnostic shall be provided with LEDs for lamp driver status, lamp status, (on, idle, preheat, fault), power and communication status.
  8. At a minimum, the following external indicators (protections, status, warnings, and alarms) shall be provided: lamp status, driver status, driver high temperature, input voltage out of range, lamp arc circuit open/short/out of range, lamp filament open circuit/out of range, end of lamp life (EOLL), ground fault, lamp circuit leakage (water in the sleeve), communication time-out. All signals shall be sent to the SCC and be available for monitoring at the plant SCADA System.
  9. The lamp driver shall be UL, CE, RoHS compliant.
- E. Water Level Sensor:
1. A water level sensor shall be provided for each channel with the equipment to indicate low water level conditions to the UV System SCC. The water level sensor shall be a GEMS Series 3R probe, or equal. Probe shall be 316 stainless steel with PVC heat shrink. Provide NEMA 4X 304 stainless steel enclosure with strain relief cable glands.
  2. The level sensor control box shall be powered from the power distribution center, as shown on the Drawings.
  3. During all modes of system operation (manual, automatic and remote), if the water level in the channel drops below an acceptable level, lamps shall extinguish automatically.
  4. On loss of power, lamps shall not restart simultaneously. Lamps shall be staged such that the generator is not overloaded.
- F. On-Line UV Transmission Monitor:
1. On-line UVT monitor shall be provided with the equipment where shown on the drawings to automatically and continuously track the UV transmission of the effluent at the 254 nm wavelength. UVT probe shall be as manufactured by YSI IQ UVT-254, or equal.
  2. The UVT monitor shall send the measured UVT to the UV SCC. The SCC will modulate the lamp intensity in response to the effluent UV Transmission. Provide one-year supply of cleaning and calibration materials for the probe.
- G. UV System Slide Gates, Sluice Gates, and PDC Automatic Controls: Each of the UV System influent channel slide gates (SG-95-01 and SG-95-02 (Town Branch)) and sluice gates (SLG-80-01, SLG-80-02, SLG-80-03, and SLG-80-04 (West Hickman)) and the associated channel's PDCs shall be controlled from the UV PLC with a software Hand-Auto selector switch on the UV system OIP as follows. The plant effluent flow shall be received via the plant SCADA system.
1. With the OIP H-A selector switch in the "Hand" position, each of the gates shall be opened and closed with OIP "Open" and Close" pushbuttons. Once each of the gates open, the associated UV System PDCs shall operate as described herein.
  2. With the OIP H-A selector switch in the "Auto" position, the gates and associated PDCs shall be controlled based on plant effluent flow and a SCADA selector switch.
    - a. With the OIP selector switch in the "North Channel Lead" position, the slide gates and UV System PDCs shall be controlled as follows:
      - (1) The North Channel gates SG-95-01 (Town Branch) or SLG-80-01 and SLG-80-02 (West Hickman) shall open and the associated PDCs shall operate as described herein. When the UV System effluent flow rises above an

operator-adjustable "Open Lag UV Channel" flow setpoint (0.0 to 55.0 MGD) for an operator-adjustable "Open/Close Lag UV Channel Time Delay" (0 to 30.0 minutes), slide gates SG-95-02 (Town Branch) or SLG-80-03 and SLG-80-04 (West Hickman) shall open and the associated PDCs shall operate as described herein.

