

CITY OF ANN ARBOR
INVITATION TO BID

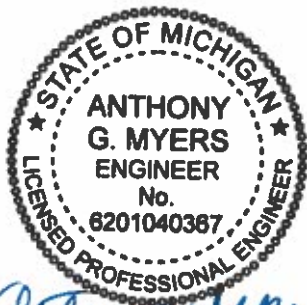


WTP UV DISINFECTION SYSTEM

ITB No. 4568

Due Date: February 28, 2019, 2:00 pm (Local Time)

Public Services Area/Water Treatment Services Unit
Administering Service Area/Unit



Anthony G. Myers
01-29-2019

Issued By:

City of Ann Arbor
Procurement Unit
301 E. Huron Street
Ann Arbor, MI 48104

TABLE OF CONTENTS

TABLE OF CONTENTS.....	TC-1 to 3
NOTICE OF PRE-BID CONFERENCE.....	NP-1
INSTRUCTIONS TO BIDDERS.....	IB-1 to 7
INVITATION TO BID.....	ITB-1 to 3
BID FORMS.....	BF-1 to 9

CITY OF ANN ARBOR DOCUMENTS AND FORMS

- City of Ann Arbor Prevailing Wage Declaration of Compliance
- City of Ann Arbor Living Wage Ordinance Declaration of Compliance
- Vendor Conflict of Interest Disclosure Form
- City of Ann Arbor Declaration of Compliance - Non-Discrimination Ordinance
- Michigan Department of Transportation Certified Payroll

REQUIRED STANDARD CONTRACT LANGUAGE: CLEAN WATER STATE REVOLVING FUND AND DRINKING WATER REVOLVING FUND

- Drinking Water Revolving Loan Supplements:
 - Supplement A – Standard Contract Language: Clean Water State Revolving Fund and Drinking Water Revolving Fund
 - Supplement B – Frequently Asked Questions about Davis Bacon Act Compliance During Revolving Fund Loan Project Construction
 - Supplement C – American Iron and Steel Contract Language
 - Supplement D – American Iron and Steel Guidance
 - Supplement E – Disadvantaged Business Enterprise (DBE) Program DBE Subcontractor Participation Form
- Prevailing Wage Rates

CONTRACT.....	C-13 to 3
BOND FORMS.....	B-1 to 2
GENERAL CONDITIONS.....	GC-1 to 17
STANDARD SPECIFICATIONS.....	SS-1

SPECIFICATIONS

DIVISION 01—GENERAL REQUIREMENTS

01 11 00	Summary of Work.....	1-	6
01 26 00	Contract Modification Procedures	1-	7
01 29 00	Payment Procedures.....	1-	6
01 31 13	Project Coordination	1-	10
01 31 19	Project Meetings	1-	3
01 32 00	Construction Progress Documentation	1-	5
01 33 00	Submittal Procedures	1-	9
	Transmittal of Contractor’s Submittal	1-	1
01 42 13	Abbreviations and Acronyms	1-	5
01 43 33	Manufacturers’ Field Services	1-	7
	Manufacturer’s Certificate of Proper Installation	1-	1

01 45 33	Special Inspection, Observation, and Testing.....	1-	6
	Fabricator’s Certificate of Compliance.....	1-	1
	Statement of Special Inspections	1-	2
	2015 IBC Tables 1-6.....	1-	8
01 50 00	Temporary Facilities and Controls.....	1-	7
01 61 00	Common Product Requirements	1-	8
	Manufacturer’s Certificate of Compliance	1-	1
01 77 00	Closeout Procedures.....	1-	7
01 78 23	Operation and Maintenance Data.....	1-	12
	Maintenance Summary Form.....	1-	2
01 80 00	Certified Payroll Compliance and Reporting.....	1-	2
01 88 15	Anchorage and Bracing.....	1-	5
01 91 14	Equipment Testing and Facility Startup	1-	17
	Unit Process Startup Form	1-	1
	Facility Performance Demonstration/Certification Form	1-	1

DIVISION 02—EXISTING CONDITIONS

02 41 00	Demolition	1-	8
02 41 01	Lead Paint Abatement.....	1-	7

DIVISION 03—CONCRETE

03 30 10	Structural Concrete	1-	18
	Concrete Mix Design, Class 4500F0S1P1C1	1-	2

DIVISION 05—METALS

05 05 19	Post-Installed Anchors	1-	9
05 50 00	Metal Fabrications	1-	10
05 52 19	Steel Railings	1-	7
05 53 00	Metal Gratings	1-	4

DIVISION 07—THERMAL AND MOISTURE PROTECTION

07 92 00	Joint Sealants	1-	4
----------	----------------------	----	---

DIVISION 09—FINISHES

09 90 00	Painting and Coating.....	1-	18
	Paint System Data Sheet (PSDS).....	1-	1
	Product Data Sheet (PDS).....	1-	1

DIVISION 10—SPECIALTIES

10 14 00	Signage.....	1-	3
	Sign Schedule.....	1-	1
10 44 00	Fire Protection Specialties	1-	3

DIVISION 26—ELECTRICAL

26 05 01 Electrical 1- 36

DIVISION 33—UTILITIES

33 13 00 Disinfection of Water Utility Distribution Facilities 1- 6

DIVISION 40—PROCESS INTERCONNECTIONS

40 05 15 Piping Support Systems 1- 6
40 27 00 Process Piping—General 1- 11
Piping Schedule Legend 1- 2
Piping Schedule 1- 2
40 27 00.01 Cement-Mortar-Lined Ductile Iron Pipe and Fittings 1- 2
40 27 00.08 Stainless Steel Pipe and Fittings—General Service 1- 2
40 27 00.10 Polyvinyl Chloride (PVC) Pipe and Fittings 1- 2
40 27 00.13 Copper and Copper Alloy Pipe Tubing and
Fittings Data Sheet 1- 1
40 27 01 Process Piping Specialties 1- 4
40 27 02 Process Valves and Operators 1- 14
Electric Actuated Valve Schedule 1- 1
40 42 13 Process Piping Insulation 1- 4
Service and Insulation Thickness Table 1- 1
40 80 01 Process Piping Leakage Testing 1- 2
40 90 00 Instrumentation and Control for Process Systems 1- 43
Loop Specifications 1- 1
PLC Input/Output List 1- 2
Loop Status Report 1- 1
Instrument Calibration Sheet 1- 1
I&C Valve Adjustment Sheet 1- 1
Performance Test Sheet 1- 1
40 90 02 Instrumentation and Control for Process Systems
Sample Forms 1- 5
40 91 00 Instrumentation and Control Components 1- 20

DIVISION 44—POLLUTION AND WASTE CONTROL EQUIPMENT

44 42 56.04 Submersible Pumps 1- 5
Data Sheets: Pump and Motor 1- 2
44 42 56.17 Sampling Pumps 1- 3
Pump Data Sheet 1- 2
44 44 73 UV System 1- 35

APPENDIX

Lead and Asbestos Survey

DRAWINGS (BOUND SEPARATELY)

END OF SECTION

NOTICE OF PRE-BID CONFERENCE

A pre-bid conference for this project will be held on **February 12, 2019 1:00 pm local time** at **the Ann Arbor Water Treatment Plant, 919 Sunset Road**. Attendance at this pre-bid conference is highly recommended. Administrative and technical questions regarding this project will be answered at this time. The pre-bid meeting is for information only. Any answers furnished will not be official until verified in writing by the Financial Service Area, Procurement Unit. Answers that change or substantially clarify the bid will be affirmed in an addendum.

A site visit will follow the pre-bid conference to allow potential bidders the opportunity to view the project site.

INSTRUCTIONS TO BIDDERS

General

Work to be done under this Contract is generally described through the detailed specifications and must be completed fully in accordance with the contract documents. All work to be done under this Contract is located in or near the City of Ann Arbor.

Any Bid which does not conform fully to these instructions may be rejected.

Preparation of Bids

Bids should be prepared providing a straight-forward, concise description of the Bidder's ability to meet the requirements of the ITB. Bids shall be written in ink or typewritten. No erasures are permitted. Mistakes may be crossed out and corrected and must be initialed and dated in ink by the person signing the Bid.

Bids must be submitted on the "Bid Forms" provided with each blank properly filled in. If forms are not fully completed it may disqualify the bid. No alternative bid will be considered unless alternative bids are specifically requested. If alternatives are requested, any deviation from the specification must be fully described, in detail on the "Alternate" section of Bid form.

Each person signing the Bid certifies that he/she is the person in the Bidder's firm/organization responsible for the decision as to the fees being offered in the Bid and has not and will not participated in any action contrary to the terms of this provision.

Questions or Clarifications / Designated City Contacts

All questions regarding this ITB shall be submitted via email. Emailed questions and inquires will be accepted from any and all prospective Bidders in accordance with the terms and conditions of the ITB.

All questions shall be due on or before **February 15, 2019, 4:00 pm local time** and should be addressed as follows:

Specification/Scope of Work questions emailed to tony.myers@jacobs.com
Bid Process and Compliance questions emailed to cspencer@a2gov.org

Any error, omissions or discrepancies in the specification discovered by a prospective contractor and/or service provider shall be brought to the attention of Tony Myers at tony.myers@jacobs.com after discovery as possible. Further, the contractor and/or service provide shall not be allowed to take advantage of errors, omissions or discrepancies in the specifications.

Addenda

If it becomes necessary to revise any part of the ITB, notice of the Addendum will be posted to Michigan Inter-governmental Trade Network (MITN) www.mitn.info and/or City of Ann Arbor web site www.A2gov.org for all parties to download.

Each Bidder must in its Bid, to avoid any miscommunications, acknowledge all addenda which it has received, but the failure of a Bidder to receive, or acknowledge receipt of; any addenda shall not relieve the Bidder of the responsibility for complying with the terms thereof. The City will not be bound by oral responses to inquiries or written responses other than written addenda.

Bid Submission

All Bids are due and must be delivered to the City of Ann Arbor Procurement Unit on or before **February 28, 2019, 2:00 pm Local Time**. Bids submitted late or via oral, telephonic, telegraphic, electronic mail or facsimile **will not** be considered or accepted.

Each Bidder must submit one (1) original Bid and five (**5**) Bid copies in a sealed envelope clearly marked: **ITB No. 4568 Ann Arbor WTP UV Disinfection System**.

Bids must be addressed and delivered to:

City of Ann Arbor
Procurement Unit,
c/o Customer Services, 1st Floor
301 East Huron Street
Ann Arbor, MI 48107

All Bids received on or before the Due Date will be publicly opened and recorded immediately. No immediate decisions are rendered.

The following forms provided within this ITB Document must be included in submitted bids.

- **City of Ann Arbor Prevailing Wage Declaration of Compliance**
- **City of Ann Arbor Living Wage Ordinance Declaration of Compliance**
- **Vendor Conflict of Interest Disclosure Form**
- **City of Ann Arbor Non-Discrimination Ordinance Declaration of Compliance**

Bids that fail to provide these completed forms listed above upon bid opening will be rejected as non-responsive and will not be considered for award.

Hand delivered bids will be date/time stamped/signed by the Procurement Unit at the address above in order to be considered. Normal business hours are 9:00 a.m. to 3:00 p.m. Monday through Friday, excluding Holidays. The City will not be liable to any Bidder for any unforeseen circumstances, delivery or postal delays. Postmarking to the Due Date will not substitute for receipt of the Bid. Each Bidder is responsible for submission of their Bid.

Additional time for submission of bids past the stated due date and time will not be granted to a single Bidder; however, additional time may be granted to all Bidders when the City determines in its sole discretion that circumstances warrant it.

Award

The City intends to award a Contract(s) to the lowest responsible Bidder(s). On multi-divisional contracts, separate divisions may be awarded to separate Bidders. The City may also utilize alternatives offered in the Bid Forms, if any, to determine the lowest responsible Bidder on each

division, and award multiple divisions to a single Bidder, so that the lowest total cost is achieved for the City. For unit price bids, the Contract will be awarded based upon the unit prices and the lump sum prices stated by the bidder for the work items specified in the bid documents, with consideration given to any alternates selected by the City. If the City determines that the unit price for any item is materially different for the work item bid than either other bidders or the general market, the City, in its sole discretion, in addition to any other right it may have, may reject the bid as not responsible or non-conforming.

The acceptability of major subcontractors will be considered in determining if a Bidder is responsible. In comparing Bids, the City will give consideration to alternate Bids for items listed in the bid forms. All key staff and subcontractors are subject to the approval by the City.

Qualifications

The City will evaluate Proposals based on cost as well as experience. Contractors that have not included the required list of similar work experience, resumes for project manager and superintendent, and associated references in Section 5 of the Bid Form may have their bid rejected.

As part of the proposal, Bidders shall provide documentation that the Bidder's company has at least 10 years' experience performing construction of water and wastewater facilities. Bidders shall also submit for the proposed Project Manager and Superintendent, resumes documenting 7 years of professional experience for each individual in the construction industry as a full-time employee, along with 3 references for each individual from previous projects completed within the past 5 years. Bidders shall also submit the attached for, "Section 5-References", which identifies a minimum of three projects completed in the past 5 years at water or wastewater facilities with a treatment capacity of 5 million gallons per day or larger, including construction cost, contractor and subcontractor information, that demonstrate similar work experience and complexity to that included within these contract documents, specifically process mechanical equipment, electrical and instrumentation and controls work at treatment plants.

All key staff and subcontractors are subject to the approval of the City.

Official Documents

The City of Ann Arbor officially distributes bid documents from the Procurement Unit or through the Michigan Intergovernmental Trade Network (MITN). Copies of the bid documents obtained from any other source are not Official copies. Addenda and other bid information will only be posted to these official distribution sites. If you obtained City of Ann Arbor Bid documents from other sources, it is recommended that you register on www.MITN.info and obtain an official Bid. Bidders do not need to be shown on the plan holders list provided by MITN to be considered an official plan holder.

Bid Security

Each bid must be accompanied by a certified check, or Bid Bond by a surety licensed and authorized to do business within the State of Michigan, in the amount of 5% of the total of the bid price.

Withdrawal of Bids

After the time of opening, no Bid may be withdrawn for the period of one hundred twenty (120) days.

Contract Time

Time is of the essence in the performance of the work under this Contract. The available time for work under this Contract is indicated on page C-1, Article III of the Contract. If these time requirements cannot be met, the Bidder must stipulate on Bid Form Section 3 - Time Alternate its schedule for performance of the work. Consideration will be given to time in evaluating bids.

Liquidated Damages

A liquidated damages clause, as given on page C-2, Article III of the Contract, provides that the Contractor shall pay the City as liquidated damages, and not as a penalty, a sum certain per day for each and every day that the Contractor may be in default of completion of the specified work, within the time(s) stated in the Contract, or written extensions.

Liquidated damages clauses, as given in the General Conditions, provide further that the City shall be entitled to impose and recover liquidated damages for breach of the obligations under Chapter 112 of the City Code.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended to preclude recovery of actual damages in addition to the recovery of liquidated damages.

Human Rights Information

All contractors proposing to do business with the City shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the Section 9:158 of the Ann Arbor City Code. Breach of the obligation not to discriminate as outlined in Section 5, beginning at page GC-2 shall be a material breach of the contract. Contractors are required to post a copy of Ann Arbor's Non-Discrimination Ordinance attached at all work locations where its employees provide services under a contract with the City.

Wage Requirements

Section 4, beginning at page GC-1, outlines the requirements for payment of prevailing wages and for payment of a "living wage" to employees providing service to the City under this contract. The successful bidder and its subcontractors must comply with all applicable requirements and provide proof of compliance.

Pursuant to Resolution R-16-469 all public improvement contractors are subject to prevailing wage and will be required to provide to the City payroll records sufficient to demonstrate compliance with the prevailing wage requirements. Use of the Prevailing Wage Form provided in the Appendix section or a City-approved equivalent will be required along with wage rate interviews.

For laborers whose wage level are subject to federal, state and/or local prevailing wage law the appropriate Davis-Bacon wage rate classification is identified based upon the work including within this contract. **The wage determination(s) current on the date 10 days before bids are due shall apply to this contract.** The U.S. Department of Labor (DOL) has provided explanations to assist with classification in the following resource link: www.wdol.gov.

For the purposes of this ITB the Construction Type of Building will apply.

Conflict Of Interest Disclosure

The City of Ann Arbor Purchasing Policy requires that prospective Vendors complete a Conflict of Interest Disclosure form. A contract may not be awarded to the selected Vendor unless and until the Procurement Unit and the City Administrator have reviewed the Disclosure form and determined that no conflict exists under applicable federal, state, or local law or administrative regulation. Not every relationship or situation disclosed on the Disclosure Form may be a disqualifying conflict. Depending on applicable law and regulations, some contracts may awarded on the recommendation of the City Administrator after full disclosure, where such action is allowed by law, if demonstrated competitive pricing exists and/or it is determined the award is in the best interest of the City. A copy of the Vendor Conflict of Interest Disclosure Form is attached.

Major Subcontractors

The Bidder shall identify on Bid Form Section 4 each major subcontractor it expects to engage for this Contract if the work to be subcontracted is 15 percent or more of the bid sum or over \$50,000, whichever is less. The Bidder also shall identify the work to be subcontracted to each major subcontractor. The Bidder shall not change or replace a subcontractor without approval by the City.

Debarment

Submission of a Bid in response to this ITB is certification that the Bidder is not currently debarred, suspended, proposed for debarment, and declared ineligible or voluntarily excluded from participation in this transaction by any State or Federal departments or agency. Submission is also agreement that the City will be notified of any changes in this status.

Disclosures

After bids are opened, all information in a submitter's bid is subjected to disclosure under the provisions of Michigan Public Act No. 442 of 1976, as amended (MCL 15.231 et seq.) known as the "Freedom of Information Act." The Freedom of Information Act also provides for the complete disclosure of contracts and attachments thereto except where specifically exempted.

Bid Protest

All Bid protests must be in writing and filed with the Purchasing Agent within five (5) business days of the award action. The bidder must clearly state the reasons for the protest. If a bidder contacts a City Service Area/Unit and indicates a desire to protest an award, the Service Area/Unit shall refer the bidder to the Purchasing Agent. The Purchasing Agent will provide the bidder with the appropriate instructions for filing the protest. The protest shall be reviewed by the City Administrator or designee whose decision shall be final.

Any inquiries or requests regarding this procurement should be only submitted in writing to the Designated City Contacts provided herein. Attempts by any prospective bidder to initiate contact with anyone other than the Designated City Contacts provided herein that the bidder believes can influence the procurement decision, e.g., Elected Officials, City Administrator, Selection Committee Members, Appointed Committee Members, etc., may lead to immediate elimination from further consideration.

Cost Liability

The City of Ann Arbor assumes no responsibility or liability for costs incurred by the Bidder prior to the execution of a contract with the City. By submitting a bid, a bidder agrees to bear all costs incurred or related to the preparation, submission and selection process for the bid.

Reservation of Rights

The City of Ann Arbor reserves the right to accept any bid or alternative bid proposed in whole or in part, to reject any or all bids or alternatives bids in whole or in part and to waive irregularity and/or informalities in any bid and to make the award in any manner deemed in the best interest of the City.

Idle Free Ordinance

The City of Ann Arbor adopted an idling reduction Ordinance that goes into effect July 1, 2017. The full text of the ordinance (including exemptions) can be found at: www.a2gov.org/idlefree.

Under the ordinance, No Operator of a Commercial Vehicle shall cause or permit the Commercial Vehicle to Idle:

- (a) For any period of time while the Commercial Vehicle is unoccupied; or
- (b) For more than 5 minutes in any 60-minute period while the Commercial Vehicle is occupied.

In addition, generators and other internal combustion engines are covered

(1) Excluding Motor Vehicle engines, no internal combustion engine shall be operated except when it is providing power or electrical energy to equipment or a tool that is actively in use.

Environmental Commitment

The City of Ann Arbor recognizes its responsibility to minimize negative impacts on human health and the environment while supporting a vibrant community and economy. The City further recognizes that the products and services the City buys have inherent environmental and economic impacts and that the City should make procurement decisions that embody, promote, and encourage the City's commitment to the environment.

The City encourages potential vendors to bring forward emerging and progressive products and services that are best suited to the City's environmental principles.

State of Michigan Drinking Water Revolving Loan Fund

Bidders shall be advised that this is a State of Michigan Drinking Water Revolving Fund (DWRF) project. In addition, federal requirements must be met for American Iron & Steel, Disadvantage Business Enterprises (DBE), and Davis Bacon.

MDEQ Good Faith Efforts Worksheets are required to be submitted as part of the bid package. Please read in its entirety, the Disadvantaged Business Enterprise (DBE) Requirements and Frequently Asked Questions Regarding Contractor Compliance, Good Faith Efforts Worksheets and Instructions to Bidders for the Completion of the Good Faith Efforts Worksheet, and note that "Failure to show that the Good Faith Efforts were complied with during the bidding process can lead to a prime contractor being found non-responsive."

AMERICAN IRON AND STEEL REQUIREMENTS

The State Revolving Loan Fund requires compliance with American Iron and Steel (AIS) requirements. This stipulates all iron and steel products will be or have been produced in the United States in a manner that complies with AIS requirements, unless a waiver or other determination has been made by the State of Michigan in writing that the requirements do not apply to the project or certain of its requirements.

Detailed and Complete AIS Contract Language is included in Supplement C of the Instruction to Bidders. Submittal of a bid for the Contract as part of this project hereby represents and warrants to the Owner and State of Michigan, that the Contractor has reviewed and understands the AIS Requirements.

DRINKING WATER REVOLVING LOAN FUND SUPPLEMENTS

The supplements listed below are part of this Contract, and are located after BID FORMS.

1. Supplement A – Standard Contract Language: Clean Water State Revolving Fund and Drinking Water Revolving Fund.
2. Supplement B –Frequently Asked Questions about Davis Bacon Act Compliance During Revolving Fund Loan Project Construction.
3. Supplement C – American Iron and Steel Contract Language.
4. Supplement D – American Iron and Steel Guidance.
5. Supplement E – Disadvantaged Business Enterprise (DBE) Program DBE Subcontractor Participation Form.
6. Prevailing Wage Rates

INVITATION TO BID

City of Ann Arbor
Guy C. Larcom Municipal Building
Ann Arbor, Michigan 48107

Ladies and Gentlemen:

The undersigned, as Bidder, declares that this Bid is made in good faith, without fraud or collusion with any person or persons bidding on the same Contract; that this Bidder has carefully read and examined the bid documents, including City Nondiscrimination requirements and Declaration of Compliance Form, Living Wage requirements and Declaration of Compliance Form, Prevailing Wage requirements and Declaration of Compliance Form, Vendor Conflict of Interest Form, Notice of Pre-Bid Conference, Instructions to Bidders, Bid, Bid Forms, Contract, Bond Forms, General Conditions, Standard Specifications, Detailed Specifications, all Addenda, and the Plans (if applicable) and understands them. The Bidder declares that it conducted a full investigation at the site and of the work proposed and is fully informed as to the nature of the work and the conditions relating to the work's performance. The Bidder also declares that it has extensive experience in successfully completing projects similar to this one.

The Bidder acknowledges that it has not received or relied upon any representations or warrants of any nature whatsoever from the City of Ann Arbor, its agents or employees, and that this Bid is based solely upon the Bidder's own independent business judgment.

The undersigned proposes to perform all work shown on the plans or described in the bid documents, including any addenda issued, and to furnish all necessary machinery, tools, apparatus, and other means of construction to do all the work, furnish all the materials, and complete the work in strict accordance with all terms of the Contract of which this Bid is one part.

In accordance with these bid documents, and Addenda numbered _____, the undersigned, as Bidder, proposes to perform at the sites in and/or around Ann Arbor, Michigan, all the work included herein for the amounts set forth in the Bid Forms.

The Bidder declares that it has become fully familiar with the liquidated damage clauses for completion times and for compliance with City Code Chapter 112, understands and agrees that the liquidated damages are for the non-quantifiable aspects of non-compliance and do not cover actual damages that may be shown and agrees that if awarded the Contract, all liquidated damage clauses form part of the Contract.

The Bidder declares that it has become fully familiar with the provisions of Chapter 14, Section 1:320 (Prevailing wages) and Chapter 23 (Living Wage) of the Code of the City of Ann Arbor and that it understands and agrees to comply, to the extent applicable to employees providing services to the City under this Contract, with the wage and reporting requirements stated in the City Code provisions cited. Bidder certifies that the statements contained in the City Prevailing Wage and Living Wage Declaration of Compliance Forms are true and correct. Bidder further agrees that the cited provisions of Chapter 14 and Chapter 23 form a part of this Contract.

The Bidder declares that it has become familiar with the City Conflict of Interest Disclosure Form and certifies that the statement contained therein is true and correct.

The Bidder encloses a certified check or Bid Bond in the amount of 5% of the total of the Bid Price. The Bidder agrees both to contract for the work and to furnish the necessary Bonds and insurance documentation within 10 days after being notified of the acceptance of the Bid.

If this Bid is accepted by the City and the Bidder fails to contract and furnish the required Bonds and insurance documentation within 10 days after being notified of the acceptance of this Bid, then the Bidder shall be considered to have abandoned the Contract and the certified check or Bid Bond accompanying this Bid shall become due and payable to the City.

If the Bidder enters into the Contract in accordance with this Bid, or if this Bid is rejected, then the accompanying check or Bid Bond shall be returned to the Bidder.

In submitting this Bid, it is understood that the right is reserved by the City to accept any Bid, to reject any or all Bids, to waive irregularities and/or informalities in any Bid, and to make the award in any manner the City believes to be in its best interest.

SIGNED THIS _____ DAY OF _____, 2019.

Bidder's Name

Authorized Signature of Bidder

Official Address

(Print Name of Signer Above)

Telephone Number

Email Address for Award Notice

LEGAL STATUS OF BIDDER

(The Bidder shall fill out the appropriate form and strike out the other three.)

Bidder declares that it is:

* A corporation organized and doing business under the laws of the State of _____, for whom _____, bearing the office title of _____, whose signature is affixed to this Bid, is authorized to execute contracts.

NOTE: If not incorporated in Michigan, please attach the corporation's Certificate of Authority

• A limited liability company doing business under the laws of the State of _____, whom _____ bearing the title of _____ whose signature is affixed to this proposal, is authorized to execute contract on behalf of the LLC.

* A partnership, organized under the laws of the state of _____ and filed in the county of _____, whose members are (list all members and the street and mailing address of each) (attach separate sheet if necessary):

* An individual, whose signature with address, is affixed to this Bid: _____
(initial here)

Authorized Official

_____ **Date** _____, 2019

(Print) Name _____ Title _____

Company: _____

Address: _____

Contact Phone () _____ Fax () _____

Email _____

BID FORM

Section 1 – Schedule of Prices

Bidder's Company Name: _____

Project: **WTP UV Disinfection System Project, ITB No. 4568**

Base Bid:

Notes:

1. All bidders shall provide a Unit Price and Total Price for all bid items specified.
2. Quantities included in the bid table represent estimated quantities for different work. The CONTRACTOR shall be compensated for the actual number of items completed using the unit prices provided.
3. The City, at its sole discretion, may elect to delete any portion of the work delineated below, with no change to the unit prices provided. Work shall be determined based upon the availability of funds.
4. Any item not provided in the following list shall be considered incidental.
5. Contract shall be awarded based on the base bid or any combination of a base bid and alternate bid in any manner the City believes to be in its best interest.

Base Bid Items (Using Trojan UV Equipment):

<u>Item No.</u>	<u>Item Description</u>	<u>Qty</u>	<u>Unit</u>	<u>Total Price</u>
1	General Conditions (Maximum 10% of Total Base Bid)	1	LS	\$
2	Demolition and Construction	1	LS	\$
3	Commissioning/Training	1	LS	\$
4	Project Closeout	1	LS	\$
5	Certified Payroll Compliance and Reporting	1	LS	\$
6	Permit Allowance	1	ALW	\$10,000
7	Miscellaneous Allowance	1	ALW	\$25,000
8	Allowance for early completion incentive of clearwell work	1	ALW	\$20,000 *See Note 1
TOTAL	BASE BID ITEMS 1-8			\$

*Note 1: See Table 1 in Project Coordination 01 31 13, page 5. Only applies if work is successfully completed early.

Total Base Bid: _____ Dollars

(\$ _____)

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

Alternate #1 – Using Calgon Sentinel UV Equipment

The following item is an alternate for the UV disinfection system manufacturer. The Owner may elect to substitute the alternate manufacturer listed below to the Base Bid manufacturer.

In lieu of the Base Bid manufacturer, provide **Calgon Sentinel UV Equipment System** and any necessary changes to the Work or means and methods associated with this submission. The drawings provide an example of a layout using Calgon Sentinel UV equipment. Contractor shall include the cost of all changes needed for a complete and functional system, including electrical, controls, structural, grating, sampling and analyzers, computational fluid dynamic calculations to prove validation conditions, etc. Contractor shall submit revised drawings of all changes to Engineer and Owner for review and approval.

Add/Deduct (circle one) _____ Dollars (\$ _____)

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

Alternate #2 – Schedule of Deducts

The following items are deducted from the Total Base Bid lump sum price. Any or all of the items below may or may not be selected for a deduct based on the Owner's sole discretion.

Item No.	Item Description	Deduct from the Total Base Bid
1.	Delete Surface preparation and painting of the walls and ceiling.	\$
2.	Delete ladders and grating walkway system over Transfer pumps 4-6 suction piping (west wall of UV room).	\$
3.	Delete pipe and valve insulation and PVC jacket.	\$
4.	Delete motorized valve actuators, including power feed and controls on the two valves upstream of the UV reactors. Provide extension and 2-inch operating nut flush with grating walking surface in lieu of electric actuators.	\$
5.	Provide painted steel grating and supports in lieu of aluminum grating and galvanized steel supports.	\$
6.	Delete new lighting system.	\$
7.	Delete the two new chloramine analyzers and connect new sample line to existing sample line to existing analyzers.	\$
8.	Substitute Real Tech UVT analyzers for the specified S:CAN analyzers.	\$
9.	Delete portable sump pump and associated electrical and control equipment.	\$

BID FORM

Section 2 – Material, Equipment and Environmental Alternates

Bidder's Company Name: _____

The Base Bid proposal price shall include materials and equipment selected from the designated items and manufacturers listed in the bidding documents. This is done to establish uniformity in bidding and to establish standards of quality for the items named.

If the Contractor wishes to quote alternate items in addition to the UV Disinfection System for consideration by the City, it may do so under this Section. A complete description of the item and the proposed price differential must be provided. Unless approved at the time of award, substitutions where items are specifically named will be considered only as a negotiated change in Contract Sum.

If an environmental alternative is bid the City strongly encourages bidders to provide recent examples of product testing and previous successful use for the City to properly evaluate the environmental alternative. Testing data from independent accredited organizations are strongly preferred.

Item Number Description Add/Deduct Amount

		\$
		\$
		\$
		\$
		\$

If the Bidder does not suggest any material or equipment alternate, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT propose any material or equipment alternate in addition to the UV Disinfection System under the Contract.

Signature of Authorized Representative of Bidder _____ Date _____

BID FORM

Section 3 - Time Alternate

Bidder's Company Name: _____

If the Bidder takes exception to the time stipulated in Article III of the Contract, Time of Completion, page C-2, it is requested to stipulate below its proposed time for performance of the work. Consideration will be given to time in evaluating bids.

If the Bidder does not suggest any time alternate, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT propose any time alternate under the Contract.

Signature of Authorized Representative of Bidder _____ Date _____

BID FORM

Section 4 - Major Subcontractors and Suppliers

Bidder's Company Name: _____

For purposes of this Contract, a Subcontractor is anyone (other than the Contractor) who performs work (other than or in addition to the furnishing of materials, plans or equipment) at or about the construction site, directly or indirectly for or on behalf of the Contractor (and whether or not in privity of Contract with the Contractor), but shall not include any individual who furnishes merely the individual's own personal labor or services.

Contractor agrees that all subcontracts entered into by the Contractor shall contain similar wage provision to Section 4 of the General Conditions covering subcontractor's employees who perform work on this contract.

For the work outlined in these documents the Bidder expects to engage the following major subcontractors to perform the work identified:

<u>Subcontractor or Supplier (Name and Address)</u>	<u>Work</u>	<u>Amount</u>
	<u>Process Piping</u>	
	<u>Process Valves Manufacturer</u>	
<u>Trojan UV</u>	<u>UV Disinfection System Equipment</u>	
	<u>Electrical</u>	
	<u>Instrumentation and Controls</u>	
	<u>Painting</u>	
	<u>Demolition</u>	

If the Bidder does not expect to engage any major subcontractor, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT expect to engage any major subcontractor to perform work under the Contract.

Signature of Authorized Representative of Bidder _____ Date _____

BID FORM

Section 5 – References

Subcontractor Process Mechanical Name: _____

Include a minimum of 3 references from similar projects completed within the past 10 years at water or wastewater facilities with a treatment capacity of 5 million gallons per day or more.

Refer to Instructions to Bidders for additional requirements.

1) _____
Project Name Cost Date Constructed

Contact Name Phone Number

2) _____
Project Name Cost Date Constructed

Contact Name Phone Number

3) _____
Project Name Cost Date Constructed

Contact Name Phone Number

**CITY OF ANN ARBOR
DOCUMENTS AND FORMS**

CITY OF ANN ARBOR
LIVING WAGE ORDINANCE DECLARATION OF COMPLIANCE

The Ann Arbor Living Wage Ordinance (Section 1:811-1:821 of Chapter 23 of Title I of the Code) requires that an employer who is (a) a contractor providing services to or for the City for a value greater than \$10,000 for any twelve-month contract term, or (b) a recipient of federal, state, or local grant funding administered by the City for a value greater than \$10,000, or (c) a recipient of financial assistance awarded by the City for a value greater than \$10,000, shall pay its employees a prescribed minimum level of compensation (i.e., Living Wage) for the time those employees perform work on the contract or in connection with the grant or financial assistance. The Living Wage must be paid to these employees for the length of the contract/program.

Companies employing fewer than 5 persons and non-profits employing fewer than 10 persons are exempt from compliance with the Living Wage Ordinance. If this exemption applies to your company/non-profit agency please check here No. of employees__

The Contractor or Grantee agrees:

- (a) To pay each of its employees whose wage level is not required to comply with federal, state or local prevailing wage law, for work covered or funded by a contract with or grant from the City, no less than the Living Wage. The current Living Wage is defined as \$13.22/hour for those employers that provide employee health care (as defined in the Ordinance at Section 1:815 Sec. 1 (a)), or no less than \$14.75/hour for those employers that do not provide health care. The Contractor or Grantor understands that the Living Wage is adjusted and established annually on April 30 in accordance with the Ordinance and covered employers shall be required to pay the adjusted amount thereafter to be in compliance with Section 1:815(3).

Check the applicable box below which applies to your workforce

Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage without health benefits

Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage with health benefits

- (a) To post a notice approved by the City regarding the applicability of the Living Wage Ordinance in every work place or other location in which employees or other persons contracting for employment are working.
- (b) To provide to the City payroll records or other documentation within ten (10) business days from the receipt of a request by the City.
- (c) To permit access to work sites to City representatives for the purposes of monitoring compliance, and investigating complaints or non-compliance.
- (d) To take no action that would reduce the compensation, wages, fringe benefits, or leave available to any employee covered by the Living Wage Ordinance or any person contracted for employment and covered by the Living Wage Ordinance in order to pay the living wage required by the Living Wage Ordinance.

The undersigned states that he/she has the requisite authority to act on behalf of his/her employer in these matters and has offered to provide the services or agrees to accept financial assistance in accordance with the terms of the Living Wage Ordinance. The undersigned certifies that he/she has read and is familiar with the terms of the Living Wage Ordinance, obligates the Employer/Grantee to those terms and acknowledges that if his/her employer is found to be in violation of Ordinance it may be subject to civil penalties and termination of the awarded contract or grant of financial assistance.

 Company Name

 Street Address

 Signature of Authorized Representative

 Date

 City, State, Zip

 Print Name and Title

 Phone/Email address

**CITY OF ANN ARBOR
LIVING WAGE ORDINANCE**

RATE EFFECTIVE APRIL 30, 2018 - ENDING APRIL 29, 2019

\$13.22 per hour

If the employer provides health
care benefits*

\$14.75 per hour

If the employer does **NOT**
provide health care benefits*

Employers providing services to or for the City of Ann Arbor or recipients of grants or financial assistance from the City of Ann Arbor for a value of more than \$10,000 in a twelve-month period of time must pay those employees performing work on a City of Ann Arbor contract or grant, the above living wage.

ENFORCEMENT

The City of Ann Arbor may recover back wages either administratively or through court action for the employees that have been underpaid in violation of the law. Persons denied payment of the living wage have the right to bring a civil action for damages in addition to any action taken by the City.

Violation of this Ordinance is punishable by fines of not more than \$500/violation plus costs, with each day being considered a separate violation. Additionally, the City of Ann Arbor has the right to modify, terminate, cancel or suspend a contract in the event of a violation of the Ordinance.

* Health Care benefits include those paid for by the employer or making an employer contribution toward the purchase of health care. The employee contribution must not exceed \$.50 an hour for an average work week; and the employer cost or contribution must equal no less than \$1/hr for the average work week.

The Law Requires Employers to Display This Poster Where Employees Can Readily See It.

**For Additional Information or to File a Complaint Contact:
Colin Spencer at 734/794-6500 or cspencer@a2gov.org**



Vendor Conflict of Interest Disclosure Form
--

All vendors interested in conducting business with the City of Ann Arbor must complete and return the Vendor Conflict of Interest Disclosure Form in order to be eligible to be awarded a contract. Please note that all vendors are subject to comply with the City of Ann Arbor’s conflict of interest policies as stated within the certification section below.

If a vendor has a relationship with a City of Ann Arbor official or employee, an immediate family member of a City of Ann Arbor official or employee, the vendor shall disclose the information required below.

1. No City official or employee or City employee’s immediate family member has an ownership interest in vendor’s company or is deriving personal financial gain from this contract.
2. No retired or separated City official or employee who has been retired or separated from the City for less than one (1) year has an ownership interest in vendor’s Company.
3. No City employee is contemporaneously employed or prospectively to be employed with the vendor.
4. Vendor hereby declares it has not and will not provide gifts or hospitality of any dollar value or any other gratuities to any City employee or elected official to obtain or maintain a contract.
5. Please note any exceptions below:

Conflict of Interest Disclosure*	
Name of City of Ann Arbor employees, elected officials or immediate family members with whom there may be a potential conflict of interest.	<input type="checkbox"/> Relationship to employee <hr style="border: 0; border-top: 1px solid black;"/> <input type="checkbox"/> Interest in vendor’s company <input type="checkbox"/> Other (please describe in box below)

*Disclosing a potential conflict of interest does not disqualify vendors. In the event vendors do not disclose potential conflicts of interest and they are detected by the City, vendor will be exempt from doing business with the City.

I certify that this Conflict of Interest Disclosure has been examined by me and that its contents are true and correct to my knowledge and belief and I have the authority to so certify on behalf of the Vendor by my signature below:		
Vendor Name	Vendor Phone Number	
Signature of Vendor Authorized Representative	Date	Printed Name of Vendor Authorized Representative

Questions about this form? Contact Procurement Office City of Ann Arbor Phone: 734/794-6500, procurement@a2gov.org

CITY OF ANN ARBOR NON-DISCRIMINATION ORDINANCE

Relevant provisions of Chapter 112, Nondiscrimination, of the Ann Arbor City Code are included below.
You can review the entire ordinance at www.a2gov.org/humanrights.

Intent: It is the intent of the city that no individual be denied equal protection of the laws; nor shall any individual be denied the enjoyment of his or her civil or political rights or be discriminated against because of actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight.

Discriminatory Employment Practices: No person shall discriminate in the hire, employment, compensation, work classifications, conditions or terms, promotion or demotion, or termination of employment of any individual. No person shall discriminate in limiting membership, conditions of membership or termination of membership in any labor union or apprenticeship program.

Discriminatory Effects: No person shall adopt, enforce or employ any policy or requirement which has the effect of creating unequal opportunities according to actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight for an individual to obtain housing, employment or public accommodation, except for a bona fide business necessity. Such a necessity does not arise due to a mere inconvenience or because of suspected objection to such a person by neighbors, customers or other persons.

Nondiscrimination by City Contractors: All contractors proposing to do business with the City of Ann Arbor shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the guidelines of this section. All city contractors shall ensure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity and tends to eliminate inequality based upon any classification protected by this chapter. All contractors shall agree not to discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions, or privileges of employment, or a matter directly or indirectly related to employment, because of any applicable protected classification. All contractors shall be required to post a copy of Ann Arbor's Non-Discrimination Ordinance at all work locations where its employees provide services under a contract with the city.

Complaint Procedure: If any individual believes there has been a violation of this chapter, he/she may file a complaint with the City's Human Rights Commission. The complaint must be filed within 180 calendar days from the date of the individual's knowledge of the allegedly discriminatory action or 180 calendar days from the date when the individual should have known of the allegedly discriminatory action. A complaint that is not filed within this timeframe cannot be considered by the Human Rights Commission. To file a complaint, first complete the complaint form, which is available at www.a2gov.org/humanrights. Then submit it to the Human Rights Commission by e-mail (hrc@a2gov.org), by mail (Ann Arbor Human Rights Commission, PO Box 8647, Ann Arbor, MI 48107), or in person (City Clerk's Office). For further information, please call the commission at 734-794-6141 or e-mail the commission at hrc@a2gov.org.

Private Actions For Damages or Injunctive Relief: To the extent allowed by law, an individual who is the victim of discriminatory action in violation of this chapter may bring a civil action for appropriate injunctive relief or damages or both against the person(s) who acted in violation of this chapter.

THIS IS AN OFFICIAL GOVERNMENT NOTICE AND
MUST BE DISPLAYED WHERE EMPLOYEES CAN READILY SEE IT.

MICHIGAN DEPARTMENT OF TRANSPORTATION CERTIFIED PAYROLL

COMPLETION OF CERTIFIED PAYROLL FORM FULFILLS THE MINIMUM MDOT PREVAILING WAGE REQUIREMENTS

(1) NAME OF CONTRACTOR / SUBCONTRACTOR (CIRCLE ONE) (2) ADDRESS

(3) PAYROLL NO. (4) FOR WEEK ENDING (5) PROJECT AND LOCATION (6) CONTRACT ID

(a) EMPLOYEE INFORMATION	(b) WORK CLASSIFICATION	(c) Hour Type	(d) DAY AND DATE							(e) TOTAL HOURS ON PROJECT	(f) PROJECT RATE OF PAY	(g) PROJECT RATE OF FRINGE PAY	(h) GROSS PROJECT EARNED		(i) TOTAL WEEKLY HOURS WORKED ALL JOBS	(j) DEDUCTIONS						(k) TOTAL WEEKLY WAGES PAID FOR ALL JOBS		
														GROSS PROJECT EARNED		GROSS WEEKLY EARNED	FICA	FEDERAL	STATE		OTHER		TOTAL DEDUCT	
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00

Date _____

I, _____ (Name of Signatory Party) _____ (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the _____ (Contractor or Subcontractor)
 _____; that during the payroll period commencing on the _____ (Building or Work)
 _____ day of _____, _____, and ending the _____ day of _____, _____,
 all persons employed on said project have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said

_____ from the full _____ (Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part 3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948, 63 Stat. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. § 3145), and described below:

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

- in addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above referenced payroll, payments of fringe benefits as listed in the contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

- Each laborer or mechanic listed in the above referenced payroll has been paid, as indicated on the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the amount of the required fringe benefits as listed in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION
REMARKS:	
NAME AND TITLE	SIGNATURE
THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE 31 OF THE UNITED STATES CODE.	

**REQUIRED STANDARD
CONTRACT LANGUAGE:
CLEAN WATER STATE REVOLVING FUND AND
DRINKING WATER REVOLVING FUND**

REQUIRED STANDARD CONTRACT LANGUAGE: CLEAN WATER STATE REVOLVING FUND AND DRINKING WATER REVOLVING FUND

- **Davis-Bacon/Prevailing Federal Wages, Including Labor Standards Provisions**
- **Disadvantaged Business Enterprise (DBE) Requirements***
- **Debarment/Suspension Certification***

*** Bidders should note these sections contain instructions regarding forms/information that must be completed/included with any submitted bid.**

Davis-Bacon/Prevailing Federal Wage Rates

P.L. 111-88 requires compliance with the Davis Bacon Act and adherence to the current U.S. Department of Labor Wage Decision. Attention is called to the fact that not less than the minimum salaries and wages as set forth in the Contract Documents (see Wage Decision included herein) must be paid on this project. The Wage Decision, including modifications, must be posted by the Contractor on the job site. A copy of the Federal Labor Standards Provisions is included and is hereby a part of this contract.

MICHIGAN WAGE RATES – DAVIS BACON

General Decision Number: MI190100 01/04/2019 MI100

Superseded General Decision Number: MI20180100

State: Michigan

Construction Type: Building

County: Washtenaw County in Michigan.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2019. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/04/2019

ASBE0025-003 06/01/2018

Townships of Ann Arbor, Augusta, Lodi, Northfield, Pittsfield, Salem, Saline, Scio, Superior, Webster, Ypsilanti & York

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR.....	\$ 31.58	32.32

ASBE0047-001 07/01/2018

Townships of Bridgewater, Dexter, Freedom, Lims, Lyndon, Manchester, Sharon & Sylvan

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR.....	\$ 30.82	17.88

 BOIL0169-001 03/01/2018

	Rates	Fringes
BOILERMAKER.....	\$ 38.65	26.22

 BRMI0009-010 08/01/2018

	Rates	Fringes
BRICKLAYER.....	\$ 35.65	21.72
TILE FINISHER.....	\$ 27.94	19.12
TILE SETTER.....	\$ 34.66	19.12

 CARP0687-001 06/01/2018

	Rates	Fringes
CARPENTER, Includes Drywall Hanging, Form Work, and Metal Stud Installation.....	\$ 32.00	27.82

 CARP1045-001 06/01/2018

	Rates	Fringes
CARPENTER (Floor Layer - Carpet, Resilient, & Vinyl Flooring).....	\$ 28.60	23.88

 CARP1102-002 06/01/2018

	Rates	Fringes
MILLWRIGHT.....	\$ 33.65	32.25

 ELECO252-010 05/28/2018

	Rates	Fringes
ELECTRICIAN.....	\$ 44.12	23.54

 ENGI0324-017 08/01/2018

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1.....	\$ 40.99	23.95
GROUP 2.....	\$ 39.49	23.95
GROUP 3.....	\$ 37.99	23.95
GROUP 4.....	\$ 37.69	23.95
GROUP 5.....	\$ 36.87	23.95
GROUP 6.....	\$ 36.01	23.95

GROUP 7.....	\$ 35.04	23.95
GROUP 8.....	\$ 33.33	23.95
GROUP 9.....	\$ 24.99	23.95

FOOTNOTES:

Tower cranes: to be paid the crane operator rate determined by the combined length of the mast and the boom. If the worker must climb 50 ft. or more to the work station, \$.25 per hour additional.

Derrick and cranes where the operator must climb 50 ft. or more to the work station, \$.25 per hour additional to the applicable crane operator rate.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane with boom and jib or leads 400' or longer

GROUP 2: Crane with boom and jib or leads 300' or longer

GROUP 3: Crane with boom and jib or leads 220' or longer

GROUP 4: Crane with boom and jib or leads 140' or longer

GROUP 5: Crane with boom and jib or leads 120' or longer

GROUP 6: Regular crane operator, and concrete pump with boom operator

GROUP 7: Backhoe/Excavator/Trackhoe, bobcat/skid Loader, broom/sweeper, bulldozer, grader/blade, highlift, hoist, loader, roller, scraper, tractor & trencher

GROUP 8: Forklift & extend-a-boom forklift

GROUP 9: Oiler

IRON0025-019 06/01/2018

	Rates	Fringes
IRONWORKER		
REINFORCING.....	\$ 28.48	27.74
STRUCTURAL.....	\$ 35.52	28.65

LABO0334-005 06/01/2018

	Rates	Fringes
LABORER: Landscape & Irrigation		
GROUP 1.....	\$ 20.52	6.90
GROUP 2.....	\$ 18.52	6.90

CLASSIFICATIONS

GROUP 1: Landscape specialist, including air, gas and diesel equipment operator, lawn sprinkler installer, skidsteer (or equivalent)

GROUP 2: Landscape laborer: small power tool operator,
material mover, truck driver and lawn sprinkler installer
tender

LABO0499-005 08/01/2017

	Rates	Fringes
LABORER		
Common or General; Grade Checker; Sandblaster.....	\$ 28.70	14.20
Mason Tender - Brick; Mason Tender - Cement/Concrete.....	\$ 28.91	14.20
Pipelayer.....	\$ 29.03	14.20

PAIN0022-003 06/01/2015

	Rates	Fringes
PAINTER: Brush and Roller.....	\$ 26.06	17.66
PAINTER: Drywall Finishing/Taping.....	\$ 27.05	18.26
PAINTER: Spray.....	\$ 26.86	17.66

PAIN0357-002 06/01/2017

	Rates	Fringes
GLAZIER.....	\$ 31.72	18.71

PAID HOLIDAYS: New Year's Day, Decoration Day, Fourth of
July, Labor Day, Thanksgiving Day and Christmas Day;
provided that the employee has worked the last full regular
scheduled work day prior to the holiday, and the first full
regular scheduled work day following the holiday, provided
the employee is physically able to work.

PLAS0514-006 06/01/2018

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 31.47	13.81

PLUM0190-004 06/01/2018

	Rates	Fringes
PIPEFITTER (Including HVAC Pipe Installation; Excluding HVAC System Installation).....	\$ 41.16	22.09
PLUMBER, Excludes HVAC Pipe and Unit Installation.....	\$ 41.16	22.09

ROOF0070-001 06/01/2018

Rates	Fringes
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ROOFER.....\$ 32.72 17.03

 SFMI0704-001 06/01/2018

Rates Fringes

SPRINKLER FITTER (Fire Sprinklers).....\$ 44.20 26.72

 SHEE0080-001 07/01/2018

Rates Fringes

SHEET METAL WORKER, Includes HVAC Duct and Unit Installation.....\$ 41.05 26.66

 * TEAM0247-001 06/01/2018

Rates Fringes

TRUCK DRIVER
 GROUP 1
 Flatbed; Pickup; Dump & Tandem.....\$ 26.71 0.70+a
 GROUP 2
 Semi.....\$ 26.86 0.70+a
 GROUP 3
 Lowboy.....\$ 26.96 0.70+a

PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. If any of the above holidays fall on a Sunday, the following Monday shall be considered the holiday and, if work is performed, the rate shall be double time.

FOOTNOTE:
 a. \$456.70 per week, plus \$67.10 per day.

 SUMI2011-025 02/01/2011

Rates Fringes

IRONWORKER, ORNAMENTAL.....\$ 18.48 7.93

TRUCK DRIVER: Tractor Haul Truck.....\$ 13.57 1.18

 WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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 Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this

contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and

non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.

Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

General Decision Number: MI190157 01/25/2019 MI157

Superseded General Decision Number: MI20180157

State: Michigan

Construction Type: Heavy

PIPELINE

Counties: Michigan Statewide.

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2019. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/04/2019
1	01/25/2019

* ENGI0325-012 05/01/2018

	Rates	Fringes
Power equipment operators - gas distribution and duct installation work:		
GROUP 1.....	\$ 30.68	23.85
GROUP 2.....	\$ 30.56	23.85
GROUP 3.....	\$ 28.85	23.85

SCOPE OF WORK: The construction, installation, treating and reconditioning of pipelines transporting gas vapors within cities, towns, subdivisions, suburban areas, or within private property boundaries, up to and including private meter settings of private industrial, governmental or other premises, more commonly referred to as "distribution work," starting from the first metering station, connection,

similar or related facility, of the main or cross country pipeline and including duct installation.

Group 1: Backhoe, crane, grader, mechanic, dozer (D-6 equivalent or larger), side boom (D-4 equivalent or larger), trencher(except service), endloader (2 yd. capacity or greater).

GROUP 2: Dozer (less than D-6 equivalent), endloader (under 2 yd. capacity), side boom (under D-4 capacity), backfiller, pumps (1 or 2 of 6-inch discharge or greater), boom truck (with powered boom), tractor (wheel type other than backhoe or front endloader). Tamper (self-propelled), boom truck (with non-powered boom), concrete saw (20 hp or larger), pumps (2 to 4 under 6-inch discharge), compressor (2 or more or when one is used continuously into the second day) and trencher(service).

GROUP 3: Oiler, hydraulic pipe pushing machine, grease person and hydrostatic testing operator.

LABO1076-005 04/01/2018

MICHIGAN STATEWIDE

	Rates	Fringes
LABORER (DISTRIBUTION WORK)		
Zone 1.....	\$ 20.27	12.85
Zone 2.....	\$ 18.59	12.85
Zone 3.....	\$ 16.76	12.85
Zone 4.....	\$ 16.12	12.85
Zone 5.....	\$ 16.12	12.85

DISTRIBUTION WORK - The construction, installation, treating and reconditioning of distribution pipelines transporting coal, oil, gas or other similar materials, vapors or liquids, including pipelines within private property boundaries, up to and including the meter settings on residential, commercial, industrial, institutional, private and public structures. All work covering pumping stations and tank farms not covered by the Building Trades Agreement. Other distribution lines with the exception of sewer, water and cable television are included.

Underground Duct Layer Pay: \$.40 per hour above the base pay rate.

- Zone 1 - Macomb, Oakland and Wayne
- Zone 2 - Monroe and Washtenaw
- Zone 3 - Bay, Genesee, Lapeer, Midland, Saginaw, Sanilac, Shiawassee and St. Clair
- Zone 4 - Alger, Baraga, Chippewa, Delta, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon and Schoolcraft
- Zone 5 - Remaining Counties in Michigan

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

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A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

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Wage and Hour Division
U.S. Department of Labor
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2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

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U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

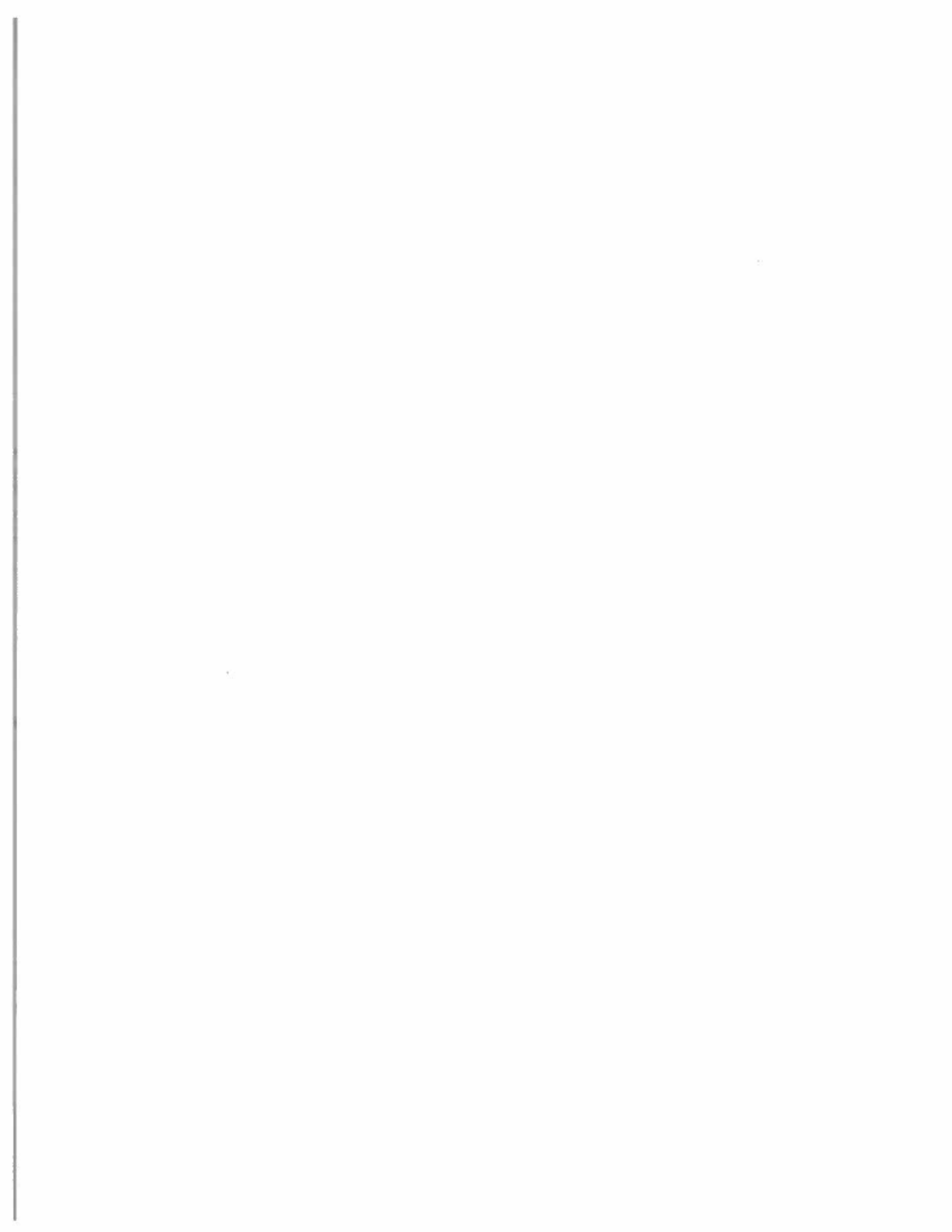
The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

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U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION



General Decision Number: MI190158 01/04/2019 MI158

Superseded General Decision Number: MI20180158

State: Michigan

Construction Type: Heavy
HAZARDOUS WASTE REMOVAL

Counties: Michigan Statewide.