- (2) Once the UV System influent flow falls below the "Open Lag UV Channel" flow setpoint for the operator adjustable "Open/Close Lag UV Channel Time Delay", the associated PDCs shall be shut down and slide gates SG-95-02 (Town Branch) or SLG-80-03 and SLG-80-04 (West Hickman) shall close.
  - b. With the SCADA selector switch in the "South Channel Lead" position, the slide gates and UV System PDCs shall be controlled in the opposite order as described above.
  3. Upon loss of UV System influent flow signal, an alarm shall be generated at the plant SCADA System and the operator shall be able to adjust the UV Lamp Output Intensity (0 to 100%) at the OIP.
- H. All gates controlled automatically from SCC-UV shall have "Call-to-Open/Close" signals (as applicable) generated from the SCC-UV PLC. These signals shall be displayed at the SCC-UV OIP. The SCC-UV PLC shall also generate a "Call-to-Open/Close Fail" if the valve/gate is called-to-open/close but does not open/close within a specific time period. The "Call-to-Open/Close Fail" signal shall be generated within the SCC-UV PLC software and may not be combined with other fail signals.
- I. Dose-Pacing:
1. A dose-pacing system will be supplied to modulate the lamp UV output in relationship to a 4-20 mA DC signal from effluent flow meter(s) (supplied and installed by Others) and UV intensity sensor(s).
  2. The system to be dose-paced such that as the flow and effluent quality change, the design UV dose is delivered while conserving power.
  3. The dose-pacing system will allow the operator to vary the design dose setting. Logic and time delays will be provided to regulate UV Bank ON/OFF cycling.

## 2.08 SPARE PARTS

- A. The following safety equipment shall be provided with the equipment as a minimum:
1. Four face shields shall be provided per plant to block UV light wavelength between 200 and 400 nm.
  2. Five area warning signs per plant.
- B. The following spare parts shall be provided for each plant:
1. Twenty-two lamps.
  2. Twenty-two sleeves.
  3. Six lamp drivers.
  4. Twenty-two wiper rings.

## 2.09 FINISHES

- A. It is the intent of these specifications that equipment, support and accessories be furnished factory shop-primed and finish-painted. Equipment and appurtenances shall be prepared in accordance with commercial grade SSPC specifications No. 6. Priming and finish painting shall be as recommended by manufacturer and shall be suitable to the environment and intended use. Touchup paint shall be provided by manufacturer.

- B. All stainless steel parts and components shall be finished by electro-polishing, bead blasting, or other similar acceptable method as recommended by equipment manufacturer to remove all embedded iron, surface rust, weld burns, or other surface impairments. The surface finish provided for all stainless steel parts shall be clean, uniform, and appropriate for integrity of the material in its intended service conditions. All welds shall be finished to, at a minimum, remove all pointed protrusions from underside and face of welds and to remove all weld spatter. No welding in the field during installation of the system shall be allowed unless reviewed by ENGINEER.
- C. All plastic and other unpainted, nonmetallic components in exterior locations shall be provided with the appropriate UV inhibitors and finishes to provide proper protection from breakdown because of environmental elements in its intended service conditions (sunlight, temperature, wastewater constituents).

## 2.10 ANCHOR BOLTS

- A. CONTRACTOR shall supply anchor bolts for fixed weirs. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.

### 3.02 STARTUP AND TESTING

- A. A qualified field service technician or startup engineer of the equipment manufacturer shall commission the UV equipment. A local manufacturer's representative shall not be acceptable unless authorized by the equipment manufacturer to perform startup services.
- B. Following installation, check-out, initial start-up, certification, and instruction of plant personnel, a written report summarizing the UV disinfection system manufacturer's findings and installation approval shall be submitted to ENGINEER within ten days of initial start-up. The installed UV disinfection system and all related components shall be reviewed by the manufacturer, and a certification shall be provided stating that the equipment has been properly installed and started and that nothing has been observed that will violate the warranty. This is required for each system start up at each plant.
- C. Following acceptance of manufacturer's written report, performance testing shall proceed as specified in Paragraph 1.04.B. above.
- D. Operation and Maintenance Manual shall be submitted and acknowledged by ENGINEER prior to startup.
- E. Minimum on-site time (excluding travel time) for startup and testing services shall be as follows:
  - 1. Inspection of installation: Four days per plant for each system start up.

2. Startup and system commissioning: Four days per plant for each system start up.
  3. Operator classroom and field training: One day per plant.
- F. Additional services to be provided to meet requirements of specification shall be provided without additional cost to OWNER.
- G. Refer to Section 40 70 00—Controls and Instrumentation Equipment, for other related requirements regarding field quality control and other services onsite. Services specified in this section shall be coordinated with those specified in Section 40 70 00.
- H. Following acceptance of manufacturer's written report, performance testing shall proceed as specified in Paragraph 1.04.B.