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2019. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/04/2019

ENGI0325-011 10/01/2011

AREA 1: GENESEE, LAPEER, LIVINGSTON, MACOMB, MONROE, OAKLAND, ST. CLAIR, WASHTENAW AND WAYNE COUNTIES

AREA 2: ALCONA, ALGER, ALLEGAN, ALPENA, ANTRIM, ARENAC, BARAGA, BARRY, BAY, BENZIE, BERRIEN, BRANCH, CALHOUN, CASS, CHARLEVOIX, CHEBOYGAN, CHIPPEWA, CLARE, CLINTON, CRAWFORD, DELTA, DICKINSON, EATON, EMMET, GLADWIN, GOGEBIC, GRAND TRAVERSE, GRATIOT, HILLSDALE, HOUGHTON, HURON, INGHAM, IONIA, IOSCO, IRON, ISABELLA, JACKSON, KALAMAZOO, KALKASKA, KENT, KEWEENAW, LAKE, LEELANAU, LENAWEE, LUCE, MACKINAC, MANISTEE, MARQUETTE, MASON, MECOSTA, MENOMINEE, MIDLAND, MISSAUKEE, MONTCALM, MONTMORENCY, MUSKEGON, NEWAYGO, OCEANA, OGEMAW, ONTONAGON, OSCEOLA, OSCODA, OTSEGO, OTTAWA, PRESQUE ISLE, ROSCOMMON, SAGINAW, ST. JOSEPH, SANILAC, SCHOOLCRAFT, SHIAWASSEE, TUSCOLA, VAN BUREN AND WEXFORD COUNTIES

	Rates	Fringes
Power equipment operators - hazardous waste removal: (AREA 1)		
AREA 1: LEVEL A		
Engineer when operating crane with boom and jib or leads 140' or longer....\$	34.68	19.70
Engineer when operating crane with boom and jib or leads 220' or longer....\$	34.98	19.70
GROUP 1.....\$	32.03	19.70
GROUP 2.....\$	27.80	19.70
Regular crane operator, mechanic, dragline operator, boom truck operator and concrete pump with boom operator, power shovel operator.....\$	33.00	19.70
AREA 1: LEVEL B AND C		
Engineer when operating crane with boom and jib or leads 140' or longer....\$	33.73	19.70
Engineer when operating crane with boom and jib or leads 220' or longer....\$	34.03	19.70
GROUP 1.....\$	31.08	19.70
GROUP 2.....\$	26.85	19.70
Regular crane operator, mechanic, dragline operator, boom truck operator and concrete pump with boom operator, power shovel operator.....\$	32.05	19.70
AREA 1: LEVEL D WHEN CAPPING LANDFILL		
Engineer when operating crane with boom and jib or leads 140' or longer....\$	32.18	19.70
Engineer when operating crane with boom and jib or leads 220' or longer....\$	32.48	19.70
GROUP 1.....\$	29.53	19.70
GROUP 2.....\$	25.30	19.70
Regular crane operator, mechanic, dragline operator, boom truck operator and concrete pump with boom operator, power shovel operator.....\$	29.88	19.70
AREA 1: LEVEL D		
Engineer when operating crane with boom and jib or leads 140' or longer....\$	32.43	19.70
Engineer when operating crane with boom and jib or leads 220' or longer....\$	32.73	19.70

GROUP 1.....\$ 29.78	19.70
GROUP 2.....\$ 25.55	19.70
Regular crane operator, mechanic, dragline operator, boom truck operator and concrete pump with boom operator, power shovel operator.....\$ 30.75	19.70
Power equipment operators - hazardous waste removal: (AREA 2)	
AREA 2: LEVEL A	
Engineer when operating crane with boom and jib or leads 140' or longer....\$ 32.97	19.70
Engineer when operating crane with boom and jib or leads 220' or longer....\$ 33.27	19.70
GROUP 1.....\$ 30.32	19.70
GROUP 2.....\$ 25.92	19.70
Regular crane operator, mechanic, dragline operator, boom truck operator and concrete pump with boom operator, power shovel operator.....\$ 31.29	19.70
AREA 2: LEVEL B AND C	
Engineer when operating crane with boom and jib or leads 140' or longer....\$ 31.91	19.70
Engineer when operating crane with boom and jib or leads 220' or longer....\$ 32.23	19.70
GROUP 1.....\$ 29.37	19.70
GROUP 2.....\$ 24.98	19.70
Regular crane operator, mechanic, dragline operator, boom truck operator and concrete pump with boom operator, power shovel operator.....\$ 30.34	19.70
AREA 2: LEVEL D WHEN CAPPING LANDFILL	
Engineer when operating crane with boom and jib or leads 140' or longer....\$ 30.47	19.70
Engineer when operating crane with boom and jib or leads 220' or longer....\$ 30.77	19.70
GROUP 1.....\$ 27.82	19.70
GROUP 2.....\$ 23.43	19.70
Regular crane operator, mechanic, dragline operator, boom truck operator and concrete pump with boom operator, power shovel operator.....\$ 28.79	19.70
AREA 2: LEVEL D	
Engineer when operating crane with boom and jib	

or leads 140' or longer....\$ 30.72	19.70
Engineer when operating crane with boom and jib or leads 220' or longer....\$ 31.02	19.70
GROUP 1.....\$ 28.07	19.70
GROUP 2.....\$ 23.68	19.70
Regular crane operator, mechanic, dragline operator, boom truck operator and concrete pump with boom operator, power shovel operator.....\$ 29.04	19.70

HAZARDOUS WASTE REMOVAL CLASSIFICATIONS

Group 1: Backhoe, batch plant operator, clamshell, concrete breaker when attached to hoe, concrete cleaning decontamination machine operator, concrete pump, concrete paver, crusher, dozer, elevating grader, endloader, farm tractor (90 h.p. and higher), gradall, grader, heavy equipment robotics operator, loader, pug mill, pumpcrete machines, pump trucks, roller, scraper (self-propelled or tractor drawn), side boom tractor, slip form paver, slope paver, trencher, ultra high pressure waterjet cutting tool system, vactors, vacuum blasting machine operator, vertical lifting hoist, vibrating compaction equipment (self-propelled), well drilling rig and hydro excavator

GROUP 2: Air compressor, concrete breaker when not attached to hoe, elevator, end dumps, equipment decontamination operator, farm tractor (less than 90 h.p.), forklift, generator, heater, mulcher, pigs (portable reagent storage tanks), power screens, pumps (water), stationary compressed air plant, sweeper, welding machine and water wagon

* LABO0005-006 10/01/2017

	Rates	Fringes
Laborers - hazardous waste abatement: (ALCONA, ALPENA, ANTRIM, BENZIE, CHARLEVOIX, CHEBOYGAN, CRAWFORD, EMMET, GRAND TRAVERSE, IOSCO, KALKASKA, LEELANAU, MISSAUKEE, MONTMORENCY, OSCODA, OTSEGO, PRESQUE ISLE AND WEXFORD COUNTIES - Zone 10)		
Levels A, B or C.....\$ 17.45	12.75	
class b.....\$ 18.00	12.85	
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;		
Also, Level D.....\$ 16.45	12.75	
class a.....\$ 17.00	12.85	
Zone 10		
Laborers - hazardous waste		

abatement: (ALGER, BARAGA,
CHIPPEWA, DELTA, DICKINSON,
GOGEBIC, HOUGHTON, IRON,
KEWEENAW, LUCE, MACKINAC,
MARQUETTE, MENOMINEE,
ONTONAGON AND SCHOOLCRAFT
COUNTIES - Zone 11)

Levels A, B or C.....\$ 21.63	12.88
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
Also, Level D.....\$ 20.63	12.88

Laborers - hazardous waste
abatement: (ALLEGAN, BARRY,
BERRIEN, BRANCH, CALHOUN,
CASS, IONIA COUNTY (except
the city of Portland);
KALAMAZOO, KENT, LAKE,
MANISTEE, MASON, MECOSTA,
MONTCALM, MUSKEGON, NEWAYGO,
OCEANA, OSCEOLA, OTTAWA, ST.
JOSEPH AND VAN BUREN COUNTIES
- Zone 9)

Levels A, B or C.....\$ 20.95	12.85
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
Also, Level D.....\$ 19.95	12.85

Laborers - hazardous waste
abatement: (ARENAC, BAY,
CLARE, GLADWIN, GRATIOT,
HURON, ISABELLA, MIDLAND,
OGEMAW, ROSCOMMON, SAGINAW
AND TUSCOLA COUNTIES - Zone 8)

Levels A, B or C.....\$ 20.65	12.85
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
Also, Level D.....\$ 19.65	12.85

Laborers - hazardous waste
abatement: (CLINTON, EATON
AND INGHAM COUNTIES; IONIA
COUNTY (City of Portland);
LIVINGSTON COUNTY (west of
Oak Grove Rd., including the
City of Howell) - Zone 6)

Levels A, B or C.....\$ 24.65	12.85
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
Also, Level D.....\$ 23.65	12.85

Laborers - hazardous waste

abatement: (GENESEE, LAPEER AND SHIAWASSEE COUNTIES - Zone 7)	
Levels A, B or C.....\$ 23.61	13.41
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
Also, Level D.....\$ 22.61	13.41
Laborers - hazardous waste abatement: (HILLSDALE, JACKSON AND LENAWEЕ COUNTIES - Zone 4)	
Levels A, B or C.....\$ 24.19	12.85
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
Also, Level D.....\$ 23.19	12.85
Laborers - hazardous waste abatement: (LIVINGSTON COUNTY (east of Oak Grove Rd. and south of M-59, excluding the city of Howell); AND WASHTENAW COUNTY - Zone 3)	
Levels A, B or C.....\$ 29.70	14.20
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
Also, Level D.....\$ 28.70	14.20
Laborers - hazardous waste abatement: (MACOMB AND WAYNE COUNTIES - Zone 1)	
Levels A, B or C.....\$ 28.35	16.75
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
Also, Level D.....\$ 27.35	16.75
Laborers - hazardous waste abatement: (MONROE COUNTY - Zone 4)	
Levels A, B or C.....\$ 30.85	14.45
Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
Also, Level D.....\$ 29.84	14.45
Laborers - hazardous waste abatement: (OAKLAND COUNTY and the Northeast portion of LIVINGSTON COUNTY bordered by Oak Grove Road on the West and M-59 on the South - Zone	

2)	Level A, B, C.....\$ 28.85	16.75
	Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
	Also, Level D.....\$ 27.85	16.75
Laborers - hazardous waste abatement: (SANILAC AND ST. CLAIR COUNTIES - Zone 5)		
	Levels A, B or C.....\$ 25.19	15.86
	Work performed in conjunction with site preparation not requiring the use of personal protective equipment;	
	Also, Level D.....\$ 24.19	15.86

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

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Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

General Decision Number: MI190074 01/04/2019 MI74

Superseded General Decision Number: MI20180074

State: Michigan

Construction Type: Heavy

County: Washtenaw County in Michigan.

Heavy, Includes Water, Sewer Lines and Excavation (Excludes Hazardous Waste Removal; Coal, Oil, Gas, Duct and other similar Pipeline Construction)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2019. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/04/2019

CARP0687-006 06/01/2018

	Rates	Fringes
CARPENTER, Includes Form Work....	\$ 32.00	27.82

ELEC0252-009 05/28/2018

	Rates	Fringes
ELECTRICIAN.....	\$ 44.12	23.54

* ENGI0325-019 09/01/2018

POWER EQUIPMENT OPERATORS: Underground Construction (Including Sewer)

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1.....	\$ 32.53	23.85
GROUP 2.....	\$ 27.80	23.85
GROUP 3.....	\$ 27.07	23.85
GROUP 4.....	\$ 26.50	23.85

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Backhoe/ Excavator, Boring Machine, Bulldozer, Crane, Grader/ Blade, Loader, Roller, Scraper, Trencher (over 8 ft. digging capacity)

GROUP 2: Trencher (8-ft digging capacity and smaller)

GROUP 3: Boom Truck (non-swinging, non- powered type boom)

GROUP 4: Broom/ Sweeper, Fork Truck, Tractor, Bobcat/ Skid Steer /Skid Loader

ENGI0326-008 06/01/2018

EXCLUDES UNDERGROUND CONSTRUCTION

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1.....	\$ 40.99	23.95
GROUP 2.....	\$ 39.49	23.95
GROUP 3.....	\$ 37.99	23.95
GROUP 4.....	\$ 37.69	23.95
GROUP 5.....	\$ 36.87	23.95
GROUP 6.....	\$ 36.01	23.95
GROUP 7.....	\$ 35.04	23.95
GROUP 8.....	\$ 33.33	23.95
GROUP 9.....	\$ 24.99	23.95

FOOTNOTES: Tower cranes: to be paid the crane operator rate determined by the combined length of the mast and the boom.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane with boom & jib or leads 400' or longer

GROUP 2: Crane with boom & jib or leads 300' or longer

GROUP 3: Crane with boom & jib or leads 220' or longer

GROUP 4: Crane with boom & jib or leads 140' or longer

GROUP 5: Crane with boom & jib or leads 120' or longer

GROUP 6: Regular crane operator

GROUP 7: Backhoe/Excavator, Bobcat/Skid Loader, Boring Machine, Broom/Sweeper, Bulldozer, Grader/Blade, Loader, Roller, Scraper, Tractor, Trencher

GROUP 8: Forklift

GROUP 9: Oiler

IRON0025-006 06/17/2018

	Rates	Fringes
IRONWORKER		
Reinforcing.....	\$ 29.48	27.74
Structural.....	\$ 35.52	28.65

LABO0334-009 06/01/2018

EXCLUDES OPEN CUT CONSTRUCTION

	Rates	Fringes
Landscape Laborer		
GROUP 1.....	\$ 20.52	6.90
GROUP 2.....	\$ 18.52	6.90

LANDSCAPE LABORER CLASSIFICATIONS

GROUP 1: Landscape specialist, including air, gas and diesel equipment operator, lawn sprinkler installer and skidsteer (or equivalent)

GROUP 2: Landscape laborer: small power tool operator, material mover, truck driver and lawn sprinkler installer tender

LABO0334-018 09/01/2018

SCOPE OF WORK:

OPEN CUT CONSTRUCTION: Excavation of earth and sewer, utilities, and improvements, including underground piping/conduit (including inspection, cleaning, restoration, and relining)

	Rates	Fringes
LABORER		
(1) Common or General.....	\$ 23.75	12.85
(2) Mason Tender- Cement/Concrete.....	\$ 23.86	12.85
(4) Grade Checker.....	\$ 24.05	12.85
(5) Pipelayer.....	\$ 22.90	12.75
(524.20) Pipelayer.....	\$ 22.90	12.85
(7) Landscape.....	\$ 18.14	12.85

LABO0499-020 08/01/2017

EXCLUDES OPEN CUT CONSTRUCTION

	Rates	Fringes
LABORER		
GROUP 1.....	\$ 28.70	14.20
GROUP 2.....	\$ 28.91	14.20
GROUP 3.....	\$ 29.03	14.20

LABORER CLASSIFICATIONS

GROUP 1: Common or General; Grade Checker

GROUP 2: Mason Tender - Cement/Concrete

GROUP 3: Pipelayer

PAIN0022-005 07/01/2008

	Rates	Fringes
PAINTER		
Brush & Roller.....	\$ 25.06	14.75
Spray.....	\$ 25.86	14.75

PLAS0514-002 06/01/2018

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 31.47	13.81

PLUM0190-010 06/01/2017

	Rates	Fringes
PLUMBER.....	\$ 40.13	21.62

TEAM0007-006 06/01/2018

	Rates	Fringes
TRUCK DRIVER		
Dump Truck under 8 cu. yds.; Tractor Haul Truck....	\$ 26.40	.50 + a+b
Dump Truck, 8 cu. yds. and over.....	\$ 26.50	.50 + a+b
Lowboy/Semi-Trailer Truck...	\$ 26.65	.50 + a+b

FOOTNOTE:

- a. \$446.70 per week.
- b. \$67.00 daily.

SUMI2010-072 11/09/2010

	Rates	Fringes
TRUCK DRIVER: Off the Road Truck.....	\$ 20.82	3.69

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing

this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

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A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

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- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.)

and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

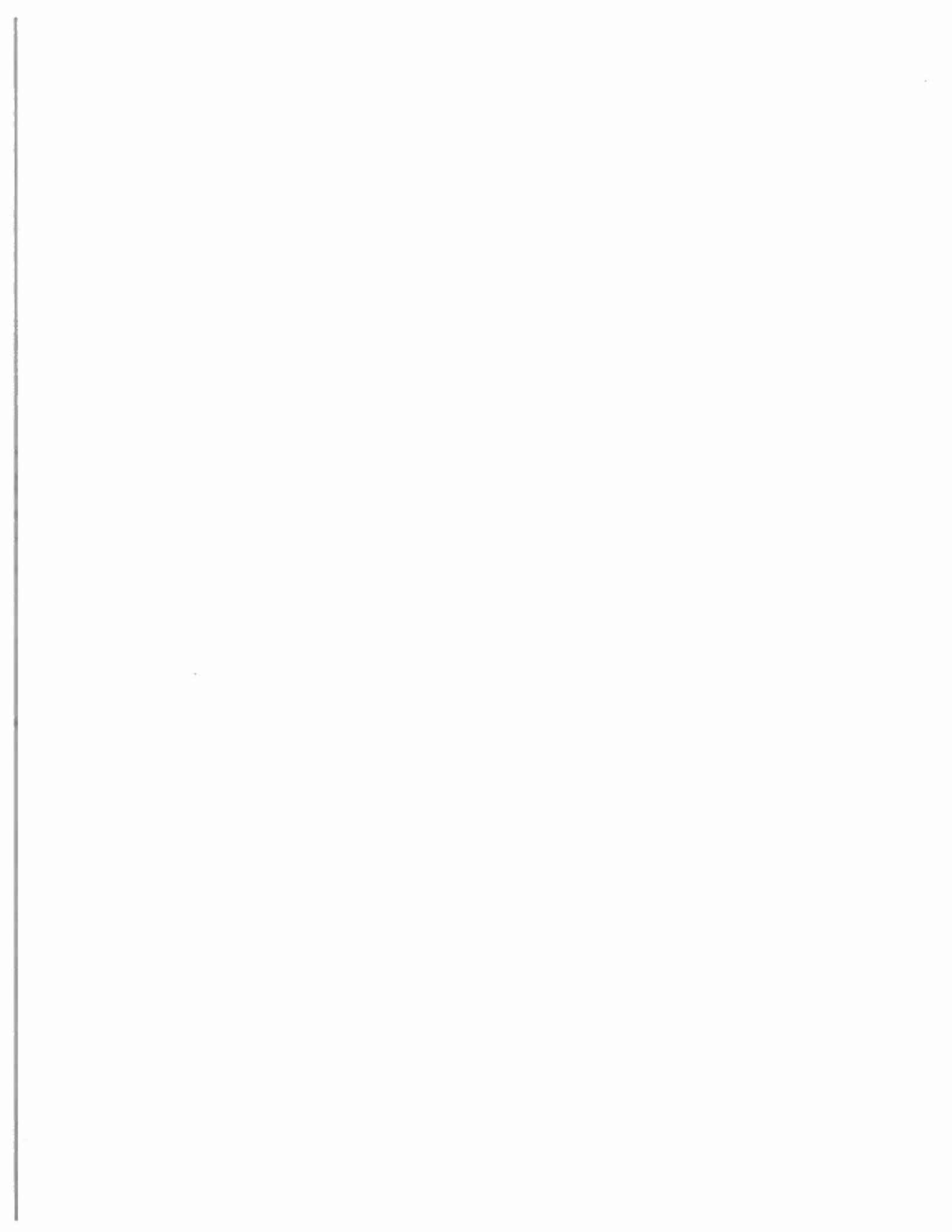
The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION



29 CFR Part 5 – Labor Standards Provisions for Federally Assisted Projects

§ 5.5 Contract provisions and related matters.

(a) The Agency head shall cause or require the contracting officer to insert in full in any contract in excess of \$2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a public building or public work, or building or work financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in Sec. 5.1, the following clauses (or any modifications thereof to meet the particular needs of the agency, *Provided*, That such modifications are first approved by the Department of Labor):

(1) *Minimum wages.* (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in Sec. 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) *Withholding.* The (write in name of Federal Agency or the loan or grant recipient) 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 the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of

1949 in the construction or development of the project), all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) *Payrolls and basic records.* (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency). The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/whd/forms/wh347.pdf> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency), the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under Sec. 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under Sec. 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the (write the name of the agency) or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) *Apprentices and trainees--(i) Apprentices.* Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its

program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) *Trainees.* Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) *Equal employment opportunity.* The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) *Compliance with Copeland Act requirements.* The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) *Subcontracts.* The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the (write in the name of the Federal agency) may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) *Contract termination: debarment.* A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) *Compliance with Davis-Bacon and Related Act requirements.* All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) *Disputes concerning labor standards.* Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(10) *Certification of eligibility.* (i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(b) *Contract Work Hours and Safety Standards Act.* The Agency Head shall cause or require the contracting officer to insert the following clauses set forth in paragraphs (b)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Sec. 5.5(a) or 4.6 of part 4 of this title. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(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 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 workweek.

(2) *Violation; liability for unpaid wages; liquidated damages.* In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible there for 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 (b)(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 (b)(1) of this section.

(3) *Withholding for unpaid wages and liquidated damages.* The (write in the name of the Federal agency or the loan or grant recipient) 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 (b)(2) of this section.

(4) *Subcontracts.* The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(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 (b)(1) through (4) of this section.

(c) In addition to the clauses contained in paragraph (b), in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in Sec. 5.1, the Agency Head shall cause or require the contracting officer to insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Agency Head shall cause or require the contracting officer to insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

Disadvantaged Business Enterprises (DBE)

Prime contractors bidding on this project must follow, document, and maintain documentation of their Good Faith Efforts, as listed below, to ensure that Disadvantaged Business Enterprises (DBEs) have the opportunity to participate in the project by increasing DBE awareness of procurement efforts and outreach. Bidders must make the following Good Faith Efforts for any work that will be subcontracted.

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. Place DBEs on solicitation lists and solicit DBEs whenever they are potential sources.
2. Make information on forthcoming opportunities available to DBEs. Arrange time-frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. Whenever possible, post solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date. The DBEs should be given a minimum of 5 days to respond to the posting.
3. Consider in the contracting process whether firms competing for large contracts can be subcontracted with DBEs. Divide total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.
4. Encourage contracting with a consortium of DBEs when a contract is too large for one DBE firm to handle individually.
5. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the U.S. Department of Commerce.

Subsequent to compliance with the Good Faith Efforts, the following conditions also apply under the DBE requirements. Completed Good Faith Efforts Worksheets (Attachment 1), along with the required supporting documentation outlined in the instructions, must be submitted with your bid proposal. EPA form 6100-2 must also be provided at the pre-bid meeting. A copy of this form is available on the Forms and Guidance page of the Revolving Loan website.

1. The prime contractor must pay its subcontractor for work that has been satisfactorily completed no more than 30 days from the prime contractor's receipt of payment from the owner.
2. The prime contractor must notify the owner in writing prior to the termination of any DBE subcontractor for convenience by the prime contractor and employ the Good Faith Efforts if soliciting a replacement contractor.
3. If a DBE contractor fails to complete work under the subcontract for any reason, the prime contractor must employ the Good Faith Efforts if soliciting a replacement contractor.
4. The prime contractor must employ the Good Faith Efforts.

Debarment Certification

The prime contractor must provide a completed **Certification Regarding Debarment, Suspension, and Other Responsibility Matters Form** with its bid or proposal package to the owner (Attachment 2).

Attachment 1

**Disadvantaged Business Enterprise (DBE) Utilization
GOOD FAITH EFFORTS WORKSHEET**

**Michigan Department of Environmental Quality
Office of Drinking Water and Municipal Assistance– Revolving Loan Section
Disadvantaged Business Enterprise (DBE) Utilization
State Revolving Fund/Drinking Water Revolving Fund
GOOD FAITH EFFORTS WORKSHEET**

Bidder: _____

Subcontract Area of Work (one per worksheet): _____

Outreach Goal: Solicit a minimum of three (3) DBEs via email/letter/fax. It is recommended that various sources be used to locate the minimum number of DBEs. The Michigan Department of Transportation (MDOT) website and www.sam.gov registries may be two resources used to find a minimum of three DBEs.

List the DBEs contacted for the above area of work and complete the following information for each DBE.

Company Name	Type of Contact	Date of Contact	Price Quote Received	Accepted/ Rejected	Please Explain if Rejected
				<input type="checkbox"/> A <input type="checkbox"/> R	
				<input type="checkbox"/> A <input type="checkbox"/> R	
				<input type="checkbox"/> A <input type="checkbox"/> R	
				<input type="checkbox"/> A <input type="checkbox"/> R	
				<input type="checkbox"/> A <input type="checkbox"/> R	
				<input type="checkbox"/> A <input type="checkbox"/> R	

Explanation for Not Achieving a Minimum of Three Contacts; you may include a printout of the MDOT and www.sam.gov search results (attach extra sheets if necessary):

MITA DBE Posting Date (if applicable): _____
(attach a copy of the DBE advertisement)

Other Efforts (attach extra sheets if necessary):

Please include the completed worksheet and supporting documentation with the bid proposal.

Rev.3-2015

Rick Snyder, Governor



Dan Wyant, Director

**Michigan Department of Environmental Quality
Office of Drinking Water and Municipal Assistance– Revolving Loan Section
Disadvantaged Business Enterprise (DBE) Utilization
State Revolving Fund/Drinking Water Revolving Fund
GOOD FAITH EFFORTS WORKSHEET**

Instructions to Bidders for the Completion of the Good Faith Efforts Worksheet

1. Separate worksheets must be provided for each area of work to be subcontracted out. This includes both major and minor subcontracts.
2. A minimum of three (3) DBEs must be contacted by a verifiable means of communication such as e-mail, letter, or fax for each area of work to be subcontracted out. Copies of the solicitation letters/e-mails and fax confirmation sheets must be provided with the worksheet.
3. If less than three (3) DBEs exist statewide for the area of work, then provide documentation that other DBE resources were consulted. This may include the MDOT and www.sam.gov registries and an advertisement in a publication. A printout of the website searched (conducted prior to the end of the bid period) must be submitted.
4. Posting solicitations for quotes/proposals from DBEs on the MITA website (www.mitadbe.com) is highly recommended to facilitate participation in the competitive process whenever possible. The solicitation needs to identify the project and the areas of work to be subcontracted out. A copy of the MITA DBE advertisement must be submitted with the Good Faith Efforts worksheet, if used, or a printout of the resulting quotes posted to the MITA website can be submitted with this form as supporting documentation.
5. If the area of work is so specialized that no DBEs exist, then an explanation is required to support that conclusion, including the documentation required in No. 3 above.
6. The date of the DBE contact must be identified, as it is important to document that the DBE solicitation was made during the bid period and that sufficient time was given for the DBE to return a quote.
7. Each DBE firm's price quote must be identified if one was received or N/A entered on the worksheet if a quote was not received. Copies of all quotes must be submitted with the worksheet.
8. If a quote was received, indicate if it was accepted or rejected. Justification for not accepting a quote and not using the DBE subcontractor must be provided.
9. Under Other Efforts, please indicate additional steps you have taken to obtain DBE contractors and provide the appropriate supporting documentation such as:
 - Follow-up e-mails, faxes, or letters.
 - Copies of announcements/postings in newspapers, trade publications, or minority media that target DBE firms.

Rev. 3-2015

Attachment 2

***Certification Regarding
Debarment, Suspension, and Other Responsibility Matters***

**Certification Regarding
Debarment, Suspension, and Other Responsibility Matters**

The prospective participant certifies, to the best of its knowledge and belief, that it and its principals:

- (1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in transactions under federal nonprocurement programs by any federal department or agency;
- (2) Have not, within the three year period preceding the proposal, had one or more public transactions (federal, state, or local) terminated for cause or default; and
- (3) Are not presently indicted or otherwise criminally or civilly charged by a government entity (federal, state, or local) and have not, within the three year period preceding the proposal, been convicted of or had a civil judgment rendered against it:
 - (a) For the commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public transaction (federal, state, or local) or a procurement contract under such a public transaction;
 - (b) For the violation of federal or state antitrust statutes, including those proscribing price fixing between competitors, the allocation of customers between competitors, or bid rigging; or
 - (c) For the commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

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

Name and Title of Authorized Representative

Name of Participant Agency or Firm

Signature of Authorized Representative

Date

I am unable to certify to the above statement. Attached is my explanation.

Attachment 3

***Frequently Asked Questions About
Disadvantaged Business Enterprise (DBE) Solicitation***

Disadvantaged Business Enterprise (DBE) Requirements Frequently Asked Questions Regarding Contractor Compliance

Q: What is the Good Faith Efforts Worksheet form and how is it to be completed?

A: This form captures efforts by the prime contractor to solicit DBEs for each area of work type that will be subcontracted out. A separate Good Faith Efforts Worksheet must be provided by the prime contractor for each area of work type to be subcontracted out. There are specific instructions that accompany this form that prescribe minimum efforts which bidders must make in order to be in compliance with the DBE requirements.

Q: Can non-certified DBEs be used?

A: While non-certified DBEs can be used, only DBEs, MBEs, and WBEs that are certified by EPA, SBA, or MDOT (or by tribal, state and local governments, as long as their standards for certification meet or exceed the standards in EPA policy) can be counted toward the fair share goal. Proof of certification by one of these recognized and approved agencies should be sought from each DBE.

Q: How does a DBE get certified?

A: Applications for certification under MDOT can be found at <http://mdotiboss.state.mi.us/UCP/LearnHowServlet>.

Applications for certification under EPA can be found on EPA's Small Business Programs website at http://www.epa.gov/osbp/dbe_firm.htm under Certification Forms.

Q: If a bidder follows the MDOT DBE requirements, will the bidder be in compliance with the SRF/DWRF DBE requirements?

A: No. Federally funded highway projects utilize DBE goals, which require that a certain percentage of work be performed by DBE subcontractors. For SRF/DWRF projects, there is no financial goal. However, there is a solicitation effort goal. Bidders must use Good Faith Efforts for each and every area of work to be subcontracted out to obtain DBEs. The bidders are not required to use DBEs if the quotes are higher than non-DBE subcontractors. **There is no required DBE participation percentage contract goal for the SRF/DWRF.** However, if the SRF/DWRF project is part of a joint project with MDOT, the project can be excluded from SRF/DWRF DBE requirements (i.e., the Good Faith Efforts Worksheet is not required) as it would be difficult to comply with both programs' requirements.

Q: Must the Good Faith Efforts Worksheet and supporting documentation be turned in with the bid proposals?