END OF SECTION

**SCADA SYSTEM I/O LISTING**

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
 LEXINGTON, KENTUCKY  
 TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION  
 PROCESS REPLACEMENT PROJECT  
 CONTRACT 131-2024  
 SCADA SYSTEM I/O LISTING - SCC-UV1

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
UV1	<b>UV DISINFECTION SYSTEM</b>							
UV1	Common Minor Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV1	Common Major Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV1	Common Critical Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV1	Channel 1 Flow		0	0	1	0	SH.PR	From Flow Transmitter
UV1	<b>UV CHANNEL NO. 1</b>							
UV1	Low Water Level		1	0	0	0	ENET	From PDC-1A-1C
UV1	<b>UV BANK 1A</b>							
UV1	Bank in Operation		1	0	0	0	ENET	From PDC-1A-1C
UV1	Bank in Auto		1	0	0	0	ENET	From PDC-1A-1C
UV1	Low UV Intensity Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV1	Major Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV1	UV Intensity		0	0	0	1	ENET	From PDC-1A-1C
UV1	Wiper Sequence in Process		1	0	0	0	ENET	From PDC-1A-1C
UV1	Lamp Failure		1	0	0	0	ENET	From PDC-1A-1C
UV1	Ballast Failure		1	0	0	0	ENET	From PDC-1A-1C
UV1	Power Loss Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV1	Lamp Hours		0	0	1	0	ENET	From PDC-1A-1C
UV1	Lamp Power		0	0	1	0	ENET	From PDC-1A-1C
UV1	<b>UV BANK 1B</b>							
UV1	Same as Bank 1A		8	0	2	1	ENET	From PDC-1A-1C
UV1	<b>UV BANK 1C</b>							
UV1	Same as Bank 1A		8	0	2	1	ENET	From PDC-1A-1C
UV1	<b>UV BANK 2A</b>							
UV1	Same as Bank 1A		8	0	2	1	ENET	From PDC-2A-2C
UV1	<b>UV BANK 2B</b>							
UV1	Same as Bank 1A		8	0	2	1	ENET	From PDC-2A-2C
UV1	<b>UV BANK 2C</b>							
UV1	Same as Bank 1A		8	0	2	1	ENET	From PDC-2A-2C
UV1	<b>UV CHANNEL 1 INFLUENT GATE</b>	SLG-80-01						
UV1	OPEN		0	1	0	0	2-#14	To Influent Gate
UV1	CLOSE		0	1	0	0	2-#14	To Influent Gate
UV1	FULLY OPENED		1	0	0	0	2-#14	From Influent Gate
UV1	FULLY CLOSED		1	0	0	0	2-#14	From Influent Gate
UV1	IN REMOTE		1	0	0	0	2-#14	From Influent Gate
UV1	ACTUATOR FAULT		1	0	0	0	2-#14	From Influent Gate

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 SCADA SYSTEM I/O LISTING - SCC-UV1

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
UV1	<b>UV CHANNEL 1 INFLUENT GATE</b>	SLG-80-02						
UV1	OPEN		0	1	0	0	2-#14	To Influent Gate
UV1	CLOSE		0	1	0	0	2-#14	To Influent Gate
UV1	FULLY OPENED		1	0	0	0	2-#14	From Influent Gate
UV1	FULLY CLOSED		1	0	0	0	2-#14	From Influent Gate
UV1	IN REMOTE		1	0	0	0	2-#14	From Influent Gate
UV1	ACTUATOR FAULT		1	0	0	0	2-#14	From Influent Gate
UV1	<b>HYDRAULIC SYSTEM CENTER HSC-1A-1C</b>	HSC-1A-1C						
UV1	LOW FLUID LEVEL ALARM		1	0	0	0	ENET	From HSC-1A-1C
UV1	PUMP FAULT		1	0	0	0	ENET	From HSC-1A-1C
UV1	<b>HYDRAULIC SYSTEM CENTER HSC-2A-2C</b>	HSC-2A-2C						
UV1	LOW FLUID LEVEL ALARM		1	0	0	0	ENET	From HSC-2A-2C
UV1	PUMP FAULT		1	0	0	0	ENET	From HSC-2A-2C
	***TOTALS***		64	4	13	6		



LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
 LEXINGTON, KENTUCKY  
 TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION  
 PROCESS REPLACEMENT PROJECT  
 CONTRACT 131-2024  
 SCADA SYSTEM I/O LISTING - SCC-UV2

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
UV2	<b>UV DISINFECTION SYSTEM</b>							
UV2	Common Minor Alarm		1	0	0	0	ENET	From PDC-3A-3C
UV2	Common Major Alarm		1	0	0	0	ENET	From PDC-3A-3C
UV2	Channel 2 Flow		0	0	1	0	SH.PR	From Flow Transmitter
UV2	Common Critical Alarm		1	0	0	0	ENET	From PDC-3A-3C
UV2	<b>UV CHANNEL NO. 2</b>							
UV2	Low Water Level		1	0	0	0	ENET	From PDC-3A-3C
UV2	<b>UV BANK 3A</b>							
UV2	Bank in Operation		1	0	0	0	ENET	From PDC-3A-3C
UV2	Bank in Auto		1	0	0	0	ENET	From PDC-3A-3C
UV2	Low UV Intensity Alarm		1	0	0	0	ENET	From PDC-3A-3C
UV2	Major Alarm		1	0	0	0	ENET	From PDC-3A-3C
UV2	UV Intensity		0	0	0	1	ENET	From PDC-3A-3C
UV2	Wiper Sequence in Process		1	0	0	0	ENET	From PDC-3A-3C
UV2	Lamp Failure		1	0	0	0	ENET	From PDC-3A-3C
UV2	Ballast Failure		1	0	0	0	ENET	From PDC-3A-3C
UV2	Power Loss Alarm		1	0	0	0	ENET	From PDC-3A-3C
UV2	Lamp Hours		0	0	1	0	ENET	From PDC-3A-3C
UV2	Lamp Power		0	0	1	0	ENET	From PDC-3A-3C
UV2	<b>UV BANK 3B</b>							
UV2	Same as Bank 3A		8	0	2	1	ENET	From PDC-3A-3C
UV2	<b>UV BANK 3C</b>							
UV2	Same as Bank 3A		8	0	2	1	ENET	From PDC-4A-4C
UV2	<b>UV BANK 4A</b>							
UV2	Same as Bank 3A		8	0	2	1	ENET	From PDC-4A-4C
UV2	<b>UV BANK 4B</b>							
UV2	Same as Bank 3A		8	0	2	1	ENET	From PDC-4A-4C
UV2	<b>UV BANK 4C</b>							
UV2	Same as Bank 3A		8	0	2	1	ENET	From PDC-4A-4C
UV2	<b>UV CHANNEL 2 INFLUENT GATE</b>	SLG-80-03						
UV2	OPEN		0	1	0	0	2-#14	To Influent Gate
UV2	CLOSE		0	1	0	0	2-#14	To Influent Gate
UV2	FULLY OPENED		1	0	0	0	2-#14	From Influent Gate
UV2	FULLY CLOSED		1	0	0	0	2-#14	From Influent Gate
UV2	IN REMOTE		1	0	0	0	2-#14	From Influent Gate
UV2	ACTUATOR FAULT		1	0	0	0	2-#14	From Influent Gate

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT  
 LEXINGTON, KENTUCKY  
 TOWN BRANCH AND WEST HICKMAN WWTP UV DISINFECTION  
 PROCESS REPLACEMENT PROJECT  
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 SCADA SYSTEM I/O LISTING - SCC-UV2

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
UV2	<b>UV CHANNEL 2 INFLUENT GATE</b>	SLG-80-04						
UV2	OPEN		0	1	0	0	2-#14	To Influent Gate
UV2	CLOSE		0	1	0	0	2-#14	To Influent Gate
UV2	FULLY OPENED		1	0	0	0	2-#14	From Influent Gate
UV2	FULLY CLOSED		1	0	0	0	2-#14	From Influent Gate
UV2	IN REMOTE		1	0	0	0	2-#14	From Influent Gate
UV2	ACTUATOR FAULT		1	0	0	0	2-#14	From Influent Gate
UV2	<b>HYDRAULIC SYSTEM CENTER HSC-1A-1C</b>	HSC-1A-1C						
UV2	LOW FLUID LEVEL ALARM		1	0	0	0	ENET	From HSC-1A-1C
UV2	PUMP FAULT		1	0	0	0	ENET	From HSC-1A-1C
UV2	<b>HYDRAULIC SYSTEM CENTER HSC-2A-2C</b>	HSC-2A-2C						
UV2	LOW FLUID LEVEL ALARM		1	0	0	0	ENET	From HSC-2A-2C
UV2	PUMP FAULT		1	0	0	0	ENET	From HSC-2A-2C
UV2								Same as UV Channel No. 1
	***TOTALS***		64	4	13	6		

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 SCADA SYSTEM I/O LISTING - SCC-UV

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
UV	<b>UV DISINFECTION SYSTEM</b>							
UV	Common Minor Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV	Common Major Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV	Common Critical Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV	<b>UV CHANNEL NO. 1</b>							
UV	Low Water Level		1	0	0	0	ENET	From PDC-1A-1C
UV	<b>UV BANK 1A</b>							
UV	Bank in Operation		1	0	0	0	ENET	From PDC-1A-1C
UV	Bank in Auto		1	0	0	0	ENET	From PDC-1A-1C
UV	Low UV Intensity Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV	Major Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV	UV Intensity		0	0	0	1	ENET	From PDC-1A-1C
UV	Wiper Sequence in Process		1	0	0	0	ENET	From PDC-1A-1C
UV	Lamp Failure		1	0	0	0	ENET	From PDC-1A-1C
UV	Ballast Failure		1	0	0	0	ENET	From PDC-1A-1C
UV	Power Loss Alarm		1	0	0	0	ENET	From PDC-1A-1C
UV	Lamp Hours		0	0	1	0	ENET	From PDC-1A-1C
UV	Lamp Power		0	0	1	0	ENET	From PDC-1A-1C
UV	<b>UV BANK 1B</b>							
UV	Same as Bank A		8	0	2	1	ENET	From PDC-1A-1C
UV	<b>UV BANK 1C</b>							
UV	Same as Bank A		8	0	2	1	ENET	From PDC-1A-1C
UV	<b>UV BANK 1D</b>							
UV	Same as Bank A		8	0	2	1	ENET	From PDC-1D-1E
UV	<b>UV BANK 1E</b>							
UV	Same as Bank A		8	0	2	1	ENET	From PDC-1D-1E
UV	<b>UV CHANNEL 1 INFLUENT GATE</b>							
UV	OPEN		0	1	0	0	2-#14	To Influent Gate
UV	CLOSE		0	1	0	0	2-#14	To Influent Gate
UV	FULLY OPENED		1	0	0	0	2-#14	From Influent Gate
UV	FULLY CLOSED		1	0	0	0	2-#14	From Influent Gate
UV	IN REMOTE		1	0	0	0	2-#14	From Influent Gate
UV	ACTUATOR FAULT		1	0	0	0	2-#14	From Influent Gate
UV	<b>HYDRAULIC SYSTEM CENTER HSC-1A-1D</b>	HSC-1A-1D						
UV	LOW FLUID LEVEL ALARM		1	0	0	0	ENET	From HSC-1A-1D
UV	PUMP FAULT		1	0	0	0	ENET	From HSC-1A-1D

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SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
UV	<b>HYDRAULIC SYSTEM CENTER HSC-1E</b>	HSC-1E						
UV	LOW FLUID LEVEL ALARM		1	0	0	0	ENET	From HSC-1E
UV	PUMP FAULT		1	0	0	0	ENET	From HSC-1E
UV	<b>UV CHANNEL NO. 2</b>							
UV	Same as Channel No. 1		49	0	10	5	ENET	
	***TOTALS***		101	2	20	10		