A: Yes. This is a requirement to document that the contractor has complied with the DBE requirements and the Good Faith Efforts. These compliance efforts must be done during the bidding phase and not after-the-fact. It is highly recommended that the need for these efforts and the submittal of the forms with the bid proposals be emphasized at the pre-bid meetings. Failure to show that the Good Faith Efforts were complied with during the bidding process can lead to a prime contractor being found non-responsive.

Q: Does EPA form 6100-2 need to be provided at the pre-bid meeting?

A: Yes. The form must be made available at the pre-bid meeting.

Q: What kinds of documentation should a contractor provide to document solicitation efforts?

A: Documentation can include fax confirmation sheets, copies of solicitation letters/e-mails, printouts of online solicitations, printouts of online search results, affidavits of publication in newspapers, etc.

Q: How much time will compliance with the Good Faith Efforts require in terms of structuring an adequate bidding period?

A: Due to the extent of the efforts required, a minimum of 30 calendar days is recommended between bid posting and bid opening to ensure adequate time for contractors to locate certified DBEs and solicit quotes.

Q: How does a contractor locate certified DBEs?

A: The Michigan Department of Transportation has a directory of all Michigan certified entities located at <http://mdotjboss.state.mi.us/UCP/>. Additionally, the federal System for Award Management (SAM) is another place to search and can be found at www.sam.gov. SAM contains information from the former Central Contractor Registration (CCR) database.

Q: If the bidder does not intend to subcontract any work, what forms, if any, must be provided with the bid proposal?

A: The bidder should complete the Good Faith Efforts Worksheet with a notation that no subcontracting will be done. However, if the bidder is awarded the contract and then decides to subcontract work at any point, then the Good Faith Efforts must be made to solicit DBEs.

Q: In the perfect world, the Good Faith Efforts Worksheet is required to be turned in with the proposal. What if no forms are turned in with the bid proposal or forms are blank or incomplete? Should this be cause to determine that the bidder is non-responsive?

A: While the Good Faith Efforts Worksheet is important, it is more critical to confirm that the contractor complied with the DBE requirements prior to bid opening. The owner should contact the bidder as soon as deficiencies are noted for a determination/documentation of efforts taken to comply with the DBE requirements. Immediate submittal of the completed forms will be acceptable provided the Good Faith Efforts were made and it is just a matter of transferring information to the forms.

Q: If the prime contractor is a DBE, does he have to solicit DBE subcontractors?

A: Yes, the DBE requirements still apply if the prime intends to subcontract work out. Good Faith Efforts must be used to solicit DBEs.

Q: If the area of work is one where there are less than three DBE contractors, how is the contractor to document this?

A: Copies of printouts from MDOT and SAM showing no DBEs and advertisements soliciting quotes for all subcontract areas, including the questionable areas, will be adequate if the dates on the printouts are prior to the bid or proposal closing date.

Frequently Asked Questions about Davis-Bacon Act Compliance During Revolving Fund Loan Project Construction

Question 1: Who is the “Contracting Officer” or “Contracting Agency”?

Answer: Both terms refer to the applicant/municipality that awards the construction bid contract.

Question 2: How does one identify the appropriate Davis-Bacon wage rate classification (as to the type of construction, i.e., heavy, building, etc.) to incorporate into the construction bid contract?

Answer: The appropriate Davis-Bacon wage rate classification is identified based upon the work that the majority of loan funding will support within the contract. The U.S. Department of Labor (DOL) has provided explanations to assist with classification in the following resources:

<http://www.wdol.gov/aam/AAM130.pdf>

<http://www.wdol.gov/aam/AAM131.pdf>

<http://www.dol.gov/whd/recovery/pwrb/toc.htm>

Any questions or disputes regarding the appropriate classification of a project with regard to type of construction should be referred the Wage and Hour Division for resolution prior to bid opening.

Question 3: Under what circumstances is it appropriate to incorporate two or more Davis-Bacon wage rate classifications (i.e., heavy, building, etc.) into one construction bid contract?

Answer: It is appropriate to incorporate two or more Davis-Bacon wage rate classifications into one construction bid contract if 1) it is over \$1 million, AND 2) the work represented by each Davis-Bacon wage rate classification exceeds 20 percent of the total value of the contract.

Question 4: What do loan recipients have to report to the Michigan Department of Environmental Quality (DEQ) during the construction of our revolving fund loan project?

Answer: The loan recipient must complete and submit a DEQ Davis-Bacon Act Compliance Certification form with each request for loan reimbursement when reimbursement is being requested for construction costs. Although submitted with the monthly request for loan reimbursement, the certification that the revolving fund loan project has remained in compliance with Davis-Bacon requirements must be based on a weekly review of contractor payroll records. The certification form for loans containing ARRA money is available at: http://www.michigan.gov/documents/deq/deq-ess-mfs-ARRA-Davis-BaconCertForm_318662_7.pdf. The certification form for loans without

ARRA money is available at: http://www.michigan.gov/documents/deq/deq-ess-mfs-formsguidance-Davis-BaconCert_332690_7.pdf.

Question 5: Beyond submittal of the new Davis-Bacon Act Compliance Certification form, what other Davis-Bacon requirements apply during the construction of our revolving fund loan project?

- Answer:
- a. The loan recipient must review payroll submissions to confirm that its contractors' employees are paid weekly, without unauthorized payroll deductions and according to the wage determinations established in the contract.
 - b. The loan recipient must collect signed certifications from its contractors of Davis-Bacon and Related Acts (DBRA) compliance for all weeks during project construction.
 - c. The loan recipient must document that wage interviews were conducted periodically to verify that contractors and subcontractors are paying the appropriate wage rates.
 - d. The loan recipient must verify that contractor fringe contributions were made as planned.
 - e. The loan recipient must verify that contractors and subcontractors have the proper registrations/certifications for all apprentices and trainees working on the project.
 - f. The loan recipient must verify that the ratio of apprentices and trainees working on the project is consistent with the ratio prescribed in the U.S. Department of Labor's approved program for apprentices and trainees.
 - g. The loan recipient must verify that the Davis-Bacon wage poster and applicable Davis-Bacon wage rates are posted at the construction site.

Question 6: Must a certified weekly payroll be collected from the prime contractor during the construction of our revolving fund loan project?

Answer: Yes, the loan recipient must collect the payroll records, using DOL Form WH-347 or its equivalent, for all laborers and mechanics for all weeks of project construction. These payroll records must be collected from the prime contractor for each contract and checked each week. Form WH-347 is available at: <http://www.dol.gov/whd/forms/wh347instr.htm>.

Question 7: I would like to have the contractor submit the certified weekly payrolls with each month's payment request. Is this an acceptable frequency?

Answer: No, the certified payrolls must be collected weekly.

Question 8: Do the certified weekly payrolls requirements apply to "minor" subcontracts?

Answer: The payroll certification requirements apply to any contract worth more than \$2,000.

Question 9: Is there anything more I must do regarding the weekly payrolls beyond collection and record keeping?

Answer: The loan recipient must document, using General Services Administration Form SF-1445 or its equivalent, that wage interviews were conducted periodically to verify that contractors and subcontractors are paying the appropriate wage rates. We recommend that at least two interviews be conducted on every revolving fund loan project which will take six or fewer months to complete. A higher frequency is recommended for projects which will take twelve or months to complete or where the loan recipient finds a pattern of errors in weekly payroll submissions. Form SF-1445 is available at: <http://www.gsa.gov/portal/forms/download/115910>.

Question 10: My project is being handled under a construction management or design-build contract. Do Davis-Bacon requirements apply to my project?

Answer: Yes, DBRA requirements apply to all revolving fund loan projects. In your case, a construction management or engineering consulting firm is acting as your general contractor and is responsible for Davis-Bacon compliance for all of its subcontractors.

Question 11: Do Davis-Bacon Act requirements apply to my Strategic Water Quality Initiatives Funding (SWQIF) loan?

Answer: No, DBRA requirements apply only to revolving fund loan projects which were fully or partially funded by federal dollars. The SWQIF program is completely state funded.

Question 12: Are there any other Davis-Bacon requirements that apply during the construction of our revolving fund loan project?

Answer: Yes. All revolving fund loan projects must have the applicable Davis-Bacon wage determinations and Davis-Bacon wage posters (WH-1321) in all relevant languages posted at the construction site in a conspicuous place and protected from the weather.

Question 13: Are there other resources available for loan recipients to use in understanding Davis-Bacon requirements?

Answer: Yes. For questions not answered in these FAQs, please consult the U.S. DOL website (www.dol.gov) or call 616-456-2004.

If you have further questions, please contact your DEQ project manager.

American Iron and Steel Contract Language

The Contractor acknowledges to and for the benefit of the city of _____ (“Purchaser”) and the Michigan Department of Environmental Quality (the “State”) that it understands the goods and services under this Agreement are being funded with monies made available by the State Revolving Fund and/or the Drinking Water Revolving Fund and such law contains provisions commonly known as “American Iron and Steel (AIS);” that requires all iron and steel products used in the project be produced in the United States (“AIS Requirements”) including iron and steel provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the AIS Requirements, (b) all iron and steel used in the project will be and/or have been produced in the United States in a manner that complies with the AIS Requirements, unless a waiver of the requirements is approved or the State made the determination in writing that the AIS Requirements do not apply to the project, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the AIS requirements, as may be requested by the Purchaser. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense or cost (including without limitation attorney’s fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

American Iron and Steel

Projects receiving State Revolving Fund (SRF) or Drinking Water Revolving Fund (DWRP) funding after January 17, 2014, are required to comply with the American Iron and Steel (AIS) provisions unless the project plans and specifications were approved by the DEQ prior to January 17, 2014, or the project was provided a waiver.

The U.S. Environmental Protection Agency (EPA) has provided strict guidance regarding the AIS. You can read the guidance at http://water.epa.gov/grants_funding/aisrequirement.cfm. In order to comply with AIS, specific AIS contract language must be included in each contract, including purchase agreements. The DEQ has posted a copy of the AIS contract language on our Forms and Guidance web link ([American Iron and Steel Boilerplate Contract Language](#)).

The EPA strongly recommends the use of a step certification, similar to one used by the Federal Highway Administration. The final manufacturer can also certify that the manufacturing process occurred in the United States. Refer to the EPA guidance above for more detail (see page 9). Review of the certification(s) may occur during site visits of the project by the EPA, DEQ, or contracted staff.

If use of a noncompliant iron and/or steel product is permanently incorporated into a project, one or more of the following can occur:

1. Request a waiver where appropriate.
2. Require the removal of the non-domestic item.
3. Withhold payment for all or part of the project.

If you have any questions, please contact our office.

Disadvantaged Business Enterprise (DBE) Program DBE Subcontractor Participation Form

An EPA Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE¹ subcontractor² the opportunity to describe work received and/or report any concerns regarding the EPA-funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the EPA DBE Coordinator at any time during the project period of performance.

Subcontractor Name		Project Name	
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact	
Address			
Telephone No.		Email Address	
Prime Contractor Name		Issuing/Funding Entity:	

Contract Item Number	Description of Work Received from the Prime Contractor Involving Construction, Services, Equipment or Supplies	Amount Received by Prime Contractor

¹ A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

² Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

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

Please use the space below to report any concerns regarding the above EPA-funded project:

Subcontractor Signature	Print Name
Title	Date

The public reporting and recordkeeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

SAMPLE STANDARD CONTRACT

If a contract is awarded, the selected contractor will be required to adhere to a set of general contract provisions which will become a part of any formal agreement. These provisions are general principles which apply to all contractors of service to the City of Ann Arbor such as the following:

CONTRACT

THIS AGREEMENT is made on the _____ day of _____, 2019, between the CITY OF ANN ARBOR, a Michigan Municipal Corporation, 301 East Huron Street, Ann Arbor, Michigan 48104 ("City") and _____ ("Contractor")

(An individual/partnership/corporation, include state of incorporation)

(Address)

Based upon the mutual promises below, the Contractor and the City agree as follows:

ARTICLE I - Scope of Work

The Contractor agrees to furnish all of the materials, equipment and labor necessary; and to abide by all the duties and responsibilities applicable to it for the project titled [Insert Title of Bid and Bid Number] in accordance with the requirements and provisions of the following documents, including all written modifications incorporated into any of the documents, which are incorporated as part of this Contract:

Non-discrimination and Living Wage
Declaration of Compliance Forms (if
applicable)
Vendor Conflict of Interest Form
Prevailing Wage Declaration of
Compliance Form (if applicable)
Bid Forms
Contract and Exhibits
Bonds

General Conditions
Standard Specifications
Detailed Specifications
Plans
Addenda
State of Michigan Drinking Water
Revolving Loan Fund Requirements

ARTICLE II - Definitions

Administering Service Area/Unit means: **Water Treatment Services Unit.**

Project means: **WTP UV Disinfection System Project.**

ARTICLE III - Time of Completion

- (A) The work to be completed under this Contract shall begin immediately on the date specified in the Notice to Proceed issued by the City.
- (B) The entire work for this Contract shall be completed within Twelve (12) consecutive calendar months.
- (C) The anticipated Notice to Proceed date is approximately August 1, 2019. The substantial completion date shall be no later than June 20, 2020.

- (D) Failure to complete all the work within the time specified above, including any extension granted in writing by the Supervising Professional, shall obligate the Contractor to pay the City, as liquidated damages and not as a penalty, an amount equal to \$500 for each calendar day of delay in the completion of all the work. If any liquidated damages are unpaid by the Contractor, the City shall be entitled to deduct these unpaid liquidated damages from the monies due the Contractor.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended to preclude recovery of actual damages in addition to the recovery of liquidated damages.

See Table 1 in section 01 31 13, Project Coordination for additional liquidated damages and interim milestones.

ARTICLE IV - The Contract Sum

- (A) The City shall pay to the Contractor for the performance of the Contract, the lump sum price as given in the Bid Form in the amount of:

_____ Dollars (\$_____)

- (B) The amount paid shall be equitably adjusted to cover changes in the work ordered by the Supervising Professional but not required by the Contract Documents. Increases or decreases shall be determined only by written agreement between the City and Contractor.

ARTICLE V - Assignment

This Contract may not be assigned or subcontracted any portion of any right or obligation under this contract without the written consent of the City. Notwithstanding any consent by the City to any assignment, Contractor shall at all times remain bound to all warranties, certifications, indemnifications, promises and performances, however described, as are required of it under this contract unless specifically released from the requirement, in writing, by the City.

ARTICLE VI - Choice of Law

This Contract shall be construed, governed, and enforced in accordance with the laws of the State of Michigan. By executing this agreement, the Contractor and the City agree to venue in a court of appropriate jurisdiction sitting within Washtenaw County for purposes of any action arising under this Contract. The parties stipulate that the venue referenced in this Contract is for convenience and waive any claim of non-convenience.

Whenever possible, each provision of the Contract will be interpreted in a manner as to be effective and valid under applicable law. The prohibition or invalidity, under applicable law, of any provision will not invalidate the remainder of the Contract.

ARTICLE VII - Relationship of the Parties

The parties of the Contract agree that it is not a Contract of employment but is a Contract to accomplish a specific result. Contractor is an independent Contractor performing services for the City. Nothing contained in this Contract shall be deemed to constitute any other relationship between the City and the Contractor.

Contractor certifies that it has no personal or financial interest in the project other than the compensation it is to receive under the Contract. Contractor certifies that it is not, and shall not become, overdue or in default to the City for any Contract, debt, or any other obligation to the City including real or personal property taxes. City shall have the right to set off any such debt against compensation awarded for services under this agreement.

ARTICLE VIII - Notice

All notices given under this Contract shall be in writing, and shall be by personal delivery or by certified mail with return receipt requested to the parties at their respective addresses as specified in the Contract Documents or other address the Contractor may specify in writing. Notice will be deemed given on the date when one of the following first occur: (1) the date of actual receipt; or (2) three days after mailing certified U.S. mail.

ARTICLE IX - Indemnification

To the fullest extent permitted by law, Contractor shall indemnify, defend and hold harmless the City, its officers, employees and agents harmless from all suits, claims, judgments and expenses including attorney’s fees resulting or alleged to result, in whole or in part, from any act or omission, which is in any way connected or associated with this Contract, by the Contractor or anyone acting on the Contractor’s behalf under this Contract. Contractor shall not be responsible to indemnify the City for losses or damages caused by or resulting from the City’s sole negligence. The provisions of this Article shall survive the expiration or earlier termination of this contract for any reason.

ARTICLE X - Entire Agreement

This Contract represents the entire understanding between the City and the Contractor and it supersedes all prior representations, negotiations, agreements, or understandings whether written or oral. Neither party has relied on any prior representations in entering into this Contract. No terms or conditions of either party’s invoice, purchase order or other administrative document shall modify the terms and conditions of this Contract, regardless of the other party’s failure to object to such form. This Contract shall be binding on and shall inure to the benefit of the parties to this Contract and their permitted successors and permitted assigns and nothing in this Contract, express or implied, is intended to or shall confer on any other person or entity any legal or equitable right, benefit, or remedy of any nature whatsoever under or by reason of this Contract. This Contract may be altered, amended or modified only by written amendment signed by the City and the Contractor.

FOR CONTRACTOR

By _____

Its: _____

FOR THE CITY OF ANN ARBOR

By _____
Christopher Taylor, Mayor

By _____
Jacqueline Beaudry, City Clerk

Approved as to substance

By _____
Howard S. Lazarus, City Administrator

By _____
Craig Hupy, Public Services Area
Administrator

Approved as to form and content

Stephen K. Postema, City Attorney

PERFORMANCE BOND

- (1) _____ (referred to as "Principal"), and _____, a corporation duly authorized to do business in the State of Michigan (referred to as "Surety"), are bound to the City of Ann Arbor, Michigan (referred to as "City"), for \$ _____, the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by this bond.
- (2) The Principal has entered a written Contract with the City dated _____, 2019, for: _____ and this bond is given for that Contract in compliance with Act No. 213 of the Michigan Public Acts of 1963, as amended, being MCL 129.201 et seq.
- (3) Whenever the Principal is declared by the City to be in default under the Contract, the Surety may promptly remedy the default or shall promptly:
- (a) complete the Contract in accordance with its terms and conditions; or
 - (b) obtain a bid or bids for submission to the City for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, arrange for a Contract between such bidder and the City, and make available, as work progresses, 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 Surety may be liable hereunder, the amount set forth in paragraph 1.
- (4) Surety shall have no obligation to the City if the Principal fully and promptly performs under the Contract.
- (5) Surety agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder, or the specifications accompanying it shall in any way affect its obligations on this bond, and waives notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work, or to the specifications.

SIGNED AND SEALED this _____ day of _____, 2019.

(Name of Surety Company)
By _____
(Signature)

Its _____
(Title of Office)

Approved as to form:

Stephen K. Postema, City Attorney

(Name of Principal)
By _____
(Signature)

Its _____
(Title of Office)

Name and address of agent:

LABOR AND MATERIAL BOND

- (1) _____
of _____(referred to as "Principal"), and _____, a corporation duly authorized to do business in the State of Michigan, (referred to as "Surety"), are bound to the City of Ann Arbor, Michigan (referred to as "City"), for the use and benefit of claimants as defined in Act 213 of Michigan Public Acts of 1963, as amended, being MCL 129.201 et seq., in the amount of \$ _____, for the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by this bond.
- (2) The Principal has entered a written Contract with the City, dated _____, 2019, for _____; and this bond is given for that Contract in compliance with Act No. 213 of the Michigan Public Acts of 1963 as amended;
- (3) If the Principal fails to promptly and fully repay claimants for labor and material reasonably required under the Contract, the Surety shall pay those claimants.
- (4) Surety's obligations shall not exceed the amount stated in paragraph 1, and Surety shall have no obligation if the Principal promptly and fully pays the claimants.

SIGNED AND SEALED this _____ day of _____, 2019

(Name of Surety Company)

By _____
(Signature)

Its _____
(Title of Office)

Approved as to form:

Stephen K. Postema, City Attorney

(Name of Principal)

By _____
(Signature)

Its _____
(Title of Office)

Name and address of agent:

GENERAL CONDITIONS

Section 1 - Execution, Correlation and Intent of Documents

The contract documents shall be signed in 2 copies by the City and the Contractor.

The contract documents are complementary and what is called for by any one shall be binding. The intention of the documents is to include all labor and materials, equipment and transportation necessary for the proper execution of the work. Materials or work described in words which so applied have a well-known technical or trade meaning have the meaning of those recognized standards.

In case of a conflict among the contract documents listed below in any requirement(s), the requirement(s) of the document listed first shall prevail over any conflicting requirement(s) of a document listed later.

(1) Addenda in reverse chronological order; (2) Detailed Specifications; (3) Standard Specifications; (4) Plans; (5) General Conditions; (6) Contract; (7) Bid Forms; (8) Bond Forms; (9) Bid.

Section 2 - Order of Completion

The Contractor shall submit with each invoice, and at other times reasonably requested by the Supervising Professional, schedules showing the order in which the Contractor proposes to carry on the work. They shall include the dates at which the Contractor will start the several parts of the work, the estimated dates of completion of the several parts, and important milestones within the several parts.

Section 3 - Familiarity with Work

The Bidder or its representative shall make personal investigations of the site of the work and of existing structures and shall determine to its own satisfaction the conditions to be encountered, the nature of the ground, the difficulties involved, and all other factors affecting the work proposed under this Contract. The Bidder to whom this Contract is awarded will not be entitled to any additional compensation unless conditions are clearly different from those which could reasonably have been anticipated by a person making diligent and thorough investigation of the site.

The Bidder shall immediately notify the City upon discovery, and in every case prior to submitting its Bid, of every error or omission in the bidding documents that would be identified by a reasonably competent, diligent Bidder. In no case will a Bidder be allowed the benefit of extra compensation or time to complete the work under this Contract for extra expenses or time spent as a result of the error or omission.

Section 4 - Wage Requirements

Under this Contract, the Contractor shall conform to Chapter 14 of Title I of the Code of the City of Ann Arbor as amended; which in part states "...that all craftsmen, mechanics and laborers employed directly on the site in connection with said improvements, including said employees of subcontractors, shall receive the prevailing wage for the corresponding classes of craftsmen, mechanics and laborers, as determined by statistics for the Ann Arbor area compiled by the United States Department of Labor. At the request of the City, any contractor or subcontractor shall provide satisfactory proof of compliance with the contract provisions required by the Section.

Pursuant to Resolution R-16-469 all public improvement contractors are subject to prevailing wage and will be required to provide to the City payroll records sufficient to demonstrate compliance with the prevailing wage requirements. A sample Prevailing Wage Form is provided in the Appendix herein for reference as to what will be expected from contractors. Use of the Prevailing Wage Form provided in the Appendix section or a City-approved equivalent will be required along with wage rate interviews.

Where the Contract and the Ann Arbor City Ordinance are silent as to definitions of terms required in determining contract compliance with regard to prevailing wages, the definitions provided in the Davis-Bacon Act as amended (40 U.S.C. 278-a to 276-a-7) for the terms shall be used.

If the Contractor is a "covered employer" as defined in Chapter 23 of the Ann Arbor City Code, the Contractor agrees to comply with the living wage provisions of Chapter 23 of the Ann Arbor City Code. The Contractor agrees to pay those employees providing Services to the City under this Agreement a "living wage," as defined in Section 1:815 of the Ann Arbor City Code, as adjusted in accordance with Section 1:815(3); to post a notice approved by the City of the applicability of Chapter 23 in every location in which regular or contract employees providing services under this Agreement are working; to maintain records of compliance; if requested by the City, to provide documentation to verify compliance; to take no action that would reduce the compensation, wages, fringe benefits, or leave available to any employee or person contracted for employment in order to pay the living wage required by Section 1:815; and otherwise to comply with the requirements of Chapter 23.

Contractor agrees that all subcontracts entered into by the Contractor shall contain similar wage provision covering subcontractor's employees who perform work on this contract.

Section 5 - Non-Discrimination

The Contractor agrees to comply, and to require its subcontractor(s) to comply, with the nondiscrimination provisions of MCL 37.2209. The Contractor further agrees to comply with the provisions of Section 9:158 of Chapter 112 of Title IX of the Ann Arbor City Code, and to assure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity.

Section 6 - Materials, Appliances, Employees

Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light, power, transportation, and other facilities necessary or used for the execution and completion of the work. Unless otherwise specified, all materials incorporated in the permanent work shall be new, and both workmanship and materials shall be of the highest quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

The Contractor shall at all times enforce strict discipline and good order among its employees, and shall seek to avoid employing on the work any unfit person or anyone not skilled in the work assigned.

Adequate sanitary facilities shall be provided by the Contractor.

Section 7 - Qualifications for Employment

The Contractor shall employ competent laborers and mechanics for the work under this Contract. For work performed under this Contract, employment preference shall be given to qualified local residents.

Section 8 - Royalties and Patents

The Contractor shall pay all royalties and license fees. It shall defend all suits or claims for infringements of any patent rights and shall hold the City harmless from loss on account of infringement except that the City shall be responsible for all infringement loss when a particular process or the product of a particular manufacturer or manufacturers is specified, unless the City has notified the Contractor prior to the signing of the Contract that the particular process or product is patented or is believed to be patented.

Section 9 - Permits and Regulations

The Contractor must secure and pay for all permits, permit or plan review fees and licenses necessary for the prosecution of the work. These include but are not limited to City building permits, right-of-way permits, lane closure permits, right-of-way occupancy permits, and the like. The City shall secure and pay for easements shown on the plans unless otherwise specified.

The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the contract documents are at variance with those requirements, it shall promptly notify the Supervising Professional in writing, and any necessary changes shall be adjusted as provided in the Contract for changes in the work.

Section 10 - Protection of the Public and of Work and Property

The Contractor is responsible for the means, methods, sequences, techniques and procedures of construction and safety programs associated with the work contemplated by this contract. The Contractor, its agents or sub-contractors, shall comply with the "General Rules and Regulations for the Construction Industry" as published by the Construction Safety Commission of the State of Michigan and to all other local, State and National laws, ordinances, rules and regulations pertaining to safety of persons and property.

The Contractor shall take all necessary and reasonable precautions to protect the safety of the public. It shall continuously maintain adequate protection of all work from damage, and shall take all necessary and reasonable precautions to adequately protect all public and private property from injury or loss arising in connection with this Contract. It shall make good any damage, injury or loss to its work and to public and private property resulting from lack of reasonable protective precautions, except as may be due to errors in the contract documents, or caused by agents or employees of the City. The Contractor shall obtain and maintain sufficient insurance to cover damage to any City property at the site by any cause.

In an emergency affecting the safety of life, or the work, or of adjoining property, the Contractor is, without special instructions or authorization from the Supervising Professional, permitted to act at its discretion to prevent the threatened loss or injury. It shall also so act, without appeal, if authorized or instructed by the Supervising Professional.

Any compensation claimed by the Contractor for emergency work shall be determined by agreement or in accordance with the terms of Claims for Extra Cost - Section 15.

Section 11 - Inspection of Work

The City shall provide sufficient competent personnel for the inspection of the work.

The Supervising Professional shall at all times have access to the work whenever it is in preparation or progress, and the Contractor shall provide proper facilities for access and for inspection.

If the specifications, the Supervising Professional's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Supervising Professional timely notice of its readiness for inspection, and if the inspection is by an authority other than the Supervising Professional, of the date fixed for the inspection. Inspections by the Supervising Professional shall be made promptly, and where practicable at the source of supply. If any work should be covered up without approval or consent of the Supervising Professional, it must, if required by the Supervising Professional, be uncovered for examination and properly restored at the Contractor's expense.

Re-examination of any work may be ordered by the Supervising Professional, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to be in accordance with the contract documents, the City shall pay the cost of re-examination and replacement. If the work is not in accordance with the contract documents, the Contractor shall pay the cost.

Section 12 - Superintendence

The Contractor shall keep on the work site, during its progress, a competent superintendent and any necessary assistants, all satisfactory to the Supervising Professional. The superintendent will be responsible to perform all on-site project management for the Contractor. The superintendent shall be experienced in the work required for this Contract. The superintendent shall represent the Contractor and all direction given to the superintendent shall be binding as if given to the Contractor. Important directions shall immediately be confirmed in writing to the Contractor. Other directions will be confirmed on written request. The Contractor shall give efficient superintendence to the work, using its best skill and attention.

Section 13 - Changes in the Work

The City may make changes to the quantities of work within the general scope of the Contract at any time by a written order and without notice to the sureties. If the changes add to or deduct from the extent of the work, the Contract Sum shall be adjusted accordingly. All the changes shall be executed under the conditions of the original Contract except that any claim for extension of time caused by the change shall be adjusted at the time of ordering the change.

In giving instructions, the Supervising Professional shall have authority to make minor changes in the work not involving extra cost and not inconsistent with the purposes of the work, but otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless in pursuance of a written order by the Supervising Professional, and no claim for an addition to the Contract Sum shall be valid unless the additional work was ordered in writing.

The Contractor shall proceed with the work as changed and the value of the work shall be determined as provided in Claims for Extra Cost - Section 15.

Section 14 - Extension of Time

Extension of time stipulated in the Contract for completion of the work will be made if and as the Supervising Professional may deem proper under any of the following circumstances:

- (1) When work under an extra work order is added to the work under this Contract;
- (2) When the work is suspended as provided in Section 20;
- (3) When the work of the Contractor is delayed on account of conditions which could not have been foreseen, or which were beyond the control of the Contractor, and which were not the result of its fault or negligence;
- (4) Delays in the progress of the work caused by any act or neglect of the City or of its employees or by other Contractors employed by the City;
- (5) Delay due to an act of Government;
- (6) Delay by the Supervising Professional in the furnishing of plans and necessary information;
- (7) Other cause which in the opinion of the Supervising Professional entitles the Contractor to an extension of time.