## **DRAWINGS**

## STANDARD DETAIL



01-975-43A

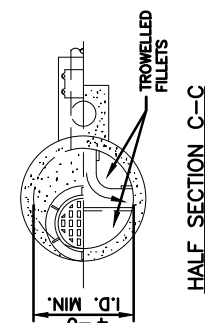
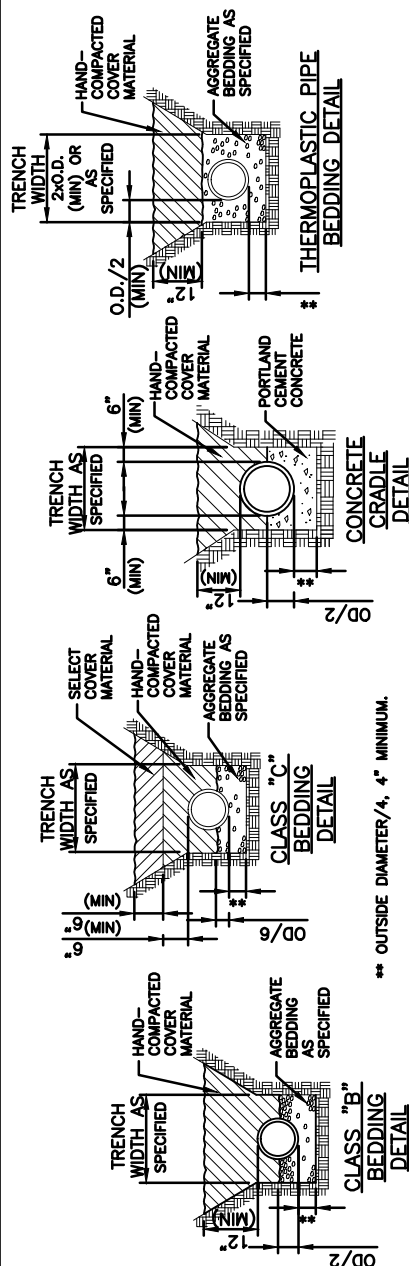
OCTOBER 2011

## NOTES

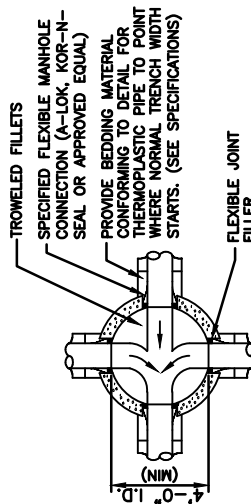
1. DETAILS RELATIVE TO ITEMS SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
2. VARIATIONS IN DIMENSIONS AND DESIGN MAY BE PERMISSIBLE, PROVIDING EQUIVALENT CAPACITY AND STRENGTH ARE ATTAINED.
3. ALL CONCRETE FILLETS SHALL BE HAND TROWELED WITH A 1 1/4" FT. SLOPE.
4. INSIDE DIMENSIONS FOR MANHOLES: USE MINIMUM 4" DIAMETER FOR SEWER LESS THAN 18" IN DIAMETER; USE MINIMUM 5" DIAMETER FOR SEWER 18" THRU 24" IN DIAMETER; USE MINIMUM 6" DIAMETER OR MINIMUM 6' SQUARE FOR SEWER OVER 24" IN DIAMETER.
5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.
6. DROP TYPE ENTRANCE TO STANDARD MANHOLE WILL BE PAID FOR SEPARATELY IF SO LISTED IN THE BID.
7. SEE DRAWINGS FOR DROP TYPE ENTRANCES FOR SANITARY SEWERS LARGER THAN 15".
8. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF REGULATORY BODIES OF THE STATE AND APPLICABLE MUNICIPAL ORDINANCES.
9. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.
10. FLAT SLAB TOPS SHALL BE DESIGNED FOR H=20 TRUCK LOADING AND SHALL MEET REQUIREMENTS OF ASTM C-478.
11. BASE SLABS SHALL BE REINFORCED AS FOLLOWS: REINFORCING SHALL BE PLACED IN EACH DIRECTION AT 2" CLEAR FROM TOP SURFACE OF SLAB. REINFORCING SHALL BE GRADE 60. USE OF CAST-IN-PLACE SLAB SHALL NOT RELIEVE CONTRACTOR OF REQUIREMENTS TO PROVIDE WATERTIGHT JOINTS.