The Contractor shall notify the Supervising Professional within 7 days of an occurrence or conditions which, in the Contractor's opinion, entitle it to an extension of time. The notice shall be in writing and submitted in ample time to permit full investigation and evaluation of the Contractor's claim. The Supervising Professional shall acknowledge receipt of the Contractor's notice within 7 days of its receipt. Failure to timely provide the written notice shall constitute a waiver by the Contractor of any claim.

In situations where an extension of time in contract completion is appropriate under this or any other section of the contract, the Contractor understands and agrees that the only available adjustment for events that cause any delays in contract completion shall be extension of the required time for contract completion and that there shall be no adjustments in the money due the Contractor on account of the delay.

Section 15 - Claims for Extra Cost

If the Contractor claims that any instructions by drawings or other media issued after the date of the Contract involved extra cost under this Contract, it shall give the Supervising Professional written notice within 7 days after the receipt of the instructions, and in any event before proceeding to execute the work, except in emergency endangering life or property. The procedure shall then be as provided for Changes in the Work-Section 13. No claim shall be valid unless so made.

If the Supervising Professional orders, in writing, the performance of any work not covered by the contract documents, and for which no item of work is provided in the Contract, and for which no unit price or lump sum basis can be agreed upon, then the extra work shall be done on a Cost-Plus-Percentage basis of payment as follows:

- (1) The Contractor shall be reimbursed for all reasonable costs incurred in doing the work, and shall receive an additional payment of 15% of all the reasonable costs to cover both its indirect overhead costs and profit;

- (2) The term "Cost" shall cover all payroll charges for employees and supervision required under the specific order, together with all worker's compensation, Social Security, pension and retirement allowances and social insurance, or other regular payroll charges on same; the cost of all material and supplies required of either temporary or permanent character; rental of all power-driven equipment at agreed upon rates, together with cost of fuel and supply charges for the equipment; and any costs incurred by the Contractor as a direct result of executing the order, if approved by the Supervising Professional;
- (3) If the extra is performed under subcontract, the subcontractor shall be allowed to compute its charges as described above. The Contractor shall be permitted to add an additional charge of 5% percent to that of the subcontractor for the Contractor's supervision and contractual responsibility;
- (4) The quantities and items of work done each day shall be submitted to the Supervising Professional in a satisfactory form on the succeeding day, and shall be approved by the Supervising Professional and the Contractor or adjusted at once;
- (5) Payments of all charges for work under this Section in any one month shall be made along with normal progress payments. Retainage shall be in accordance with Progress Payments-Section 16.

No additional compensation will be provided for additional equipment, materials, personnel, overtime or special charges required to perform the work within the time requirements of the Contract.

When extra work is required and no suitable price for machinery and equipment can be determined in accordance with this Section, the hourly rate paid shall be 1/40 of the basic weekly rate listed in the Rental Rate Blue Book published by Dataquest Incorporated and applicable to the time period the equipment was first used for the extra work. The hourly rate will be deemed to include all costs of operation such as bucket or blade, fuel, maintenance, "regional factors", insurance, taxes, and the like, but not the costs of the operator.

Section 16 - Progress Payments

The Contractor shall submit each month, or at longer intervals, if it so desires, an invoice covering work performed for which it believes payment, under the Contract terms, is due. The submission shall be to the City's Finance Department - Accounting Division. The Supervising Professional will, within 10 days following submission of the invoice, prepare a certificate for payment for the work in an amount to be determined by the Supervising Professional as fairly representing the acceptable work performed during the period covered by the Contractor's invoice. To insure the proper performance of this Contract, the City will retain a percentage of the estimate in accordance with Act 524, Public Acts of 1980. The City will then, following the receipt of the Supervising Professional's Certificate, make payment to the Contractor as soon as feasible, which is anticipated will be within 15 days.

An allowance may be made in progress payments if substantial quantities of permanent material have been delivered to the site but not incorporated in the completed work if the Contractor, in the opinion of the Supervising Professional, is diligently pursuing the work under this Contract. Such materials shall be properly stored and adequately protected. Allowance in the estimate shall be at the invoice price value of the items. Notwithstanding any payment of any allowance, all risk of loss due to vandalism or any damages to the stored materials remains with the Contractor.

In the case of Contracts which include only the Furnishing and Delivering of Equipment, the payments shall be; 60% of the Contract Sum upon the delivery of all equipment to be furnished, or in the case of delivery of a usable portion of the equipment in advance of the total equipment delivery, 60% of the estimated value of the portion of the equipment may be paid upon its delivery in advance of the time of the remainder of the equipment to be furnished; 30% of the Contract Sum upon completion of erection of all equipment furnished, but not later than 60 days after the date of delivery of all of the equipment to be furnished; and payment of the final 10% on final completion of erection, testing and acceptance of all the equipment to be furnished; but not later than 180 days after the date of delivery of all of the equipment to be furnished, unless testing has been completed and shows the equipment to be unacceptable.

With each invoice for periodic payment, the Contractor shall enclose a Contractor's Declaration - Section 43, and an updated project schedule per Order of Completion - Section 2.

Section 17 - Deductions for Uncorrected Work

If the Supervising Professional decides it is inexpedient to correct work that has been damaged or that was not done in accordance with the Contract, an equitable deduction from the Contract price shall be made.

Section 18 - Correction of Work Before Final Payment

The Contractor shall promptly remove from the premises all materials condemned by the Supervising Professional as failing to meet Contract requirements, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute the work in accordance with the Contract and without expense to the City and shall bear the expense of making good all work of other contractors destroyed or damaged by the removal or replacement.

If the Contractor does not remove the condemned work and materials within 10 days after written notice, the City may remove them and, if the removed material has value, may store the material at the expense of the Contractor. If the Contractor does not pay the expense of the removal within 10 days thereafter, the City may, upon 10 days written notice, sell the removed materials at auction or private sale and shall pay to the Contractor the net proceeds, after deducting all costs and expenses that should have been borne by the Contractor. If the removed material has no value, the Contractor must pay the City the expenses for disposal within 10 days of invoice for the disposal costs.

The inspection or lack of inspection of any material or work pertaining to this Contract shall not relieve the Contractor of its obligation to fulfill this Contract and defective work shall be made good. Unsuitable materials may be rejected by the Supervising Professional notwithstanding that the work and materials have been previously overlooked by the Supervising Professional and accepted or estimated for payment or paid for. If the work or any part shall be found defective at any time before the final acceptance of the whole work, the Contractor shall forthwith make good the defect in a manner satisfactory to the Supervising Professional. The judgment and the decision of the Supervising Professional as to whether the materials supplied and the work done under this Contract comply with the requirements of the Contract shall be conclusive and final.

Section 19 - Acceptance and Final Payment

Upon receipt of written notice that the work is ready for final inspection and acceptance, the Supervising Professional will promptly make the inspection. When the Supervising Professional finds the work acceptable under the Contract and the Contract fully performed, the Supervising Professional will promptly sign and issue a final certificate stating that the work required by this Contract has been completed and is accepted by the City under the terms and conditions of the Contract. The entire balance found to be due the Contractor, including the retained percentage, shall be paid to the Contractor by the City within 30 days after the date of the final certificate.

Before issuance of final certificates, the Contractor shall file with the City:

- (1) The consent of the surety to payment of the final estimate;
- (2) The Contractor's Affidavit in the form required by Section 44.

In case the Affidavit or consent is not furnished, the City may retain out of any amount due the Contractor, sums sufficient to cover all lienable claims.

The making and acceptance of the final payment shall constitute a waiver of all claims by the City except those arising from:

- (1) unsettled liens;
- (2) faulty work appearing within 12 months after final payment;
- (3) hidden defects in meeting the requirements of the plans and specifications;
- (4) manufacturer's guarantees.

It shall also constitute a waiver of all claims by the Contractor, except those previously made and still unsettled.

Section 20 - Suspension of Work

The City may at any time suspend the work, or any part by giving 5 days' notice to the Contractor in writing. The work shall be resumed by the Contractor within 10 days after the date fixed in the written notice from the City to the Contractor to do so. The City shall reimburse the Contractor for expense incurred by the Contractor in connection with the work under this Contract as a result of the suspension.

If the work, or any part, shall be stopped by the notice in writing, and if the City does not give notice in writing to the Contractor to resume work at a date within 90 days of the date fixed in the written notice to suspend, then the Contractor may abandon that portion of the work suspended and will be entitled to the estimates and payments for all work done on the portions abandoned, if any, plus 10% of the value of the work abandoned, to compensate for loss of overhead, plant expense, and anticipated profit.

Section 21 - Delays and the City's Right to Terminate Contract

If the Contractor refuses or fails to prosecute the work, or any separate part of it, with the diligence required to insure completion, ready for operation, within the allowable number of consecutive calendar days specified plus extensions, or fails to complete the work within the required time, the City may, by written notice to the Contractor, terminate its right to proceed with the work or any part of the work as to which there has been delay. After providing the notice the City may take over the work and prosecute it to completion, by contract or otherwise, and the Contractor and its sureties shall be liable to the City for any excess cost to the City. If the Contractor's right

to proceed is terminated, the City may take possession of and utilize in completing the work, any materials, appliances and plant as may be on the site of the work and useful for completing the work. The right of the Contractor to proceed shall not be terminated or the Contractor charged with liquidated damages where an extension of time is granted under Extension of Time – Section 14.

If the Contractor is adjudged a bankrupt, or if it makes a general assignment for the benefit of creditors, or if a receiver is appointed on account of its insolvency, or if it persistently or repeatedly refuses or fails except in cases for which extension of time is provided, to supply enough properly skilled workers or proper materials, or if it fails to make prompt payments to subcontractors or for material or labor, or persistently disregards laws, ordinances or the instructions of the Supervising Professional, or otherwise is guilty of a substantial violation of any provision of the Contract, then the City, upon the certificate of the Supervising Professional that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor 3 days written notice, terminate this Contract. The City may then take possession of the premises and of all materials, tools and appliances thereon and without prejudice to any other remedy it may have, make good the deficiencies or finish the work by whatever method it may deem expedient, and deduct the cost from the payment due the Contractor. The Contractor shall not be entitled to receive any further payment until the work is finished. If the expense of finishing the work, including compensation for additional managerial and administrative services exceeds the unpaid balance of the Contract Sum, the Contractor and its surety are liable to the City for any excess cost incurred. The expense incurred by the City, and the damage incurred through the Contractor's default, shall be certified by the Supervising Professional.

Section 22 - Contractor's Right to Terminate Contract

If the work should be stopped under an order of any court, or other public authority, for a period of 3 months, through no act or fault of the Contractor or of anyone employed by it, then the Contractor may, upon 7 days written notice to the City, terminate this Contract and recover from the City payment for all acceptable work executed plus reasonable profit.

Section 23 - City's Right To Do Work

If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this Contract, the City, 3 days after giving written notice to the Contractor and its surety may, without prejudice to any other remedy the City may have, make good the deficiencies and may deduct the cost from the payment due to the Contractor.

Section 24 - Removal of Equipment and Supplies

In case of termination of this Contract before completion, from any or no cause, the Contractor, if notified to do so by the City, shall promptly remove any part or all of its equipment and supplies from the property of the City, failing which the City shall have the right to remove the equipment and supplies at the expense of the Contractor.

The removed equipment and supplies may be stored by the City and, if all costs of removal and storage are not paid by the Contractor within 10 days of invoicing, the City upon 10 days written notice may sell the equipment and supplies at auction or private sale, and shall pay the Contractor the net proceeds after deducting all costs and expenses that should have been borne by the Contractor and after deducting all amounts claimed due by any lien holder of the equipment or supplies.

Section 25 - Responsibility for Work and Warranties

The Contractor assumes full responsibility for any and all materials and equipment used in the construction of the work and may not make claims against the City for damages to materials and equipment from any cause except negligence or willful act of the City. Until its final acceptance, the Contractor shall be responsible for damage to or destruction of the project (except for any part covered by Partial Completion and Acceptance - Section 26). The Contractor shall make good all work damaged or destroyed before acceptance. All risk of loss remains with the Contractor until final acceptance of the work (Section 19) or partial acceptance (Section 26). The Contractor is advised to investigate obtaining its own builders risk insurance.

The Contractor shall guarantee the quality of the work for a period of one year. The Contractor shall also unconditionally guarantee the quality of all equipment and materials that are furnished and installed under the contract for a period of one year. At the end of one year after the Contractor's receipt of final payment, the complete work, including equipment and materials furnished and installed under the contract, shall be inspected by the Contractor and the Supervising Professional. Any defects shall be corrected by the Contractor at its expense as soon as practicable but in all cases within 60 days. Any defects that are identified prior to the end of one year shall also be inspected by the Contractor and the Supervising Professional and shall be corrected by the Contractor at its expense as soon as practicable but in all cases within 60 days. The Contractor shall assign all manufacturer or material supplier warranties to the City prior to final payment. The assignment shall not relieve the Contractor of its obligations under this paragraph to correct defects.

Section 26 - Partial Completion and Acceptance

If at any time prior to the issuance of the final certificate referred to in Acceptance and Final Payment - Section 19, any portion of the permanent construction has been satisfactorily completed, and if the Supervising Professional determines that portion of the permanent construction is not required for the operations of the Contractor but is needed by the City, the Supervising Professional shall issue to the Contractor a certificate of partial completion, and immediately the City may take over and use the portion of the permanent construction described in the certificate, and exclude the Contractor from that portion.

The issuance of a certificate of partial completion shall not constitute an extension of the Contractor's time to complete the portion of the permanent construction to which it relates if the Contractor has failed to complete it in accordance with the terms of this Contract. The issuance of the certificate shall not release the Contractor or its sureties from any obligations under this Contract including bonds.

If prior use increases the cost of, or delays the work, the Contractor shall be entitled to extra compensation, or extension of time, or both, as the Supervising Professional may determine.

Section 27 - Payments Withheld Prior to Final Acceptance of Work

The City may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any certificate to the extent reasonably appropriate to protect the City from loss on account of:

- (1) Defective work not remedied;

- (2) Claims filed or reasonable evidence indicating probable filing of claims by other parties against the Contractor;
- (3) Failure of the Contractor to make payments properly to subcontractors or for material or labor;
- (4) Damage to another Contractor.

When the above grounds are removed or the Contractor provides a Surety Bond satisfactory to the City which will protect the City in the amount withheld, payment shall be made for amounts withheld under this section.

Section 28 - Contractor's Insurance

- (1) The Contractor shall procure and maintain during the life of this Contract, including the guarantee period and during any warranty work, such insurance policies, including those set forth below, as will protect itself and the City from all claims for bodily injuries, death or property damage which may arise under this Contract; whether the act(s) or omission(s) giving rise to the claim were made by the Contractor or by any subcontractor or anyone employed by them directly or indirectly. In the case of all contracts involving on-site work, the Contractor shall provide to the City, before the commencement of any work under this contract, certificates of insurance and other documentation satisfactory to the City demonstrating it has obtained the policies and endorsements required on behalf of itself, and when requested, any subcontractor(s). The certificates of insurance endorsements and/or copies of policy language shall document that the Contractor satisfies the following minimum requirements.

- (a) Worker's Compensation Insurance in accordance with all applicable state and federal statutes. Further, Employers Liability Coverage shall be obtained in the following minimum amounts:

- Bodily Injury by Accident - \$500,000 each accident
- Bodily Injury by Disease - \$500,000 each employee
- Bodily Injury by Disease - \$500,000 each policy limit

- (b) Commercial General Liability Insurance equivalent to, as a minimum, Insurance Services Office form CG 00 01 07 98 or current equivalent. The City of Ann Arbor shall be named as an additional insured. There shall be no added exclusions or limiting endorsements specifically for the following coverages: Products and Completed Operations, Explosion, Collapse and Underground coverage or Pollution. Further there shall be no added exclusions or limiting endorsements which diminish the City's protections as an additional insured under the policy. The following minimum limits of liability are required:

- \$1,000,000 Each occurrence as respect Bodily Injury Liability or Property Damage Liability, or both combined.
- \$2,000,000 Per Job General Aggregate
- \$1,000,000 Personal and Advertising Injury
- \$2,000,000 Products and Completed Operations Aggregate

- (c) Motor Vehicle Liability Insurance, including Michigan No-Fault Coverages, equivalent to, as a minimum, Insurance Services Office form CA 00 01 07 97 or current equivalent. Coverage shall include all owned vehicles, all non-owned vehicles and all hired vehicles. The City of Ann Arbor shall be named as an additional insured. There shall be no added exclusions or limiting endorsements which diminish the City's protections as an additional insured under the policy. Further, the limits of liability shall be \$1,000,000 for each occurrence as respects Bodily Injury Liability or Property Damage Liability, or both combined.
- (d) Umbrella/Excess Liability Insurance shall be provided to apply excess of the Commercial General Liability, Employers Liability and the Motor Vehicle coverage enumerated above, for each occurrence and for aggregate in the amount of \$1,000,000.
- (2) Insurance required under subsection (1)(b) and (1)(c) above shall be considered primary as respects any other valid or collectible insurance that the City may possess, including any self-insured retentions the City may have; and any other insurance the City does possess shall be considered excess insurance only and shall not be required to contribute with this insurance. Further, the Contractor agrees to waive any right of recovery by its insurer against the City.
- (3) Insurance companies and policy forms are subject to approval of the City Attorney, which approval shall not be unreasonably withheld. Documentation must provide and demonstrate an unconditional 30 day written notice of cancellation in favor of the City of Ann Arbor. Further, the documentation must explicitly state the following: (a) the policy number; name of insurance company; name and address of the agent or authorized representative; name and address of insured; project name; policy expiration date; and specific coverage amounts; (b) any deductibles or self-insured retentions which shall be approved by the City, in its sole discretion; (c) that the policy conforms to the requirements specified Contractor shall furnish the City with satisfactory certificates of insurance and endorsements prior to commencement of any work. Upon request, the Contractor shall provide within 30 days a copy of the policy(ies) to the City. If any of the above coverages expire by their terms during the term of this Contract, the Contractor shall deliver proof of renewal and/or new policies and endorsements to the Administering Service Area/Unit at least ten days prior to the expiration date.
- (4) Any Insurance provider of Contractor shall be admitted and authorized to do business in the State of Michigan and shall carry and maintain a minimum rating assigned by A.M. Best & Company's Key Rating Guide of "A-" Overall and a minimum Financial Size Category of "V". Insurance policies and certificates issued by non-admitted insurance companies are not acceptable unless approved in writing by the City.
- (5) City reserves the right to require additional coverage and/or coverage amounts as may be included from time to time in the Detailed Specifications for the Project.
- (6) The provisions of General Condition 28 shall survive the expiration or earlier termination of this contract for any reason.

Section 29 - Surety Bonds

Bonds will be required from the successful bidder as follows:

- (1) A Performance Bond to the City of Ann Arbor for the amount of the bid(s) accepted;
- (2) A Labor and Material Bond to the City of Ann Arbor for the amount of the bid(s) accepted.

Bonds shall be executed on forms supplied by the City in a manner and by a Surety Company authorized to transact business in Michigan and satisfactory to the City Attorney.

Section 30 - Damage Claims

The Contractor shall be held responsible for all damages to property of the City or others, caused by or resulting from the negligence of the Contractor, its employees, or agents during the progress of or connected with the prosecution of the work, whether within the limits of the work or elsewhere. The Contractor must restore all property injured including sidewalks, curbing, sodding, pipes, conduit, sewers or other public or private property to not less than its original condition with new work.

Section 31 - Refusal to Obey Instructions

If the Contractor refuses to obey the instructions of the Supervising Professional, the Supervising Professional shall withdraw inspection from the work, and no payments will be made for work performed thereafter nor may work be performed thereafter until the Supervising Professional shall have again authorized the work to proceed.

Section 32 - Assignment

Neither party to the Contract shall assign the Contract without the written consent of the other. The Contractor may assign any monies due to it to a third party acceptable to the City.

Section 33 - Rights of Various Interests

Whenever work being done by the City's forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the Supervising Professional, to secure the completion of the various portions of the work in general harmony.

The Contractor is responsible to coordinate all aspects of the work, including coordination of, and with, utility companies and other contractors whose work impacts this project.

Section 34 - Subcontracts

The Contractor shall not award any work to any subcontractor without prior written approval of the City. The approval will not be given until the Contractor submits to the City a written statement concerning the proposed award to the subcontractor. The statement shall contain all information the City may require.

The Contractor shall be as fully responsible to the City for the acts and omissions of its subcontractors, and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it.

The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of the General Conditions and all other contract documents applicable to the work of the subcontractors and to give the Contractor the same power to terminate any subcontract that the City may exercise over the Contractor under any provision of the contract documents.

Nothing contained in the contract documents shall create any contractual relation between any subcontractor and the City.

Section 35 - Supervising Professional's Status

The Supervising Professional has the right to inspect any or all work. The Supervising Professional has authority to stop the work whenever stoppage may be appropriate to insure the proper execution of the Contract. The Supervising Professional has the authority to reject all work and materials which do not conform to the Contract and to decide questions which arise in the execution of the work.

The Supervising Professional shall make all measurements and determinations of quantities. Those measurements and determinations are final and conclusive between the parties.

Section 36 - Supervising Professional's Decisions

The Supervising Professional shall, within a reasonable time after their presentation to the Supervising Professional, make decisions in writing on all claims of the City or the Contractor and on all other matters relating to the execution and progress of the work or the interpretation of the contract documents.

Section 37 - Storing Materials and Supplies

Materials and supplies may be stored at the site of the work at locations agreeable to the City unless specific exception is listed elsewhere in these documents. Ample way for foot traffic and drainage must be provided, and gutters must, at all times, be kept free from obstruction. Traffic on streets shall be interfered with as little as possible. The Contractor may not enter or occupy with agents, employees, tools, or material any private property without first obtaining written permission from its owner. A copy of the permission shall be furnished to the Supervising Professional.

Section 38 - Lands for Work

The Contractor shall provide, at its own expense and without liability to the City, any additional land and access that may be required for temporary construction facilities or for storage of materials.

Section 39 - Cleaning Up

The Contractor shall, as directed by the Supervising Professional, remove at its own expense from the City's property and from all public and private property all temporary structures, rubbish and waste materials resulting from its operations unless otherwise specifically approved, in writing, by the Supervising Professional.

Section 40 - Salvage

The Supervising Professional may designate for salvage any materials from existing structures or underground services. Materials so designated remain City property and shall be transported or stored at a location as the Supervising Professional may direct.

Section 41 - Night, Saturday or Sunday Work

No night or Sunday work (without prior written City approval) will be permitted except in the case of an emergency and then only to the extent absolutely necessary. The City may allow night work which, in the opinion of the Supervising Professional, can be satisfactorily performed at night. Night work is any work between 8:00 p.m. and 7:00 a.m. No Saturday work will be permitted unless the Contractor gives the Supervising Professional at least 48 hours but not more than 5 days' notice of the Contractor's intention to work the upcoming Saturday.

Section 42 - Sales Taxes

Under State law the City is exempt from the assessment of State Sales Tax on its direct purchases. Contractors who acquire materials, equipment, supplies, etc. for incorporation in City projects are not likewise exempt. State Law shall prevail. The Bidder shall familiarize itself with the State Law and prepare its Bid accordingly. No extra payment will be allowed under this Contract for failure of the Contractor to make proper allowance in this bid for taxes it must pay.

Section 43 - CONTRACTOR'S DECLARATION

I hereby declare that I have not, during the period _____, 2019, to _____, 2019, performed any work, furnished any materials, sustained any loss, damage or delay, or otherwise done anything in addition to the regular items (or executed change orders) set forth in the Contract titled _____, for which I shall ask, demand, sue for, or claim compensation or extension of time from the City, except as I hereby make claim for additional compensation or extension of time as set forth on the attached itemized statement. I further declare that I have paid all payroll obligations related to this Contract that have become due during the above period and that all invoices related to this Contract received more than 30 days prior to this declaration have been paid in full except as listed below.

There is/is not (Contractor please circle one and strike one as appropriate) an itemized statement attached regarding a request for additional compensation or extension of time.

Contractor

Date

By _____
(Signature)

Its _____
(Title of Office)

Past due invoices, if any, are listed below.

Section 44

CONTRACTOR'S AFFIDAVIT

The undersigned Contractor, _____, represents that on _____, 2019, it was awarded a contract by the City of Ann Arbor, Michigan to _____ under the terms and conditions of a Contract titled _____. The Contractor represents that all work has now been accomplished and the Contract is complete.

The Contractor warrants and certifies that all of its indebtedness arising by reason of the Contract has been fully paid or satisfactorily secured; and that all claims from subcontractors and others for labor and material used in accomplishing the project, as well as all other claims arising from the performance of the Contract, have been fully paid or satisfactorily settled. The Contractor agrees that, if any claim should hereafter arise, it shall assume responsibility for it immediately upon request to do so by the City of Ann Arbor.

The Contractor, for valuable consideration received, does further waive, release and relinquish any and all claims or right of lien which the Contractor now has or may acquire upon the subject premises for labor and material used in the project owned by the City of Ann Arbor.

This affidavit is freely and voluntarily given with full knowledge of the facts.

Contractor

Date

By _____
(Signature)

Its _____
(Title of Office)

Subscribed and sworn to before me, on this _____ day of _____, 2019
_____, _____ County, Michigan

Notary Public
_____ County, MI

My commission expires on:

STANDARD SPECIFICATIONS

All work under this contract shall be performed in accordance with the Public Services Department Standard Specifications in effect at the date of availability of the contract documents stipulated in the Bid. All work under this Contract which is not included in these Standard Specifications, or which is performed using modifications to these Standard Specifications, shall be performed in accordance with the Detailed Specifications included in these contract documents.

Standard Specifications are available online:

<http://www.a2gov.org/departments/engineering/Pages/Engineering-and-Contractor-Resources.aspx>

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The completed Work will provide Owner with a fully functional ultraviolet light (UV) disinfection system at the Ann Arbor Water Treatment Plant and includes:
1. UV disinfection equipment installed on the discharge of existing pumps in an existing water plant room.
 2. Demolition of existing piping and grating/stairs.
 3. Removal and replacement of existing piping and valves.
 4. Piping, valves, flowmeters and analytical monitoring equipment.
 5. New grating, stairs, handrails and supports.
 6. Instrumentation, controls and integration services associated with the new equipment.
 7. Electrical and lighting work for the new equipment.
 8. Painting of piping and concrete walls/ceilings.
 9. The foregoing description(s) shall not be construed as a complete description of all work required.

1.02 CONTRACT DOCUMENTS

- A. Where references in the Contract Documents are made to Contractors for specific disciplines of work (e.g. Electrical Contractor, etc.), these references shall be interpreted to be the single prime Contractor when the project is bid or awarded as a single prime contract.
- B. The prime Contractor shall be responsible for all work in the Contract Documents regardless of the division of disciplines.
- C. The Contractor shall be responsible for the production of construction sets.
- D. The General Conditions refer to and define a “Supervising Professional”. The terms “Engineer” or “Owner’s Representative” shall be synonymous with Supervising Professional.
- E. The term “City of Ann Arbor” or the “City” shall be synonymous with “Owner”.

1.03 GENERAL ARRANGEMENT

- A. Drawings indicate the extent and general arrangement of the work. If any departures from the Drawings are deemed necessary by the Contractor to accommodate the materials and equipment Contractor proposes to furnish, details of such departures and reasons therefore shall be submitted as soon as practicable to the Engineer for approval by Owner and Engineer. No such departures shall be made without the prior written approval of the Owner or Engineer. Approved changes shall be made without additional cost to the Owner for this work or related work under other Contracts of the Project.
- B. The specific equipment proposed for use by the Contractor on the project may require changes in structures, auxiliary equipment, piping, electrical, mechanical, controls or other work to provide a complete satisfactory operating installation. The Contractor shall submit to the Engineer, for approval by Owner and Engineer, all necessary Drawings and details showing such changes to verify conformance with the overall project structural and architectural requirements and overall project operating performance. The Bid Price shall include all costs in connection with the preparation of new drawings and details and all changes to construction work to accommodate the proposed equipment, including increases in the costs of other Contracts.

1.04 CONSTRUCTION PERMITS

- A. The Owner shall obtain or cause to be obtained all permanent and temporary construction easements required. No easements are anticipated for this project.
- B. The Contractor shall obtain, keep current and pay all fees for any other necessary construction permits from those authorities, agencies, or municipalities having jurisdiction over land areas, utilities, or structures which are located within the Contract limits and which will be occupied, encountered, used, or temporarily interrupted by the Contractor's operations unless otherwise stated. Contractor shall pay plan review fees and any other fees for required permits. Record copies of all permits shall be furnished to the Engineer and Owner.
- C. When construction permits are accompanied by regulations or requirements issued by a particular authority, agency or municipality, it shall be the Contractor's operations unless otherwise stated. Contractor shall pay plan review fees and any other fees for required permits. Record copies of all permits shall be furnished to the Engineer and Owner.
- D. The Contractor will be required to follow the requirements established by all permits necessary for the construction of this project. The following is a list of all permits that must be obtained prior to the beginning of construction.
 - 1. MEDQ Permit for Water System Construction (Part 399).

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Applicable City Building Permits (all trades).

- E. The permit for water system construction will be applied for and obtained by the Owner through the Michigan Department of Environmental Quality. The Contractor shall obtain a copy of this permit from the Engineer prior to construction.
- F. The permits for the various trades shall be applied for and paid for by the Contractor. The Contractor must submit a copy of these permits to the Engineer prior to construction.
- G. Charges assessed to the Contractor for additional engineering and inspection costs will be determined bases on actual hours charged to the job by the Engineer. Daily rates will depend on the number and classifications of employees involved, but in no case shall such charges exceed \$900 per day for field personnel and \$1,100 per day for engineering personnel, based on an eight hour workday.
- H. Charges for additional Owner's expenses shall be in addition to any liquidated damages assessed in accordance with the Contract.

1.05 PROTECTION OF WORK

- A. Unless otherwise specifically permitted, all work that would be subject to damage shall be stopped during inclement, stormy or freezing weather. Only such work as will not suffer injury to workmanship or materials will be permitted. Contractor shall carefully protect the work against damage or injury from the weather, and when work is permitted during freezing weather, Contractor shall provide and maintain approved facilities for heating the materials and for protecting the finished work.

1.06 ULTIMATE DISPOSITION OF CLAIMS BY ONE CONTRACTOR ARISING FROM ALLEGED DAMAGE BY ANOTHER CONTRACTOR

- A. During the progress of the work, other Contractors may be engaged in performing other work or may be awarded other Contracts for additional work on this project and/or on this site. In that event, the Contractor shall coordinate the work to be done hereunder with the work of such other Contractors and the Contractor shall fully cooperate with such other Contractors and carefully fit its own work to that provided under other Contracts as may be directed by the Owner. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other Contractor.

- B. If the Owner shall determine that the Contractor is failing to coordinate this work with the work of the other Contracts as the Owner directed, then the Owner shall have the right to withhold any payments otherwise due hereunder until the Contractor completely complies with the Owner's directions.
- C. If the Contractor notifies the Owner in writing that another Contractor is failing to coordinate his work with the work of this Contract as directed, the Owner will promptly investigate the charge. If the Owner finds it to be true, he will promptly issue such directions to the other Contractor with respect thereto as the situation may require. The Owner, the Engineer, nor any of their agents shall not, however, be liable for any damages suffered by the Contractor by reason of the other Contractor's failure to promptly comply with the directions so issued by the Owner, or by reason of another Contractor's default in performance, it being understood that the Owner does not guarantee the responsibility or continued efficiency of any Contractor.
- D. The Contractor shall indemnify and hold the Owner and the Engineer harmless from any and all claims of judgements for damages and from costs and expenses to which the Owner may be subjected or which it may suffer or incur by reason of the Contractor's failure to comply with the Owner's directions promptly.
- E. Should the Contractor sustain any damage through any act of omission of any other Contractor having a Contract with the Owner for the performance of work upon the site or of work which may be necessary to be performed for the proper execution of the work to be performed hereunder, or through any act or omission of a Subcontractor of such Contract, the Contractor shall have no claim against the Owner or the Engineer for such damage, but shall have a right to recover such damage from the other Contractor.
- F. Should any other Contractor having or who shall hereafter have a Contract with the Owner for the performance of work upon the site sustain any damage through any act or omission of the Contractor hereunder or through any act or omission of any Subcontractor of the Contractor, the Contractor agrees to reimburse such other Contractor for all such damages and to defend at his own expense any suit based upon such claim and if any judgment or claims against the Owner shall be allowed, the Contractor shall pay or satisfy such judgement or claim and pay all costs and expenses in connection therewith and shall indemnify and hold the Owner harmless from all such claims.
- G. The Owner's right to indemnification hereunder shall in no way be diminished, waived or discharged, by its recourse to assessment of liquidated damages as provided in the Contract, or by the exercise of any other remedy provided for by Contract Documents or by law.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

1.07 LIMITS OF WORK AREA

- A. The Contractor shall confine the construction operations within the Contract limits shown on the Drawings and/or property lines and/or fence lines. Storage of equipment and materials, or erection and use of sheds outside of the Contract limits, if such areas are the property of the Owner, shall be used only with the Owner's approval. Such storage or temporary structures, even within the Contractor's limits, shall be confined to the Owner's property and shall not be placed on properties designated as easements or rights-of-way unless specifically permitted elsewhere in the Contract Documents.

1.08 USE OF FACILITIES BEFORE COMPLETION

- A. The Owner reserves the right to enter and use any portion of the constructed facilities before final completion of the whole work to be done under this Contract. However, only those portions of the facilities which have been completed to the Owner's satisfaction, as evidenced by issuing a Certificate of Partial Completion covering that part of the work, shall be placed in service.
- B. It shall be the Owner's responsibility to prevent premature connections to or use of any portion of the installed facilities by private or public parties, persons or groups of persons, before the Owner issues the Certificate of Partial Completion covering that portion of the work to be placed in service.
- C. Consistent with the approved progress schedule, the Contractor shall cooperate with the Owner, his agents, and the Engineer to accelerate completion of those facilities, or portions thereof, which have been designated for early use by the Owner.

1.09 PIPING, VALVES AND SUPPORTS

- A. Various pipelines and conduits are shown on the Plans in diagram form. Where such pipelines and conduits are shown only in diagram, they shall be arranged clear of other pipelines, equipment and walking areas, and be accessible for maintenance. Such pipelines shall be fitted and installed in a neat and workmanlike manner in accordance with approved shop drawings. An adequate number of unions shall be provided in main pipe and branch pipe runs to facilitate dismantling or removal of pipeline sections without disturbing adjacent branch or connecting lines. Pipe and conduit supports shall be designed by Contractor and approved by Engineer unless noted otherwise in the Contract Documents.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. All materials, supplies and equipment, whether furnished by the Contractor or by the Owner, shall be delivered, stored and handled as to prevent the inclusion of foreign materials and/or damage by water, freezing, breakage or other causes. The Owner may require the Contractor to provide an enclosed storage shed for the storage of the above mentioned materials, supplies and equipment. Packaged materials shall be delivered in the original unopened containers and shall be stored until ready for use. All materials which have been stored shall meet the requirements of the Specifications at the time they are used in the project.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 PROPOSAL REQUESTS

- A. Owner may, in anticipation of ordering an addition, deletion, or revision to the Work, request Contractor to prepare a detailed proposal of cost and times to perform contemplated change.
- B. Proposal request will include reference number for tracking purposes and detailed description of and reason for proposed change, and such additional information as appropriate and as may be required for Contractor to accurately estimate cost and time impact on Project.
- C. Proposal request is for information only; Contractor is neither authorized to execute proposed change nor to stop Work in progress as result of such request.
- D. Contractor's written proposal shall be transmitted to Owner promptly, but not later than 14 days after Contractor's receipt of Owner's written request. Proposal shall remain firm for a maximum period of 45 days after receipt by Engineer.
- E. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a Claim for an adjustment in Contract Price or Contract Times (or Milestones).

1.02 CLAIMS

- A. Include, at a minimum:
 - 1. Specific references including (i) Drawing numbers, (ii) Specification section and article/paragraph number, and (iii) Submittal type, Submittal number, date reviewed, Engineer's comment, as applicable, with appropriate attachments.
 - 2. Stipulated facts and pertinent documents, including photographs and statements.
 - 3. Interpretations relied upon.
 - 4. Description of (i) nature and extent of Claim, (ii) who or what caused the situation, (iii) impact to the Work and work of others, and (iv) discussion of claimant's justification for requesting a change to price or times or both.

5. Estimated adjustment in price claimant believes it is entitled to with full documentation and justification.
6. Requested Change in Contract Times: Include at least (i) Progress Schedule documentation showing logic diagram for request, (ii) documentation that float times available for Work have been used, and (iii) revised activity logic with durations including sub-network logic revisions, duration changes, and other interrelated schedule impacts, as appropriate.
7. Documentation as may be necessary as set forth below for Work Change Directive, and as Engineer may otherwise require.

1.03 WORK CHANGE DIRECTIVES

A. Procedures:

1. Engineer will:
 - a. Initiate, including a description of the Work involved and any attachments.
 - b. Affix signature, demonstrating Engineer's recommendation.
 - c. Transmit to Owner for authorization.
2. Owner will:
 - a. Affix signature, demonstrating approval of the changes involved.
 - b. Return copies to Engineer, who will retain one copy, send a copy to the field representative, and forward a copy to Contractor.
3. Upon completion of Work covered by the Work Change Directive or when final Contract Times and Contract Price are determined, Contractor shall submit documentation for inclusion in a Change Order.
4. Contractor's documentation shall include but not be limited to:
 - a. Appropriately detailed records of Work performed to enable determination of value of the Work.
 - b. Full information required to substantiate resulting change in Contract Times and Contract Price for Work. On request of Engineer, provide additional data necessary to support documentation.
 - c. Support data for Work performed on a unit price or Cost of the Work basis with additional information such as:
 - 1) Dates Work was performed, and by whom.
 - 2) Time records, wage rates paid, and equipment rental rates.
 - 3) Invoices and receipts for materials, equipment, and subcontracts, all similarly documented.

- B. Effective Date of Work Change Directive: Date of signature by Owner, unless otherwise indicated thereon.

1.04 CHANGE ORDERS

A. Procedure:

1. Engineer will prepare copies of proposed Change Order and transmit such with Engineer's written recommendation and request to Contractor for signature.
2. Contractor shall, upon receipt, either: (i) promptly sign copies, retaining one for its file, and return remaining copies to Engineer for Owner's signature, or (ii) return unsigned copies with written justification for not executing Change Order.
3. Engineer will, upon receipt of Contractor signed copies, promptly forward Engineer's written recommendation and partially executed copies for Owner's signature, or if Contractor fails to execute the Change Order, Engineer will promptly so notify Owner and transmit Contractor's justification to Owner.
4. Upon receipt of Contractor-executed Change Order, Owner will promptly either:
 - a. Execute Change Order, retaining a copy for its file and returning a copy to Engineer; or
 - b. Return to Engineer unsigned copies with written justification for not executing Change Order.
5. Upon receipt of Owner-executed Change Order, Engineer will transmit copies to Contractor, or other field representative, and retain a copy, or if Owner fails to execute the Change Order, Engineer will promptly so notify Contractor and transmit Owner's justification to Contractor.
6. Upon receipt of Owner-executed Change Order, Contractor shall:
 - a. Perform Work covered by Change Order.
 - b. Revise Schedule of Values to adjust Contract Price and submit with next Application for Payment.
 - c. Revise Progress Schedule to reflect changes in Contract Times, if any, and to adjust times for other items of Work affected by change.
 - d. Enter changes in Project record documents after completion of change related Work.

B. In signing a Change Order, Owner and Contractor acknowledge and agree that:

1. Stipulated compensation (Contract Price or Contract Times, or both) set forth includes payment for (i) the Cost of the Work covered by the Change Order, (ii) Contractor's fee for overhead and profit, (iii) interruption of Progress Schedule, (iv) delay and impact, including cumulative impact, on other Work under the Contract Documents, and (v) extended overheads.

2. Change Order constitutes full mutual accord and satisfaction for the change to the Work.
3. Unless otherwise stated in the Change Order, all requirements of the original Contract Documents apply to the Work covered by the Change Order.

1.05 COST OF THE WORK

- A. In determining the supplemental costs allowed in the General Conditions for rental equipment and machinery, the following will apply.
- B. Rental of construction equipment and machinery and the parts thereof having a replacement value in excess of \$1,000, whether owned by Contractor or rented or leased from others, shall meet the following requirements:
 1. Full rental costs for leased equipment shall not exceed rates listed in the Rental Rate Blue Book published by Equipment Watch, as adjusted to the regional area of the Project. Owned equipment costs shall not exceed the single shift rates established in the Cost Reference Guide (CRG) published by Equipment Watch. The most recent published edition in effect at commencement of actual equipment use shall be used.
 2. Rates shall apply to equipment in good working condition. Equipment not in good condition, or larger than required, may be rejected by Engineer or accepted at reduced rates.
 3. Leased Equipment: For equipment leased or rented in arm's length transactions from outside vendors, maximum rates shall be determined by the following actual usage/Payment Category:
 - a. Less than 8 hours: Hourly rate.
 - b. 8 or more hours but less than 7 days: Daily rate.
 - c. 7 or more days but less than 30 days: Weekly rate.
 - d. 30 days or more: Monthly rate.
 4. Arm's length rental and lease transactions are those in which the firm involved in the rental or lease of equipment is not associated with, owned by, have common management, directorship, facilities and/or stockholders with the firm renting the equipment.
 5. Financial arrangements associated with rental and lease transactions that provide Contractor remuneration or discounts not visible to the Owner must be disclosed and integrated with charged rates.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

6. Leased Equipment in Use: Actual equipment use time documented by Engineer shall be the basis that equipment was on and utilized at the Project Site. In addition to the leasing rate above, equipment operational costs shall be paid at the estimated hourly operating cost rate set forth in the Rental Rate Blue Book if not already included in the lease rate. Hours of operation shall be based upon actual equipment usage to the nearest quarter hour, as recorded by Engineer.
7. Leased Equipment, When Idle (Standby): Idle or standby equipment is equipment onsite or in transit to and from the Work Site and necessary to perform the Work under the modification, but not in actual use. Idle equipment time, as documented by Engineer, shall be paid at the leasing rate determined above, excluding operational costs.
8. Owned and Other Equipment in Use: Equipment rates for owned equipment or equipment provided in other than arm's length transaction shall not exceed the single shift total hourly costs rate developed in accordance with the CRG and as modified herein for multiple shifts. This total hourly rate will be paid for each hour the equipment actually performs work. Hours of operation shall be based upon actual equipment usage as recorded by Engineer. This rate shall represent payment in full for Contractor's direct costs.
9. Owned and Other Equipment, When Idle (Standby): Equipment necessary to be onsite to perform the Work on single shift operations, but not utilized, shall be paid for at the ownership hourly expense rate developed in accordance with the CRG, provided its presence and necessity onsite has been documented by Engineer. Payment for idle time of portions of a normal workday, in conjunction with original contract Work, will not be allowed. In no event shall idle time claimed in a day for a particular piece of equipment exceed the normal Work or shift schedule established for the Project. It is agreed that this rate shall represent payment in full for Contractor's direct costs. When Engineer determines that the equipment is not needed to continuously remain at the Work Site, payment will be limited to actual hours in use.
10. Owned and Other Equipment, Multiple Shifts: For multiple shift operations, the CRG single shift total hourly costs rate shall apply to the operating equipment during the first shift. For subsequent shifts, up to two in a 24-hour day, operating rate shall be the sum of the total hourly CRG operating cost and 60 percent of the CRG ownership and overhaul expense. Payment for idle or standby time for second and third shifts shall be 20 percent of the CRG ownership and overhaul expense.

11. When necessary to obtain owned equipment from sources beyond the Project limits, the actual cost to transfer equipment to the Site and return it to its original location will be allowed as an additional item of expense. Move-in and move-out allowances will not be made for equipment brought to the Project if the equipment is also used on original Contract or related Work.
12. If the move-out destination is not to the original location, payment for move-out will not exceed payment for move-in.
13. If move is made by common carrier, the allowance will be the amount paid for the freight. If equipment is hauled with Contractor's own forces, rental will be allowed for the hauling unit plus the hauling unit operator's wage. If equipment is transferred under its own power, the rental will be 75 percent of the appropriate total hourly costs for the equipment, without attachments, plus the equipment operator's wage.
14. Charges for time utilized in servicing equipment to ready it for use prior to moving and similar charges will not be allowed.
15. When a breakdown occurs on any piece of owned equipment, payment shall cease for that equipment and any other owned equipment idled by the breakdown.
16. If any part of the Work is shut down by Owner, standby time will be paid during nonoperating hours if diversion of equipment to other Work is not practicable. Engineer reserves the right to cease standby time payment when an extended shutdown is anticipated.
17. If a rate has not been established in the CRG for owned equipment, Contractor may:
 - a. If approved by Engineer, use the rate of the most similar model found, considering such characteristics as manufacturer, capacity, horsepower, age, and fuel type, or
 - b. Request Equipment Watch to furnish a written response for a rate on the equipment, which shall be presented to Engineer for approval; or
 - c. Request Engineer to establish a rate.

1.06 FIELD ORDER

- A. Engineer will issue Field Orders, with three copies to Contractor.
- B. Effective date of the Field Order shall be the date of signature by Engineer, unless otherwise indicated thereon.
- C. Contractor shall acknowledge receipt by signing and returning one copy to Engineer.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- D. Field Orders will be incorporated into subsequent Change Orders, as a no-cost change to the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 29 00
PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Informational Submittals:
 - 1. Schedule of Values: Submit on Contractor's standard form.
 - 2. Application for Payment.
 - 3. Final Application for Payment.

1.02 SCHEDULE OF VALUES

- A. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.
- B. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.
- C. Lump Sum Work:
 - 1. Reflect specified cash and contingency allowances and alternates, as applicable.
 - 2. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, training, O&M manuals and contract closeout separately.
 - a. Mobilization includes, at minimum, items identified in Section 01 50 00, Temporary Facilities and Controls.
 - b. Include item(s) for monthly progress schedule update.
- D. An unbalanced or front-end loaded schedule will not be acceptable.
- E. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

1.03 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

- A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.

- B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.04 APPLICATION FOR PAYMENT

- A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.
- B. Use detailed Application for Payment Form in standard AIA format.
- C. Provide separate form for each schedule as applicable.
- D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.
- E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.
- F. Preparation:
 - 1. Round values to nearest dollar.
 - 2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.05 MEASUREMENT—GENERAL

- A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.
- B. Whenever pay quantities of material are determined by weight, weigh material on scales furnished by Contractor and certified accurate by state agency responsible. Obtain weight or load slip from weigher and deliver to Owner's representative at point of delivery of material.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- C. If material is shipped by rail, car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.
- D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by Engineer. Each vehicle shall bear a plainly legible identification mark.
- E. Units of measure shown on Bid Form shall be as follows, unless specified otherwise.

Item	Method of Measurement
AC	Acre—Field Measure by Engineer
CY	Cubic Yard—Field Measure by Engineer within limits specified or shown
CY-VM	Cubic Yard—Measured in Vehicle by Volume
EA	Each—Field Count by Engineer
GAL	Gallon—Field Measure by Engineer
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by Engineer
MFBM	Thousand Foot Board Measure
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

1.06 PAYMENT

- A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.
- B. Payment for Lump Sum Work covers all Work specified or shown within the limits or Specification sections.

1.07 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

- A. Payment will not be made for following:
1. Loading, hauling, and disposing of rejected material.
 2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
 3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
 4. Material not unloaded from transporting vehicle.
 5. Defective Work not accepted by Owner.
 6. Material remaining on hand after completion of Work.

1.08 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer.
- B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.09 PARTIAL PAYMENT FOR UNDELIVERED, PROJECT-SPECIFIC MANUFACTURED OR FABRICATED EQUIPMENT

- A. Notwithstanding above provisions, partial payments for undelivered (not yet delivered to Site or not stored in the vicinity of Site) products specifically manufactured for this Project, excluding off the shelf or catalog items, will be made for products listed below when all following conditions exist:
1. Partial payment request is supported by written acknowledgment from Suppliers that invoice requirements have been met.
 2. Equipment is adequately insured, maintained, stored, and protected by appropriate security measures.
 3. Each equipment item is clearly marked and segregated from other items to permit inventory and accountability.
 4. Authorization has been provided for access to storage Site for Engineer and Owner.
 5. Equipment meets applicable Specifications of these Contract Documents.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

B. Applicable Items:

Specification Section	Specific Product
44 44 73	UV Disinfection Equipment

- C. Payment of 5 percent of manufacturer's quoted price for undelivered, Project-specific manufactured equipment will be made following Shop Drawing approval.
- D. Payment of 20 percent of manufacturer's quoted price will be made following accepted delivery, unloading and storage.
- E. Payment of 25 percent of manufacturer's quoted price will be made following signed certificate of proper installation.
- F. Payment of 40 percent of manufacturer's quoted price will be made following substantial completion.
- G. Failure of Contractor to continue compliance with above requirements shall give cause for Owner to withhold payments made for such equipment from future partial payments.

1.10 ADDITIONAL ENGINEERING SERVICES

- A. In the event that the Engineer is required to provide additional engineering services as a result of substitution of materials or equipment which are not 'or equal' by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the Owner.
- B. Structural design shown on the Contract Drawings is based upon typical weights for major items of equipment as indicated on the Contract Drawings and specified. If the equipment furnished exceeds the weights of said equipment, the Contractor shall assume the responsibility for all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's expenses in connection therewith.

- C. In the event that the Engineer is required to provide additional engineering services as a result of Contractor's errors, omissions, or failure to conform to the requirements of the Contract Documents, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Engineer's charges in connection with such connection with such additional services shall be charged to the Contractor by the Owner.

1.11 ADDITIONAL OWNER'S EXPENSES

- A. In the event the Work of this Contract is not completed within the time set forth in the Contract or within the time to which such completion may have been extended in accordance with the Contract Documents, the additional engineering or inspection charges incurred by the Owner may be charged to the Contractor and deducted from the monies due the Contractor. Extra work or supplemental Contract work added to the original Contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due consideration by the Owner before assessing engineering and inspection charges against the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 31 13
PROJECT COORDINATION**

PART 1 GENERAL

1.01 RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, listed henceforth, is anticipated to be performed at Site by others.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
3. Include sequencing constraints specified herein as a part of Progress Schedule.

B. Related work:

1. The following work may be done by other contractors during this project.
 - a. Lime sludge dewatering.
 - b. SCADA system improvements.
 - c. Masonry and roofing replacement.

C. Schedule: For general guidance only, the anticipated Notice to Proceed date is August 1, 2019.

1.02 FACILITY OPERATIONS

- A. Continuous operation of Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.
- B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.
- C. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner's facility.
- D. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Engineer. Such authorization will be considered within 48 hours after receipt of Contractor's written request.

- E. Process or Facility Shutdown:
 - 1. Provide 10 days advance written request for approval of need to shut down a process or facility to Owner and Engineer.
 - 2. Power outages will be considered upon 48 hours written request to Owner and Engineer. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components.
- F. Do not proceed with Work affecting a facility's operation without obtaining Owner's and Engineer's advance approval of the need for and duration of such Work.
- G. Relocation of Existing Facilities:
 - 1. During construction, it is expected that minor relocations of Work will be necessary.
 - 2. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
 - 3. Perform relocations to minimize downtime of existing facilities.
 - 4. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.

1.03 WORK SEQUENCING/CONSTRAINTS

- A. Include the following work sequences in the Progress Schedule.
- B. Construct Work in the following stages to allow for Owner's continuous occupancy and for uninterrupted operation during construction.
- C. The following sequence of work is provided to meet project objectives and maintain water plant production of safe water. Alternatives proposed by Contractor must be approved by Owner and Engineer.
- D. The overall objective is to get the UV system operational as soon as possible, while minimizing impacts to transfer pump and clearwell operation. Contractor may start installing the UV system piping, valves and other components not impacted by Transfer pumps 4-6 after Notice to Proceed. Clearwell 1 work, including the interconnecting piping can start in October. Clearwell 1 and the associated transfer pumps 1-3 will remain operational for most of the project, except for a short time when the interconnecting pipe is installed. Clearwell 2 and transfer pump 6 will remain operational for most of the project, except for a short time when clearwell 2 work is done, and the transfer pump 4-6 piping is connected to the UV system. More specific instructions are below.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

1. UV System:
 - a. Any component of the project, such as the UV system, including pipes, valves, flowmeters, grating, control panels, analyzers not connected to the existing transfer pumps 4-6 and existing backwash and discharge pipe to the reservoir shall be installed as soon as possible. This work can begin after Notice to Proceed.
 - b. Piping and equipment from the upstream UV flowmeter valves to the downstream UV valves are included in the work described in item 1a.
 - c. Transfer pumps 4-6 and associated discharge piping shall remain operational during the work described in items 1a and 1b.
2. Clearwell 1:
 - a. The earliest start date for this work is in Table 1.
 - b. Owner will remove water in Clearwell 1.
 - c. Owner will close the valve interconnecting Clearwell 1 and 2 to the best of their ability. There will be leakage through the existing valve. Contractor shall provide equipment to reduce leakage to a manageable level for construction, ensure water does not exceed 6-inches on the floor, and properly dispose of chloraminated water.
 - d. Replace section of 30-inch pipe from Clearwell 1 to existing valve, including installation of one new 30-inch valve closest to Clearwell 1. Close new 30-inch valve.
 - e. Disinfect Clearwell 1 and new piping/valve. Properly dispose of water. When Clearwell 1 has passed bacterial testing, Owner will fill Clearwell 1 and operate with transfer pumps 1 through 3.
 - f. Clearwell 1 and transfer pump 1-3 work shall be completed before the date shown in Table 1. The duration of time that Clearwell 1 and transfer pumps 1-3 can be out of service is in Table 1. Transfer pumps 4-6 must remain operational during this time.
3. Clearwell 2:
 - a. After Clearwell 1 and transfer pumps 1-3 are operational, Owner will remove water in Clearwell 2.
 - b. Install new 30-inch valve and piping closest to Clearwell 2.
 - c. Remove the 16-inch fittings and spool pieces downstream of the vertical elbows from transfer pumps 4 and 5 discharge line, and install blind flanges on the header tees above. Install additional pipe supports as needed.
 - d. Disinfect new piping/valve. Properly dispose of water. When piping has passed bacterial testing, Owner will fill Clearwell 2 and operate with transfer pump 6.
 - e. Clearwell 2 work shall be completed by the date in Table 1.
 - f. The duration of time that Clearwell 2 and transfer pumps 4-6 can be out of service is shown in Table 1. Transfer pumps 1-3 must remain operational during this time.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

4. Transfer Pumps 4-6:
 - a. After item 3 above is complete, Owner will start operating with Transfer pump 6 and the existing reservoir discharge line and backwash line in service.
 - b. Transfer pump 6 and the header pipe going to the backwash supply pump and the reservoir shall remain operational except where specifically stated otherwise below.
 - c. Install transfer pump 4 and 5 new discharge valves and header piping and connect to UV system piping. Transfer pump 6 and associated existing discharge piping shall remain operational to convey water to the reservoir and filter backwash. There may be leakage through the existing pump isolation valves. Contractor shall provide equipment to reduce leakage to a manageable level for construction, ensure water does not exceed 6-inches on the floor, and properly dispose of chloraminated water.
 - d. Owner will shut down Transfer pump 6.
 - e. In no more than the time stated in Table 1, remove the remaining transfer pump 6 and backwash piping and valves to be demolished, and install the remaining new piping and valves. Contractor must work overtime to ensure this work is completed in a timely manner and transfer pumps 4-6 are operational with the new UV piping.
 - f. If the UV reactors are not installed when the new UV piping system is complete, install 24-inch spool pieces so that the UV system piping and transfer pumps 4-6 can be operated.
 - g. Installation of each UV reactor may occur separately by closing UV train isolation valves.
 - h. Disinfect new piping/valves and properly dispose of water immediately after item 4e is completed. When piping has passed bacterial testing, Owner will operate transfer pumps 4 through 6.
 - i. The above work in item 4 shall be completed by the date shown in Table 1.
5. UV System Installation, Testing and Commissioning:
 - a. Once items 1-4 have been completed, any remaining components of the UV system and water quality analyzers can be installed.
 - b. Complete UV system installation, testing, and commissioning as specified herein.
 - c. A summary of the dates, notices to Owner, durations and liquidated damages are in Table 1.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

Table 1 – Ann Arbor WTP UV Disinfection System Interim Milestones and Work Constraints Summary (Note 3).

Item	Notice to Owner	Maximum Work Duration	Dates and Deadlines	Liquidated Damages (Note 3)
Anticipated Notice to Proceed (not Guaranteed)			August 1, 2019	
UV Shop Drawing delivered to Owner.		Within 30 calendar days of Notice to Proceed	September 1, 2019	\$250/day
Delivery of UV equipment to site after approved shop drawings.		12 weeks	January 3, 2020	\$250/day
Clearwell 1 shutdown, interconnect pipe and valve, disinfection.	14 days	10 consecutive calendar days. Notes 1,2	Available window Oct 1 to Nov 1, 2019	\$1,000/day
Clearwell 2 shutdown and interconnect pipe and valve. Transfer pump 4 and 5 blind flange.	14 days	5 consecutive calendar days starting on a Monday. Notes 1,2	From completion of Clearwell 1 work to Dec 1, 2019	\$1,000/day
Shutdown Transfer pumps 4-6 and clearwell 2, remove existing piping and connect to UV piping.	14 days	5 consecutive calendar days, starting on a Monday. Notes 1,2	Complete by April 1, 2020.	\$1,000/day
Disinfect UV piping	5 days	2 days	Starting immediately after UV piping is connected.	
UV startup and performance testing	14 days		Complete by May 1, 2020	
Training and 30-day operational demonstration	30 days	See UV specs for demonstration testing.	Complete by June 5, 2020	
Substantial Completion			June 20, 2020 (Fixed by MDEQ)	See Contract

Notes:

1. During clearwell 1 and 2 shutdowns, Contractor shall work overtime, including Saturdays and Sundays, to complete this work as soon as possible.
2. An incentive of \$1,000 per day shall be paid to the Contractor for early completion.
3. Liquidated damages shall apply for each item in Table 1 that exceeds the assigned maximum duration or deadline. Liquidated damages in Table 1 shall be in addition to liquidated damages in the Contract for substantial and final completion.

1.04 ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

B. Documentation:

1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs.
2. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and is for the protection of adjacent property owners, Contractor, and Owner.

1.05 CONSTRUCTION PHOTOGRAPHS

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. Engineer shall have right to select subject matter and vantage point from which photographs are to be taken.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 100 photographs of Site and property adjacent to perimeter of Site.
2. Particular emphasis shall be directed to structures both inside and outside the Site.

C. Construction Progress Photos:

1. Photographically demonstrate progress of construction, showing every aspect of Site and adjacent properties as well as interior and exterior of new or impacted structures.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Weekly: Take 10 photographs using digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color.