INSIDE DIA.	DEPTH	REINF.
4'	≤ 30'	#3@8"
5'	≤ 20'	#3@8"
5'	20'-30'	#4@10"
6'	≤ 20'	#4@10"
6'	20'-25'	#4@8"
6'	25'-30'	#4@6"

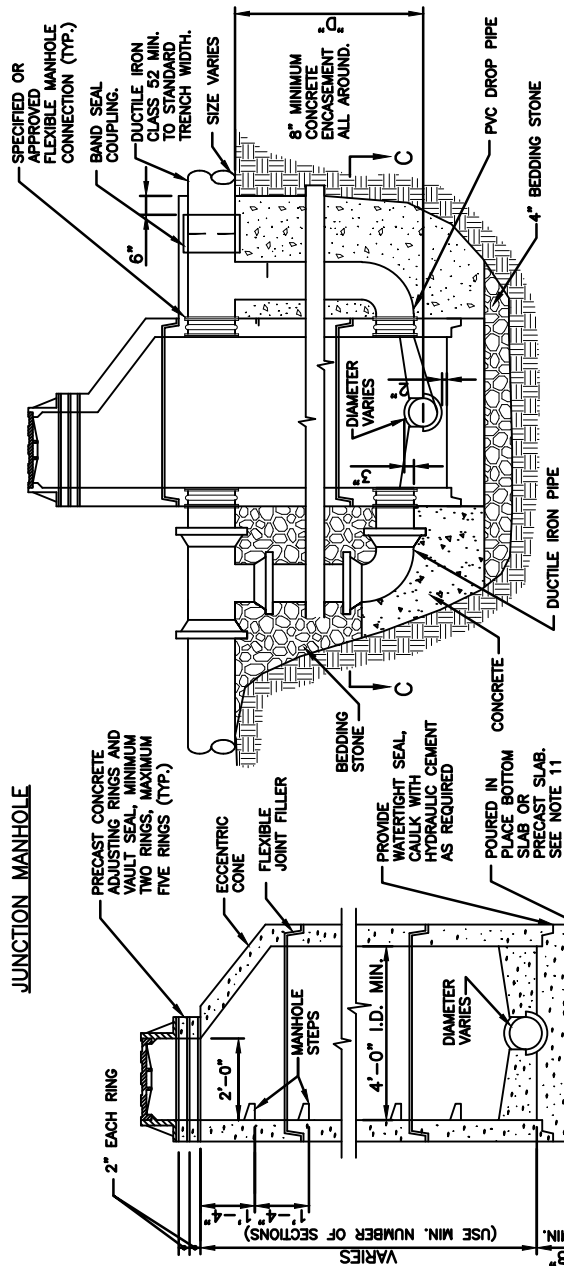
12. FLAT SLABS SHALL BE PROVIDED IN SHALLOW DEPTH SITUATIONS IN LIEU OF ECCENTRIC CONES.



HALF SECTION C-C



JUNCTION MANHOLE



### DROP TYPE ENTRANCE OPTIONS TO STANDARD MANHOLE

## STANDARD PRECAST MANHOLE

For more location information  
please visit [www.strand.com](http://www.strand.com)

## Office Locations

Ames, Iowa | 515.233.0000

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Cincinnati, Ohio | 513.861.5600

Columbus, Indiana | 812.372.9911

Columbus, Ohio | 614.835.0460

Joliet, Illinois | 815.744.4200

Lexington, Kentucky | 859.225.8500

Louisville, Kentucky | 502.583.7020

Madison, Wisconsin\* | 608.251.4843

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\*Corporate Headquarters