D. Documentation:

1. Digital Images:
 - a. Electronic image shall have date taken embedded into image.
 - b. Archive using a commercially available photo management system that provides listing of photographs including date, keyword description, and direction of photograph.

1.06 REFERENCE POINTS AND SURVEYS

A. Contractor's Responsibilities:

1. Provide survey and layout required to layout the Work.
2. Field measure existing building, piping and equipment locations prior to preparing shop drawings.
3. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
4. In event of discrepancy in data provided by Owner, request clarification before proceeding with Work.
5. Maintain complete accurate log of survey work as it progresses as a Record Document.
6. On request of Engineer, submit documentation.
7. Provide competent employee(s), tools, stakes, and other equipment and materials as Engineer may require to:
 - a. Check layout, survey, and measurement work performed by others.
 - b. Measure quantities for payment purposes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CUTTING, FITTING, AND PATCHING

- A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.
- B. Obtain prior written authorization of Owner before commencing Work to cut or otherwise alter:
 1. Structural or reinforcing steel, structural column or beam, elevated slab, trusses, or other structural member.

2. Weather-resistant or moisture-resistant elements.
 3. Efficiency, maintenance, or safety of element.
 4. Work of others.
- C. Refinish surfaces to provide an even finish.
1. Refinish continuous surfaces to nearest intersection.
 2. Refinish entire assemblies.
 3. Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and the Work is evident in finished surfaces.
- D. Restore existing work, Underground Facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown on Drawings.
- E. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.
- F. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.
- G. Remove specimens of installed Work for testing when requested by Engineer.

3.02 OTHER REQUIREMENTS

- A. No discharge of inadequately treated water shall be allowed. The Contractor shall pay all civil penalties, costs, assessments, etc., associated with any discharge of water from the WTP that does not meet water quality standards, adequate quantity requirements or maintain system pressure requirements, provided the inadequacy was associated with the Contractor's work.
- B. All shutdowns shall be coordinated with and scheduled at times suitable to the Owner. Shutdowns shall not begin until all required materials are on hand and ready for installation. Each shutdown period shall commence at a time approved by the Owner.
- C. The Contractor shall submit a proposed written plan of work, with a request to schedule shutdown work for Owner and Engineer approval. Work plan shall include sequence of events, needs for coordination with plant staff, plans for lock-out/tag-out, contingency plans for how to return equipment and tanks to service early if needed for emergencies, and details of how the duration of the shut-down will be minimized.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- D. Short-term shutdowns (24 hours or less) shall require at least 7 days prior notice to schedule date and time with Owner, unless otherwise noted herein. Once a short-term shutdown starts, Contractor shall work continuously until the work is complete and the disrupted process or system can be returned to service. Long-term shutdowns (longer than 24 hours) shall require at least 14 days prior notice to schedule date and time with Owner, unless otherwise noted herein. The Contractor shall submit a plan of work showing sequence of events throughout shutdown period, and listing all items requiring coordination with Owner's staff. The Contractor shall schedule a coordination meeting with the Owner prior to the initiation of a long-term shutdown. Once a long-term shutdown starts, Contractor shall work on the shutdown area full days, every regular work day, until the work is complete and the disrupted process or system can be returned to service, unless otherwise required herein.
- E. The Owner reserves the right to cancel a scheduled shutdown, without additional compensation due the Contractor, and will consider a contract extension if the cancellation affects the Contractor's critical path.
- F. Shutdowns shall be scheduled between Monday and Friday, unless there are extenuating circumstances approved by the Engineer.
- G. An unobstructed traffic route around the plant site shall be maintained at all times for the Owner's operations personnel, maintenance equipment, and delivery vehicles. Vehicular access to the treatment units, buildings, and bulk chemical storage facilities for Owner personnel and for chemical delivery vehicles shall be maintained at all times by the Contractor except as explicitly permitted hereinafter.
- H. The Contractor will not disturb the maintenance of plant operations without a written and approved plan. These operations at a minimum include chemical deliveries, sludge hauling and general deliveries.
- I. The Contractor will submit plans for approval for any needed outages or disturbances to operations. These plans will include the area, process or systems that will be impacted and duration of the outage. No plans can be implemented without written authorization from Owner or Engineer.
- J. Sump Pumps and Sumps: All existing sumps shall be maintained in an operable condition with either existing pumps or temporary pumps. Interim piping, power and controls shall be provided as required by the staged construction sequence.
- K. Seal Water and Service Water Piping: A supply of service and seal water and the necessary connections to existing equipment shall be maintained during construction. Interim piping shall be provided as required at no added cost to Owner.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- L. Contractor shall install as much of the new pipe that is to replace the existing pipe as feasible prior to shutdown of any pipe, to minimize the duration of the shutdown. All required hydrostatic and bacteriological testing shall be conducted prior to making the final connection. Contractor may install temporary pipe to replace demolished pipe, for Contractor's convenience, at no added cost to the Owner. Temporary pipe shall be of the same diameter and pressure rating as existing piping. Temporary pipe must be disinfected and receive bacteriological testing in accordance with ANSI/AWWA C651 prior to placement in service.
- M. Owner shall be responsible to turn all valves necessary to isolate pipe sections for connection, and to place the new pipe section to service.

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 GENERAL

- A. Owner will schedule physical arrangements for meetings throughout progress of the Work. Contractor shall, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

- A. Contractor shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Status of Bonds and insurance.
3. Sequencing of critical path work items.
4. Progress payment procedures.
5. Project changes and clarification procedures.
6. Use of Site, access, office and storage areas, security and temporary facilities.
7. Major product delivery and priorities.
8. Contractor's safety plan and representative.

- B. Attendees will include:

1. Owner's representatives.
2. Contractor's office representative.
3. Contractor's resident superintendent.
4. Subcontractors' representatives whom Contractor may to attend.
5. Engineer's representatives.
6. Others as appropriate.

1.03 PRELIMINARY SCHEDULES REVIEW MEETING

- A. As set forth in General Conditions and Section 01 32 00, Construction Progress Documentation.

1.04 PROGRESS MEETINGS

- A. Contractor will schedule regular progress meetings at Site, conducted monthly to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.
- B. Attendees will include:
 - 1. Owner's representative(s), as appropriate.
 - 2. Contractor, Subcontractors, and Suppliers, as appropriate.
 - 3. Engineer's representative(s).
 - 4. Others as appropriate.

1.05 PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS)
COORDINATION MEETINGS

- A. Contractor will schedule meetings at Site, conducted as needed to review specific requirements of PICS work.
- B. Attendees will include:
 - 1. Contractor.
 - 2. Owner.
 - 3. PICS Subcontractor/Installer.
 - 4. Engineer's representatives.

1.06 PREINSTALLATION MEETINGS

- A. When required in individual Specification sections, convene at Site prior to commencing the Work of that section.
- B. Require attendance of entities directly affecting, or affected by, the Work of that section.
- C. Notify Engineer 14 days in advance of meeting date.
- D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.07 FACILITY STARTUP MEETINGS

- A. Schedule and attend a minimum of two facility startup meetings. The first of such meetings shall be held prior to submitting Facility Startup Plan, as specified in Section 01 91 14, Equipment Testing and Facility Startup, and shall include preliminary discussions regarding such plan.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.
- C. Attendees will include:
 - 1. Contractor.
 - 2. Contractor's designated quality control representative.
 - 3. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.
 - 4. Engineer's representatives.
 - 5. Owner's operations personnel.
 - 6. Others as required by Contract Documents or as deemed necessary by Contractor.

1.08 OTHER MEETINGS

- A. Pre-Demolition Meetings: Review and discuss sequencing, time limits and operational issues before demolition of equipment, piping and facilities.
- B. Pre-Shut Down Meetings: Review and discuss sequencing, time limits and operational issues before shut down of Owner's facilities (clearwells, pumps, etc.).
- C. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule.
2. Detailed Progress Schedule:
 - a. Submit initial Detailed Progress Schedule within 14 days after Effective Date of the Agreement.
 - b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission:
 - a. Contractor's certification that Progress Schedule submission is actual schedule being used for execution of the Work.
 - b. Progress Schedule: One legible copies.
 - c. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
4. Prior to final payment, submit a final Updated Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

A. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Permits.
3. Critical path work.
4. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
5. Early procurement activities for long lead equipment and materials.
6. Initial Site work.
7. Specified Work sequences and construction constraints.
8. Contract Milestone and Completion Dates.
9. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
10. Completed work as the project proceeds.
11. Commissioning including testing and training.
12. System startup summary.
13. Highlight times when Owner assistance is needed.
14. Project close-out summary.
15. Demobilization summary.

- B. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Owner.
- C. Format: In accordance with Article Progress Schedule—Bar Chart.

1.03 DETAILED PROGRESS SCHEDULE

- A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.
- B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.
- C. When accepted by Owner, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.
- D. Format: In accordance with Article Progress Schedule—Bar Chart.
- E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.04 PROGRESS SCHEDULE—BAR CHART

- A. General: Comprehensive bar chart schedule, generally as outlined in Associated General Contractors of America (AGC) 580, “Construction Project Planning and Scheduling Guidelines.” If a conflict occurs between the AGC publication and this specification, this specification shall govern.
- B. Format:
 - 1. Unless otherwise approved, white paper, 11-inch by 17-inch sheet size.
 - 2. Title Block: Show name of Project and Owner, date submitted, revision or update number, and name of scheduler.
 - 3. Identify horizontally, across the top of the schedule, the time frame by year, month, and day.
 - 4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
 - 5. Legend: Describe standard and special symbols used.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- C. Contents: Identify, in chronological order, those activities reasonably required to complete the Work, including as applicable, but not limited to:
1. Obtaining permits, submittals for early product procurement, and long lead time items.
 2. Mobilization and other preliminary activities.
 3. Initial Site work.
 4. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s).
 5. Critical path work.
 6. Subcontract Work.
 7. Major equipment design, fabrication, factory testing, and delivery dates.
 8. Concrete Work.
 9. Structural steel Work.
 10. Architectural features Work.
 11. Equipment Work.
 12. Mechanical Work.
 13. Electrical Work.
 14. Instrumentation and control Work.
 15. Other important Work for each major facility.
 16. Equipment and system startup and test activities, including training and commissioning.
 17. Completed work as the project proceeds.
 18. Highlight times when Owner assistance is needed.
 19. Project closeout and cleanup.
 20. Demobilization.

1.05 PROGRESS OF THE WORK

- A. Updated Progress Schedule shall reflect:
1. Progress of Work to within 5 working days prior to submission.
 2. Approved changes in Work scope and activities modified since submission.
 3. Delays in Submittals or resubmittals, deliveries, or Work.
 4. Adjusted or modified sequences of Work.
 5. Other identifiable changes.
 6. Revised projections of progress and completion.
 7. Report of changed logic.
- B. Produce detailed sub-schedules during Project to further define critical portions of the Work such as facility shutdowns and demolition.

- C. If an activity is not completed by its latest scheduled completion date and this failure is anticipated to extend Contract Times (or Milestones), submit, within 7 days of such failure, a written statement as to how nonperformance will be corrected to return Project to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.
- D. Owner may order Contractor to increase plant, equipment, labor force, or working hours if Contractor fails to:
 - 1. Complete a Milestone activity by its completion date.
 - 2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.06 SCHEDULE ACCEPTANCE

- A. Owner's acceptance will demonstrate agreement that:
 - 1. Proposed schedule is accepted with respect to:
 - a. Contract Times, including Final Completion and all intermediate Milestones, are within the specified times.
 - b. Specified Work sequences and constraints are shown as specified.
 - c. Access restrictions are accurately reflected.
 - d. Startup and testing times are as specified.
 - e. Submittal review times are as specified.
 - f. Startup testing duration is as specified and timing is acceptable.
 - 2. In all other respects, Owner's acceptance of Contractor's schedule indicates that, in Owner's judgment, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Owner's or Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Owner's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.
- B. Unacceptable Preliminary Progress Schedule:
 - 1. Make requested corrections; resubmit within 5 days.
 - 2. Until acceptable to Owner as Baseline Progress Schedule, continue review and revision process, including updating schedule on a monthly basis to reflect actual progress and occurrences to date.

- C. Unacceptable Detailed Progress Schedule:
 - 1. Make requested corrections; resubmit within 10 days.
 - 2. Until acceptable to Owner as Baseline Progress Schedule, continue review and revision process.

1.07 ADJUSTMENT OF CONTRACT TIMES

- A. Reference General Conditions.
- B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.
- C. Float:
 - 1. Float time is a Project resource available to both parties to meet contract Milestones and Contract Times.
 - 2. Use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited, and use of float time disclosed or implied by use of alternate float-suppression techniques shall be shared to proportionate benefit of Owner and Contractor.
 - 3. Pursuant to above float-sharing requirement, no time extensions will be granted nor delay damages paid until a delay occurs which (i) impacts Project's critical path, (ii) consumes available float or contingency time, and (iii) extends Work beyond contract completion date.
- D. Claims Based on Contract Times:
 - 1. Where Owner has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, reflect an interim adjustment in the Progress Schedule as acceptable to Owner.
 - 2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
 - 3. Revise Progress Schedule prepared thereafter in accordance with Owner's formal decision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

- A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.
- B. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 PROCEDURES

- A. Direct submittals to Engineer at the following, unless specified otherwise.
 - 1. Available at preconstruction conference.
- B. Electronic Submittals: Submittals shall be made in electronic format.
 - 1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
 - 2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
 - 3. PDF files shall be set to open "Bookmarks and Page" view.
 - 4. Add general information to each PDF file, including title, subject, author, and keywords.
 - 5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
 - 6. Submit new electronic files for each resubmittal.
 - 7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
 - 8. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
 - 9. Engineer will set up an electronic file management system for submittals.
 - 10. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.

11. All final approved shop drawings shall be submitted by Contractor on a thumb drive at completion of show drawing reviews.

C. Transmittal of Submittal:

1. Contractor shall:
 - a. Review each submittal and check for compliance with Contract Documents.
 - b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
 - 1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
 - 2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
3. Identify each submittal with the following:
 - a. Numbering and Tracking System:
 - 1) Sequentially number each submittal.
 - 2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
 - b. Specification section and paragraph to which submittal applies.
 - c. Project title and Engineer's project number.
 - d. Date of transmittal.
 - e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

D. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual specification section. Do not combine different specification sections together in submittal package, unless otherwise directed in specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

4. Index with labeled tab dividers in orderly manner.
 5. Circle applicable items and cross out non-applicable items to clearly denote what is being provided.
- E. Timeliness: Schedule and submit in accordance Schedule of Submittals and requirements of individual specification sections.
- F. Processing Time:
1. Time for review shall commence on Engineer's receipt of submittal.
 2. Engineer will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified. Engineer will attempt to return most show drawings within 14 days.
 3. Resubmittals will be subject to same review time.
 4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.
- G. Resubmittals: Clearly identify each correction or change made.
- H. Incomplete Submittals:
1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
 2. When any of the following are missing, submittal will be deemed incomplete:
 - a. Contractor's review stamp; completed and signed.
 - b. Transmittal of Contractor's Submittal; completed and signed.
- I. Submittals not required by Contract Documents: Will not be reviewed and will be returned stamped "Not Subject to Review."

1.03 ACTION SUBMITTALS

- A. Prepare and submit Action Submittals required by individual specification sections.
- B. Shop Drawings:
1. Identify and Indicate:
 - a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.

- b. Equipment and Component Title: Identical to title shown on Drawings.
 - c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
 - d. Project-specific information drawn accurately to scale.
 - e. Contractor shall provide a piping layout drawing as a submittal for approval.
2. Manufacturer's standard schematic drawings and diagrams as follows:
 - a. Modify to delete information that is not applicable to the Work.
 - b. Supplement standard information to provide information specifically applicable to the Work.
 3. Product Data: Provide as specified in individual specifications.
 4. Deferred Submittal: See Drawings for list of deferred submittals.
 - a. Contractor-design drawings and product data related to permanent construction.
 - 1) Written and graphic information.
 - 2) Drawings.
 - 3) Cut sheets.
 - 4) Data sheets.
 - 5) Action item submittals requested in individual specification section.
 - b. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit required supporting data and drawings for review and acceptance by Engineer. Documentation of review and approval provided on Engineer's comment form, along with completed submittal, and approved by permitting agency prior to installation.
 5. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Samples:

1. Copies: Two, unless otherwise specified in individual specifications.
2. Preparation: Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
 - a. Manufacturer name.
 - b. Model number.
 - c. Material.
 - d. Sample source.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
 4. Full-size Samples:
 - a. Size as indicated in individual specification section.
 - b. Prepared from same materials to be used for the Work.
 - c. Cured and finished in manner specified.
 - d. Physically identical with product proposed for use.
- D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted:
1. Approved:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal.
 - b. Distribution: Electronic.
 2. Approved as Noted:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - b. Distribution: Electronic.
 3. Partial Approval, Resubmit as Noted:
 - a. Make corrections or obtain missing portions, and resubmit.
 - b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - c. Distribution: Electronic.
 4. Revise and Resubmit:
 - a. Contractor may not incorporate product(s) or implement Work covered by submittal.
 - b. Distribution: Electronic.

1.04 INFORMATIONAL SUBMITTALS

- A. General:
1. Refer to individual specification sections for specific submittal requirements.
 2. Engineer will review each submittal. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will require that submittal be corrected and resubmitted.

- B. Certificates:
1. General:
 - a. Provide notarized statement that includes signature of entity responsible for preparing certification.
 - b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
 2. Welding: In accordance with individual specification sections.
 3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual specification section.
 4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
 5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
 6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
 7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.
 8. Validation certification of UV Disinfection Equipment.
- C. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.
- D. Contractor-design Data (related to temporary construction):
1. Written and graphic information.
 2. List of assumptions.
 3. List of performance and design criteria.
 4. Summary of loads or load diagram, if applicable.
 5. Calculations.
 6. List of applicable codes and regulations.
 7. Name and version of software.
 8. Information requested in individual specification section.
- E. Deferred Submittals: See Drawings for list of deferred submittals.
1. Contractor-design data related to permanent construction:
 - a. List of assumptions.
 - b. List of performance and design criteria.
 - c. Summary of loads or load diagram, if applicable.
 - d. Calculations.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- e. List of applicable codes and regulations.
 - f. Name and version of design software.
 - g. Factory test results.
 - h. Informational submittals requested in individual specification section.
2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Engineer. Documentation of review and indication of compliance with general design intent and project criteria provided on Engineer's comment form as meets conditions of the Contract, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.
- F. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual specification section.
- G. Operation and Maintenance Data: As required in Section 01 78 23, Operation and Maintenance Data.
- H. Payment:
1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures. Provide four hard copies to Owner. Contractor shall include certified payrolls.
 2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.
- I. Quality Control Documentation: As required in Section 01 45 16.13, Contractor Quality Control.
- J. Schedules:
1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
 - a. Show for each, at a minimum, the following:
 - 1) Specification section number.
 - 2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
 - 3) Estimated date of submission to Engineer, including reviewing and processing time.

- b. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.
 2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.
- K. Special Guarantee: Supplier's written guarantee as required in individual specification sections.
- L. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.
- M. Submittals Required by Laws, Regulations, and Governing Agencies:
 1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
 2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.
- N. Test, Evaluation, and Inspection Reports:
 1. General: Shall contain signature of person responsible for test or report.
 2. Factory:
 - a. Identification of product and specification section, type of inspection or test with referenced standard or code.
 - b. Date of test, Project title and number, and name and signature of authorized person.
 - c. Test results.
 - d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - e. Provide interpretation of test results, when requested by Engineer.
 - f. Other items as identified in individual specification sections.
 3. Field:
 - a. As a minimum, include the following:
 - 1) Project title and number.
 - 2) Date and time.
 - 3) Record of temperature and weather conditions.
 - 4) Identification of product and specification section.
 - 5) Type and location of test, Sample, or inspection, including referenced standard or code.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- 6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
- 7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
- 8) Provide interpretation of test results, when requested by Engineer.
- 9) Other items as identified in individual specification sections.

O. Testing and Startup Data: In accordance with Section 01 91 14, Equipment Testing and Facility Startup.

P. Training Data: In accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 SUPPLEMENTS

A. The supplements listed below, following "End of Section", are part of this specification.

1. Forms: Transmittal of Contractor's Submittal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

JACOBS TRANSMITTAL OF CONTRACTOR'S SUBMITTAL (ATTACH TO EACH SUBMITTAL)			
DATE: _____			
TO: _____ _____ _____ _____ _____ FROM: _____ <div style="text-align: center;">Contractor</div> _____ _____ _____	Submittal No.: _____ <input type="checkbox"/> New Submittal <input type="checkbox"/> Resubmittal Project: _____ Project No.: _____ Specification Section No.: _____ (Cover only one section with each transmittal) Schedule Date of Submittal: _____		
SUBMITTAL TYPE:	<input type="checkbox"/> Shop Drawing	<input type="checkbox"/> Sample	<input type="checkbox"/> Informational
	<input type="checkbox"/> Deferred		

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
Contractor (Authorized Signature)

SECTION 01 42 13
ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

- A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Article 3 of the General Conditions, and as may otherwise be required herein and in the individual specification sections.
- B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.
- C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.
- D. Where two or more standards are specified to establish quality, product and workmanship shall meet or exceed requirements of most stringent.
- E. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.
- F. Copies of standards and specifications of technical societies:
 - 1. Copies of applicable referenced standards have not been bound in these Contract Documents.
 - 2. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor's personnel, Subcontractors, Owner, and Engineer.

1.02 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

1.	AA	Aluminum Association
2.	AABC	Associated Air Balance Council
3.	AAMA	American Architectural Manufacturers Association
4.	AASHTO	American Association of State Highway and Transportation Officials
5.	ABMA	American Bearing Manufacturers' Association
6.	ACI	American Concrete Institute
7.	AEIC	Association of Edison Illuminating Companies
8.	AGA	American Gas Association
9.	AGMA	American Gear Manufacturers' Association
10.	AI	Asphalt Institute
11.	AISC	American Institute of Steel Construction
12.	AISI	American Iron and Steel Institute
13.	AITC	American Institute of Timber Construction
14.	ALS	American Lumber Standards
15.	AMCA	Air Movement and Control Association
16.	ANSI	American National Standards Institute
17.	APA	APA – The Engineered Wood Association
18.	API	American Petroleum Institute
19.	APWA	American Public Works Association
20.	AHRI	Air-Conditioning, Heating, and Refrigeration Institute
21.	ASA	Acoustical Society of America
22.	ASABE	American Society of Agricultural and Biological Engineers
23.	ASCE	American Society of Civil Engineers
24.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
25.	ASME	American Society of Mechanical Engineers
26.	ASNT	American Society for Nondestructive Testing
27.	ASSE	American Society of Sanitary Engineering
28.	ASTM	ASTM International
29.	AWI	Architectural Woodwork Institute
30.	AWPA	American Wood Preservers' Association

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

31.	AWPI	American Wood Preservers' Institute
32.	AWS	American Welding Society
33.	AWWA	American Water Works Association
34.	BHMA	Builders Hardware Manufacturers' Association
35.	CBM	Certified Ballast Manufacturer
36.	CDA	Copper Development Association
37.	CGA	Compressed Gas Association
38.	CISPI	Cast Iron Soil Pipe Institute
39.	CMAA	Crane Manufacturers' Association of America
40.	CRSI	Concrete Reinforcing Steel Institute
41.	CS	Commercial Standard
42.	CSA	Canadian Standards Association
43.	CSI	Construction Specifications Institute
44.	DIN	Deutsches Institut für Normung e.V.
45.	DIPRA	Ductile Iron Pipe Research Association
46.	EIA	Electronic Industries Alliance
47.	EJCDC	Engineers Joint Contract Documents' Committee
48.	ETL	Electrical Test Laboratories
49.	FAA	Federal Aviation Administration
50.	FCC	Federal Communications Commission
51.	FDA	Food and Drug Administration
52.	FEMA	Federal Emergency Management Agency
53.	FIPS	Federal Information Processing Standards
54.	FM	FM Global
55.	Fed. Spec.	Federal Specifications (FAA Specifications)
56.	FS	Federal Specifications and Standards (Technical Specifications)
57.	GA	Gypsum Association
58.	GANA	Glass Association of North America
59.	HI	Hydraulic Institute
60.	HMI	Hoist Manufacturers' Institute
61.	IBC	International Building Code
62.	ICBO	International Conference of Building Officials
63.	ICC	International Code Council
64.	ICEA	Insulated Cable Engineers' Association
65.	IFC	International Fire Code
66.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
67.	IESNA	Illuminating Engineering Society of North America
68.	IFI	Industrial Fasteners Institute
69.	IGMA	Insulating Glass Manufacturer's Alliance

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

70.	IMC	International Mechanical Code
71.	INDA	Association of the Nonwoven Fabrics Industry
72.	IPC	International Plumbing Code
73.	ISA	International Society of Automation
74.	ISO	International Organization for Standardization
75.	ITL	Independent Testing Laboratory
76.	JIC	Joint Industry Conferences of Hydraulic Manufacturers
77.	MIA	Marble Institute of America
78.	MIL	Military Specifications
79.	MMA	Monorail Manufacturers' Association
80.	MSS	Manufacturer's Standardization Society
81.	NAAMM	National Association of Architectural Metal Manufacturers
82.	NACE	NACE International
83.	NBGQA	National Building Granite Quarries Association
84.	NEBB	National Environmental Balancing Bureau
85.	NEC	National Electrical Code
86.	NECA	National Electrical Contractor's Association
87.	NEMA	National Electrical Manufacturers' Association
88.	NESC	National Electrical Safety Code
89.	NETA	InterNational Electrical Testing Association
90.	NFPA	National Fire Protection Association
91.	NHLA	National Hardwood Lumber Association
92.	NICET	National Institute for Certification in Engineering Technologies
93.	NIST	National Institute of Standards and Technology
94.	NRCA	National Roofing Contractors Association
95.	NRTL	Nationally Recognized Testing Laboratories
96.	NSF	NSF International
97.	NSPE	National Society of Professional Engineers
98.	NTMA	National Terrazzo and Mosaic Association
99.	NWWDA	National Wood Window and Door Association
100.	OSHA	Occupational Safety and Health Act (both Federal and State)
101.	PCI	Precast/Prestressed Concrete Institute
102.	PEI	Porcelain Enamel Institute
103.	PPI	Plastic Pipe Institute
104.	PS	Product Standards Section-U.S. Department of Commerce
105.	RMA	Rubber Manufacturers' Association
106.	RUS	Rural Utilities Service
107.	SAE	SAE International

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

108. SDI	Steel Deck Institute
109. SDI	Steel Door Institute
110. SJI	Steel Joist Institute
111. SMACNA	Sheet Metal and Air Conditioning Contractors National Association
112. SPI	Society of the Plastics Industry
113. SSPC	The Society for Protective Coatings
114. STI/SPFA	Steel Tank Institute/Steel Plate Fabricators Association
115. SWI	Steel Window Institute
116. TEMA	Tubular Exchanger Manufacturers' Association
117. TCA	Tile Council of North America
118. TIA	Telecommunications Industry Association
119. UBC	Uniform Building Code
120. UFC	Uniform Fire Code
121. UL	formerly Underwriters Laboratories Inc.
122. UMC	Uniform Mechanical Code
123. USBR	U.S. Bureau of Reclamation
124. WCLIB	West Coast Lumber Inspection Bureau
125. WI	Wood Institute
126. WWPA	Western Wood Products Association

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 33
MANUFACTURERS' FIELD SERVICES

PART 1 GENERAL

1.01 DEFINITIONS

- A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02 SUBMITTALS

- A. Informational Submittals:

1. Training Schedule: Submit, in accordance with requirements of this Specification, not less than 30 days prior to start of equipment installation and revise as necessary for acceptance.
2. Lesson Plan: Submit, in accordance with requirements of this Specification, proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.
3. Training Session Recordings: Furnish Owner with complete sets of recordings fully indexed and cataloged with printed label stating session and date recorded.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual specification section.
- B. Representative subject to acceptance by Owner. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Furnish manufacturers' services, when required by an individual specification section, to meet the requirements of this section.

- B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, time required to perform specified services shall be considered incidental.
- C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.
- D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.
- E. Only those days of service approved by Engineer will be credited to fulfill specified minimum services.
- F. When specified in individual specification sections, manufacturer's onsite services shall include:
 - 1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
 - 2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
 - 3. Providing, on a daily basis, copies of manufacturers' representatives field notes and data to Owner.
 - 4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Owner and Engineer.
 - 5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
 - 6. Assistance during functional and performance testing, and facility startup and evaluation.
 - 7. Training of Owner's personnel in the operation and maintenance of respective product as required.

3.02 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

- A. When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by equipment manufacturer's representative.
- B. Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to ensure equipment is complete and operational.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.03 TRAINING

A. General:

1. Furnish manufacturers' factory representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.
3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment. Submit resume of proposed manufacturer's representative for major items such as UV equipment.
4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.
5. Coordinate training with Owner and Engineer for major items such as UV equipment.

B. Training Schedule:

1. Equipment Training: Describe equipment's fundamental operating principles and dynamics.
 - a. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
 - b. Identify an support equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.
 - c. Identify and describe safety precautions and potential hazards related to operations.
 - d. Identify and describe in detail safety and control interlocks.
2. Operational Training:
 - a. Describe operating principles and practices.
 - b. Describe routine operating, start-up, and shutdown procedures.
 - c. Describe abnormal or emergency start-up, operating, and shutdown procedures that may apply.
 - d. Describe alarm conditions and responses to alarms.
 - e. Describe routine monitoring and recordkeeping procedures.
 - f. Describe recommended housekeeping procedures.

- g. Describe how to determine if corrective maintenance or an operating parameter adjustment is required.
- 3. Maintenance Training:
 - a. Describe preventative maintenance inspection procedures required to: inspect equipment in operation, identify potential trouble symptoms and anticipate breakdowns, and forecast maintenance requirements (predictive maintenance).
 - b. Define recommended preventative maintenance intervals for each component.
 - c. Describe lubricant and replacement part recommendations and limitations.
 - d. Describe appropriate cleaning practices and recommend intervals.
 - e. Identify and describe use of special tools required for maintenance of equipment.
 - f. Describe component removal, installation, and disassembly and assembly procedures.
 - g. Perform, “hands-on ” demonstrations of preventive maintenance procedures.
 - h. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
 - i. Define recommended torqueing, mounting, calibrating, and aligning procedures and settings, as appropriate.
 - j. Describe recommended procedures to check and test equipment following corrective maintenance.
- 4. Equipment Troubleshooting:
 - a. Define recommended systematic troubleshooting procedures.
 - b. Provide component-specific troubleshooting checklists.
 - c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
 - d. Describe common corrective maintenance procedures with “hands on” demonstrations.
- 5. Instrumentation/Controls Training: Instrumentation and Controls training shall be provided in accordance with Section 40 90 00, Instrumentation and Controls for Process Equipment.
- 6. List specified equipment and systems that require training services and show:
 - a. Respective manufacturer.
 - b. Estimated dates for installation completion.
 - c. Estimated training dates.
- 7. Allow for multiple sessions when several shifts are involved.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

8. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
 9. Coordinate with Section 01 32 00, Construction Progress Documentation, and Section 01 91 14, Equipment Testing and Facility Startup.
- C. Lesson Plan: When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information:
1. Title and objectives.
 2. Recommended attendees (such as, managers, engineers, operators, maintenance).
 3. Course description, outline of course content, and estimated class duration.
 4. Format (such as, lecture, self-study, demonstration, hands-on).
 5. Instruction materials and equipment requirements.
 6. Resumes of instructors providing training.
- D. Prestartup Training:
1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01 78 23, Operation and Maintenance Data.
 2. Complete at least 14 days prior to beginning of facility startup.
- E. Post-startup Training: Furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives approximately 90 days after final completion for UV Disinfection System equipment.
- F. Recording of Training Sessions:
1. Furnish audio and color recording of pre-startup and post-startup instruction sessions, including manufacturers' representatives' hands-on equipment instruction and classroom sessions.
 2. Use DVD format suitable for playback on standard equipment available commercially in the United States. Blu-ray® DVD format is not acceptable without Engineer's prior approval.

3.04 SUPPLEMENTS

- A. The supplement listed below, following “End of Section,” is part of this specification.
1. Manufacturer’s Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO: _____
EQPT TAG NO: _____ EQPT/SYSTEM: _____
PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Installed in accordance with Manufacturer's recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical and mechanical connections meet quality and safety standards.
- All applicable safety equipment has been properly installed.
- Functional tests.
- System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)
- Attach any performance test documentation from manufacturer.

Comments: _____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate their equipment and (iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20__

Manufacturer: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

SECTION 01 45 33
SPECIAL INSPECTION, OBSERVATION, AND TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers requirements for Special Inspection, Observation, and Testing required in accordance with Chapter 17 of the 2015 IBC and is in addition to and supplements requirements included in Statement of Special Inspections shown in supplement located at end of this section.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
 2. International Code Council (ICC):
 - a. International Building Code (IBC).
 - b. Evaluation Service (ICC-ES) Reports and Legacy Reports.

1.03 DEFINITIONS

- A. Agencies and Personnel:
1. Agency Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.
 2. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
 3. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by statutory requirements of professional registration laws of state or jurisdiction in which Project is to be constructed.
 4. Special Inspector: Qualified person employed by Owner who will demonstrate competence to the satisfaction of AHJ for inspection of a particular type of construction or operation requiring Special Inspection.

- B. Statement of Special Inspections: Detailed written procedure contained in supplement located at end of this section establishing systems and components subject to Special Inspection, Observation, and Testing during construction, type and frequency of testing, extent and duration of Special Inspection, and reports to be completed and distributed by Special Inspector.
- C. Special Inspection:
1. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.
 2. Special Inspection, Continuous: Full-time observation of work requiring Special Inspection by an approved Special Inspector who is present in area where the Work is being performed.
 3. Special Inspection, Periodic: Part-time or intermittent observation of the Work requiring Special Inspection by an approved Special Inspector who is present in area where the Work has been or is being performed, and at completion of the Work.
- D. Structural Systems and Components:
1. Diaphragm: Component of structural lateral load resisting system consisting of roof, floor, or other membrane or bracing system acting to transfer lateral forces to vertical resisting elements of structure.
 2. Drag Strut or Collector: Component of structural lateral load resisting system consisting of diaphragm or shear wall element that collects and transfers diaphragm shear forces to vertical force-resisting elements or distributes forces within diaphragm or shear wall.
 3. Seismic-Force-Resisting System: That part of structural lateral load resisting system that has been considered in the design to provide required resistance to seismic forces identified on Drawings.
 4. Shear Wall: Component of structural lateral load resisting system consisting of a wall designed to resist lateral forces parallel to plane of the wall. Unless noted otherwise on Drawings, load-bearing walls with direct in-plane connections to roof and floors shall be considered to be shear walls.
 5. Wind Force Resisting System: That part of the structural system that has been considered in the design to provide required resistance to wind forces identified on Drawings.

E. Nonstructural Components:

1. Architectural Component Supports: Structural members or assemblies of members which transmit loads and forces from architectural systems or components to structure, including braces, frames, struts, and attachments.
2. Electrical Component Supports: Structural members or assemblies which transmit loads and forces from electrical equipment to structure, including braces, frames, legs, pedestals, and tethers, as well as elements forged or cast as part of component for anchorage.
3. Mechanical Component Supports: Structural members or assemblies which transmit loads and forces from mechanical equipment to structure, including braces, frames, skirts, legs, saddles, pedestals, snubbers, and tethers, as well as elements forged or cast as part of component for anchorage.

F. Professional Observation:

1. Does not include or waive responsibility for required Special Inspection or inspections by building official.
2. Requirements are indicated on Statement of Special Inspections provided in supplement located at the end of this section.
3. Structural Observation: Visual observation of structural system(s) by a registered design professional for general conformance to Contract Documents.

1.04 STATEMENT OF SPECIAL INSPECTIONS REQUIREMENTS

A. Designated Systems for Inspection:

1. Seismic-force-resisting systems designated under IBC Section 1705 and subject to Special Inspection under Section 1705: None required.
2. Wind-force-resisting systems designated under IBC Section 1705: None required.
3. Architectural, Mechanical, and Electrical Components subject to Special Inspection under IBC Section 1705.12.5 and 1705.12.6 for Seismic Resistance: None required.

B. Statement of Special Inspections:

1. As included in supplement located at the end of this section and in support of building permit application, Project-specific requirements were prepared by Registered Design Professional in Responsible Charge. The following identifies elements of inspection, observation, and testing program to be followed in construction of the Work:

- a. Special Inspection and testing required by IBC Section 1705 and other applicable sections and referenced standards therein.
 - b. Type and frequency of Special Inspection required.
 - c. Type and frequency of testing required.
 - d. Required frequency and distribution of testing and Special Inspection reports to be distributed by Special Inspector to Engineer, Contractor, building official, and Owner.
 - e. Geotechnical Observation to be Performed: Not required for this Project.
- C. Special Inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency or by Authority Having Jurisdiction's (AHJ) approved, qualified inspection staff. Owner will secure and pay for services of agency to perform Special Inspection and associated testing.
- D. Code required Special Inspection with associated testing, as provided in Statement of Special Inspections in supplement located at the end of this section and further provided in this section, is for benefit of Owner and does not:
1. Relieve Contractor of responsibility for providing adequate quality control measures.
 2. Relieve Contractor of responsibility for damage to or loss of material before acceptance.
 3. Constitute or imply acceptance.
 4. Affect continuing rights of Owner after acceptance of completed Work.
- E. The presence or absence of code required Special Inspector does not relieve Contractor from Contract requirements.
- F. Contractor is responsible for additional costs associated with Special Inspection and Testing when Work is not ready at time identified by Contractor and Special Inspectors are onsite, but not able to provide contracted services.
- G. Contractor is responsible for associated costs for additional Special Inspection and Testing by Special Inspectors required because of rejection of materials of in place Work that cannot be made compliant to Contract Document without additional inspections and testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Requirements of the Statement of Special Inspections are provided by the Owner. All other testing and inspections, unless noted otherwise, are provided by Contractor.
- B. Provide access to shop or Site for Special Inspection and Testing requirements.
- C. Notify Engineer in advance of required Special Inspection no later than 57 days prior to date of Special Inspection.
- D. Provide access for Special Inspector to construction documents.
- E. Retain special inspection records on-site to be readily available for review.
- F. Cooperate with Special Inspector and provide safe access to the Work to be inspected.
- G. Submit Fabricator's Certificates of Compliance for approved fabricators.
- H. Provide reasonable auxiliary services as requested by the Special Inspector. Auxiliary services required include, but not limited to:
 - 1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests to assist the Special Inspector in performing test/inspections.
 - 2. Providing storage space for the Special Inspector's exclusive use, such as for storing and curing concrete test samples and delivery of samples to testing laboratories.
 - 3. Providing the Special Inspector with access to all approved submittals.
 - 4. Providing security and protection of samples and test equipment at the Project Site.
 - 5. Provide samples of materials to be tested in required quantities.
- I. Materials and systems shall be inspected during placement where Continuous Special Inspection is required.

- J. Where Periodic Special Inspection is indicated in the Statement of Special Inspections:
1. Schedule inspections for either during or at completion of their placement or a combination or both.
 2. Schedule periodically inspected Work (either inspected during or after its placement) so that corrections can be completed and re-inspected before Work is inaccessible.
 3. Sampling a portion of the Work is not allowed. Schedules shall provide for inspection of all Work requiring periodic inspection.

3.02 SUPPLEMENTS

- A. The supplements listed below, following “End of Section,” are a part of this specification:
1. Fabricator’s Certificate of Compliance.
 2. Statement of Special Inspections.
 3. 2015 IBC Tables 1-6.

END OF SECTION

FABRICATOR’S CERTIFICATE OF COMPLIANCE

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2.5 of 2015 IBC must submit Fabricator’s Certificate of Compliance at the completion of fabrication.

(Project)

(Fabricator’s Name)

(Business Address)

(Certification or Approval Agency)

(Certification Number)

(Date of Last Audit or Approval)

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with approved construction documents.

(Name and Title) type or print

(Signature and Date)

Attach copies of fabricator’s certification or building code evaluation service report and fabricator’s quality control manual.

STATEMENT OF SPECIAL INSPECTIONS

GENERAL NOTES

1. THE STATEMENT OF SPECIAL INSPECTIONS PROVIDE PROJECT COMPLIANCE WITH THE PROVISIONS OF THE 2015 INTERNATIONAL BUILDING CODE (IBC) CHAPTER 17 FOR SPECIAL INSPECTION, STRUCTURAL OBSERVATION, AND TESTING. EXCEPT WHERE OTHERWISE NOTED, THIS INSPECTION IS OWNER FURNISHED.
2. STANDARD SPECIAL INSPECTION REQUIREMENTS FOR NONSTRUCTURAL COMPONENTS ARE CONTAINED IN TABLE 1.
3. STANDARD SPECIAL INSPECTION REQUIREMENTS FOR STRUCTURAL COMPONENTS ARE CONTAINED IN TABLE 2. STANDARD TESTING REQUIREMENTS FOR STRUCTURAL COMPONENTS ARE CONTAINED IN TABLE 3.
4. PROJECT SPECIFIC REQUIREMENTS FOR STRUCTURES ASSIGNED TO SEISMIC DESIGN CATEGORIES C, D, E, OR F ARE CONTAINED IN TABLE 4. ADDITIONAL TESTING REQUIREMENTS FOR STRUCTURAL RESISTANCE ARE CONTAINED IN TABLE 6.
5. PROJECT SPECIFIC REQUIREMENTS FOR STRUCTURES SUBJECT TO BASIC WIND SPEEDS [(V_{asd})] IN EXCESS OF 110 MPH ARE CONTAINED IN TABLE 5.
6. FOR ADDITIONAL REQUIREMENTS, REFER TO SPECIFICATION SECTION 01 45 33, SPECIAL INSPECTION, OBSERVATION, AND TESTING. THESE INCLUDE:
 - A. CONTRACTOR'S REQUIREMENTS TO PROVIDE ACCESS TO THE WORK FOR REQUIRED INSPECTIONS, AND TO PROVIDE NOTICE OF REQUIRED INSPECTIONS AND STRUCTURAL OBSERVATION.
 - B. DEFINITIONS AND TERMINOLOGY USED IN THIS STATEMENT OF SPECIAL INSPECTIONS.

SPECIAL INSPECTION

1. SPECIAL INSPECTION WILL BE IN ACCORDANCE WITH IBC SECTIONS 1704 AND 1705 TOGETHER WITH LOCAL AND STATE AMENDMENTS. REFER TO THE FOLLOWING TABLES FOR PROJECT SPECIFIC INSPECTION TYPES AND FREQUENCIES.
2. SPECIAL INSPECTIONS WILL BE PROVIDED BY A CERTIFIED OR QUALIFIED INSPECTOR AND ASSOCIATED TESTING WILL BE PERFORMED BY AN APPROVED ACCREDITED INDEPENDENT AGENCY. THE OWNER WILL SECURE AND PAY FOR THE SERVICES OF THE AGENCY TO PERFORM ALL SPECIAL INSPECTION AND ASSOCIATED TESTS. INSPECTORS FOR EACH SYSTEM AND MATERIAL WILL BE INTERNATIONAL CODE COUNCIL (ICC) CERTIFIED OR OTHERWISE APPROVED BY THE BUILDING OFFICIAL.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3. THE SPECIAL INSPECTOR WILL OBSERVE THE INDICATED WORK FOR COMPLIANCE WITH THE APPROVED CONTRACT DOCUMENTS AND SUBMIT RECORDS OF INSPECTION. ALL DISCREPANCIES WILL BE BROUGHT TO THE IMMEDIATE ATTENTION OF THE CONTRACTOR FOR CORRECTION.
4. SPECIAL INSPECTION AND ASSOCIATED TESTING REPORTS WILL BE SUBMITTED TO THE ENGINEER, CONTRACTOR, BUILDING OFFICIAL, AND OWNER WITHIN ONE WEEK OF INSPECTION OR WITHIN ONE WEEK OF TEST COMPLETION. INSPECTIONS FOR WHICH REPORTING WILL BE REQUIRED ARE NOTED IN THE FOLLOWING TABLES.
5. AT THE CONCLUSION OF CONSTRUCTION, A FINAL REPORT DOCUMENTING REQUIRED SPECIAL INSPECTIONS AND CORRECTION OF PREVIOUSLY NOTED DISCREPANCIES WILL BE SUBMITTED.

STRUCTURAL OBSERVATION

1. STRUCTURAL OBSERVATION IN ACCORDANCE WITH IBC SECTION 1704.6 IS NOT REQUIRED FOR THIS PROJECT.

SPECIAL INSPECTIONS FOR WIND RESISTANCE

1. SPECIAL INSPECTIONS REQUIREMENTS FOR WIND RESISTANCE IN ACCORDANCE WITH IBC SECTION 1705.11 ARE NOT APPLICABLE TO THIS PROJECT.

SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

1. SPECIAL INSPECTIONS REQUIREMENTS FOR SEISMIC RESISTANCE IN ACCORDANCE WITH IBC SECTION 1705.12 AND 1705.13 ARE NOT APPLICABLE TO THIS PROJECT.

Statement of Special Inspections Prepared by:

Type or Print Name

Signature

Date

Preparer's Seal

TABLE 1 REQUIRED NON-STRUCTURAL SPECIAL INSPECTION REFER TO SPECIFICATION SECTION 01 45 33						
SYSTEM OR MATERIAL	2015 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
GENERAL						
1. INSTALLATION OF MATERIALS THAT REQUIRE ADDITIONAL MANUFACTURER'S INSTRUCTIONS BEYOND CODE REQUIREMENTS	1703.4.2, 1705.1.1 ITEM 3	ICC-ES EVALUATION REPORTS		X		
STRUCTURAL						
SEE TABLE 2.						

NOTES:

1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING INSPECTED WORK.

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2015 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
CONCRETE						
1. INSPECTION OF REINFORCING STEEL	1908.4	ACI 318: 20, 25.2, 25.3, 26.5.1-26.5.3	X			
2. INSPECTION OF ANCHORS POST-INSTALLED IN HARDENED CONCRETE MEMBERS		ACI 318: 17.8.2, 17.8.2.4 ICC-ES EVALUATION REPORTS	X		PROVIDE CONTINUOUS SPECIAL INSPECTION FOR ADHESIVE ANCHORS DESIGNED TO RESIST SUSTAINED TENSION LOADS AND WHERE REQUIRED BY ICC-ES REPORT	
3. VERIFYING USE OF REQUIRED DESIGN MIX	1904.1,1904.2, 1908.2, 1908.3	ACI 318: Ch.19, 26.4.3, 26.4.4	X			
4. AT THE TIME FRESH CONCRETE IS SAMPLED TO FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS	1908.1	ASTM C 172, ASTM C 31, ACI 318: 26.4.5, 26.12		X		SEE TABLE 3 FOR CONCRETE TEST REQUIREMENTS

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2015 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
5. INSPECTION FOR MAINTENANCE OF SPECIFIED CURING TECHNIQUES	1908.9	ACI 318: 26.4.7-26.4.9	X			
6. INSPECT FORMWORK FOR SHAPE, LOCATION AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED	1705.3	ACI 318: 26.10.1(b)	X			
STRUCTURAL STEEL						
1. MATERIAL VERIFICATION OF STRUCTURAL STEEL:						
A. IDENTIFICATION MARKINGS TO CONFORM TO AISC 360	1705.2.1, 2203.1	Applicable ASTM Material Standards	X			
B. MANUFACTURER'S CERTIFIED TEST REPORTS	1705.2.1	AISC 360: Sec. N3.2, N5.2	X			
2. PRIOR TO BOLTING, VERIFY THAT THE FOLLOWING ARE IN COMPLIANCE:						

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2015 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
A. FASTENERS MARKED IN ACCORDANCE WITH ASTM REQUIREMENTS	1705.2.1	AISC 360: Sec. N3.2, N5.2, N5.6 Applicable ASTM Material Standards	X			
3. VERIFY DURING BOLTING:						
A. FASTENER ASSEMBLIES, OF SUITABLE CONDITION, PLACED IN ALL HOLES AND WASHERS (IF REQUIRED) ARE POSITIONED AS REQUIRED	1705.2.1	AISC 360: Sec. N5.6	X			
B. FASTENER COMPONENT NOT TURNED BY THE WRENCH PREVENTED FROM ROTATING	1705.2.1	AISC 360: Sec. N5.6	X			

NOTES:

1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING INSPECTED WORK.

TABLE 3 TESTING FOR REQUIRED SPECIAL INSPECTION REFER TO SPECIFICATION SECTION 01 45 33						
MATERIAL	TYPE OR SCOPE	STANDARD	2015 IBC CODE REFERENCE	FREQUENCY	BY WHOM	COMMENTS
CONCRETE						
CONCRETE	STRENGTH	ASTM C39	1705.3	ONCE EACH DAY, BUT NOT LESS THAN ONE SAMPLE FOR EACH 150 CUBIC YARDS OR 5,000 SFT OF WALLS OR SLABS PLACED	OWNER'S TESTING AGENCY	
CONCRETE	SLUMP	ASTM C143, C94	1705.3	ONE SAMPLE PER STRENGTH TEST	OWNER'S TESTING AGENCY	
CONCRETE	AIR CONTENT	ASTM C231, C94	1705.3	ONE SAMPLE PER STRENGTH TEST	OWNER'S TESTING AGENCY	

TABLE 4

**REQUIRED SPECIAL INSPECTION FOR SEISMIC RESISTANCE FOR STRUCTURAL SYSTEMS
REFER TO TABLE 2 FOR STANDARD STRUCTURAL SPECIAL INSPECTION REQUIREMENTS
REFER TO SPECIFICATION SECTION 01 45 33**

The Seismic Design Category (SDC) for this Project is B. Special inspection for seismic resistance is not applicable to this project.

TABLE 5
REQUIRED SPECIAL INSPECTION FOR WIND RESISTANCE FOR STRUCTURAL SYSTEMS
REFER TO SPECIFICATION SECTION 01 45 33

Special Inspection for wind resistance is not required on this project.

<p style="text-align: center;">TABLE 6 TESTING FOR SEISMIC RESISTANCE REFER TO SPECIFICATION SECTION 01 45 33</p>
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<p>TESTING FOR SEISMIC RESISTANCE IS NOT APPLICABLE TO THIS PROJECT</p>

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of Nurserymen (AAN): American Standards for Nursery Stock.
 2. Federal Emergency Management Agency (FEMA).
 3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
 4. Telecommunications Industry Association (TIA); Electronic Industries Alliance (EIA): 568B, Commercial Building Telecommunications Cabling Standard.
 5. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
 6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

- A. Informational Submittals:
1. Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
 2. Temporary Construction Submittals:
 - a. Parking area plans.
 - b. Contractor's field office, storage yard, and storage building plans, including gravel surfaced area.
 - c. Staging area location plan.
 - d. Plan for maintenance of existing plant operations.
 - e. Demolition Plans.
 3. Temporary Control Submittals:
 - a. Noise control plan.
 - b. Dust control plan.
 - c. Plan for disposal of waste materials and intended haul routes.

1.03 MOBILIZATION

- A. Mobilization includes, but is not limited to, these principal items:
 - 1. Obtaining required permits.
 - 2. Moving Contractor's field office and equipment required for first month operations onto Site.
 - 3. Installing temporary construction power, wiring, and lighting facilities.
 - 4. Providing onsite Internet service and telephones.
 - 5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
 - 6. Arranging for and erection of Contractor's work and storage yard.
 - 7. Posting OSHA required notices and establishing safety programs and procedures.
 - 8. Having Contractor's superintendent at Site full time.

1.04 PROTECTION OF WORK AND PROPERTY

- A. Comply with Owner's safety rules while on Owner's property.
- B. Keep Owner informed of serious onsite accidents and related claims.
- C. Use of Explosives: No blasting or use of explosives will be allowed onsite.

1.05 FIRE PROTECTION

- A. Contractor shall take all necessary precautions to prevent fires at or adjacent to the work, buildings, etc., and shall provide adequate facilities for extinguishing fires which do occur. Burning of debris is not permitted on the project site.
- B. When fire or explosion hazards are created in the vicinity of the work as a result of the locations of fuel tanks, or similar hazardous utilities or devices, the Contractor shall immediately alert the local Fire Marshal, the Engineer and the Owner of the tank or device. The Contractor shall exercise all safety precautions and shall comply with all instructions issued by the Fire Marshal and shall cooperate with the Owner of the tank or device to prevent the occurrence of fire or explosion.
- C. Fire protection alarm and detection systems shall comply with the Michigan International Building Code 2009 and NFPA standards.
- D. Storage area for construction materials must not interfere with fire/emergency site access.
- E. All material demolished from the site should not be stored on location.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

1.06 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether disinfectant, polymer, cleaning solution, or reactant of other classification, must show approval of either the EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with all applicable rules and regulations.
- B. Provide MSDS sheets for all chemicals to Owner.

1.07 FIRST AID FACILITIES AND ACCIDENTS

- A. First Aid Facilities: The Contractor shall provide at the site such equipment and facilities as are necessary to supply first aid to any of Contractor's personnel who may be injured in connection with the work.
- B. Accidents:
 - 1. The Contractor shall promptly report, in writing, to the Engineer and Owner all accidents whatsoever out of, or in connection with, the performance of the work, whether on or adjacent to the site, which cause death, personal injury or property damage, giving full details and statements of witnesses.
 - 2. If death, serious injuries, or serious damage are caused, the accident shall be reported immediately by telephone or messenger to both the Owner and the Engineer.
 - 3. If any claim is made by anyone against the Contractor or a Subcontractor on account of any accidents, the Contractor shall promptly report the facts, in writing, to the Engineer and Owner, giving full details of the claim.

1.08 BLASTING AND EXPLOSIVES

- A. The use of blasting or explosives shall not be allowed under this project.

PART 2 PRODUCTS

2.01 PROJECT SIGN

- A. Provide and maintain one, 8-foot-wide by 4-foot-high sign constructed of 3/4-inch exterior high density overlaid plywood. Sign shall bear name of Project, Owner, Contractor, Engineer, and other participating agencies. Lettering shall be blue applied on white background by an experienced sign painter. Include Provide exterior type enamel paint. Information to be included and logo graphic will be provided by Owner.

PART 3 EXECUTION

3.01 TEMPORARY UTILITIES

A. Power:

1. Electric power will be available at or near Site. Determine type and amount available and make arrangements for obtaining temporary electric power service, as needed.
2. Cost of electric power will be borne by Owner.

B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage because of temperature or humidity.
2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
3. Provide portable electric unit heaters, complete with controls, and suitably vented to outside as required for protection of health and property.

D. Water:

1. Owner will provide a place of temporary connection for construction water at Site. Provide temporary facilities and piping required to bring water to point of use and remove when no longer needed. Install a City approved backflow preventer, if required.
2. Owner will furnish construction water required at no cost to Contractor.
3. Contractor shall provide drinking water for contractor's employees.
4. Provide means to prevent water used for testing from flowing back into source pipeline. Contractor shall use an approved meter and double check valve backflow assembly. Contractor shall obtain backflow preventer assembly and meter from the City of Ann Arbor Customer Services Unit, and Contractor shall coordinate installation.
5. Water from draining facilities, disinfection or testing shall be handled by Contractor, including all pumps, pipes and equipment required. Dispose of water in compliance with all local, state and federal regulations.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

E. Sanitary and Personnel Facilities:

1. Provide and maintain facilities for Contractor's employees, Subcontractors, and other onsite employers' employees. Service, clean, and maintain facilities and enclosures.
2. Use of Owner's existing sanitary facilities by construction personnel will not be allowed.

F. Telephone Service:

1. Contractor: Arrange and provide onsite telephone service for use during construction. Pay costs of installation and monthly bills.

G. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.02 PROTECTION OF WORK AND PROPERTY

A. General:

1. No residence or business shall be cut off from vehicular traffic, unless special arrangements have been made.
2. Contractor shall remove vehicles if they interfere with chemical deliveries.
3. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate activities with owner of said utility and perform work to their satisfaction.
4. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
5. Do not impair operation of existing water system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering water supply, sewers, pump stations, or other sewer structures.

B. Site Security: Provide and maintain additional temporary security fences as necessary to protect the Work and Contractor-furnished products not yet installed.

C. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.

3.03 TEMPORARY CONTROLS

A. Air Pollution Control:

1. Minimize air pollution from construction operations.
2. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

B. Noise Control: Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.

3.04 STORAGE YARDS AND BUILDINGS

A. Coordinate requirements with Section 01 61 00, Common Product Requirements.

3.05 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

B. Provide parking facilities for personnel working on Project. No employee or equipment parking will be permitted on Owner's existing paved areas, except as specifically designated for Contractor's use. Contractors personal vehicles shall park on residential streets.

3.06 VEHICULAR TRAFFIC

A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Ensure the least possible obstruction to traffic and normal commercial pursuits.

B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.

C. Whenever it is necessary to cross, close, or obstruct roads, driveways, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.07 CLEANING DURING CONSTRUCTION

- A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.
- B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up and dispose of debris.
- C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least weekly, dispose of such waste materials, debris, and rubbish offsite.
- D. At least weekly, brush sweep entry drive, roadways, and other streets and walkways affected by the Work and where adjacent to the Work.
- E. The Owner's existing dumpsters shall not be used to dispose of construction debris.

END OF SECTION

**SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

- A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of latest edition of International Building Code (IBC) by International Code Council.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 966 to 993 feet above sea level.
- B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of minus 25 degrees F to 105 degrees F.

1.04 PREPARATION FOR SHIPMENT

- A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

- B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.
- C. Extra Materials, Special Tools, Test Equipment, and Expendables:
 - 1. Furnish as required by individual Specifications.
 - 2. Schedule:
 - a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
 - b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
 - 3. Packaging and Shipment:
 - a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
 - b. Prominently displayed on each package, the following:
 - 1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
 - 2) Applicable equipment description.
 - 3) Quantity of parts in package.
 - 4) Equipment manufacturer.
 - 4. Deliver materials to Site.
 - 5. Notify Contractor's Construction Manager and Owner upon arrival for transfer of materials.
 - 6. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.
- D. Request a minimum 7-day advance notice of shipment from manufacturer. Upon receipt of manufacturer's advance notice of shipment, promptly notify Owner of anticipated date and place of equipment arrival.
- E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.05 DELIVERY AND INSPECTION

- A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.
- C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.
- D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.
- E. Owner will not accept deliveries on behalf of Contractor. All deliveries must be received by Contractor.

1.06 HANDLING, STORAGE, AND PROTECTION

- A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.
- B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.
- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.
- D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.
- E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

- F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.
- G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.
- H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.
- B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.
- C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.
- D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
- F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.
- G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.
- I. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.
- J. Equipment Finish:
 - 1. Provide manufacturer's standard finish and color, except where specific color is indicated.
 - 2. If manufacturer has no standard color, provide equipment with finish as approved by Owner.
- K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.
- L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.
- M. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

- A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 30 days prior to scheduled test date, unless otherwise specified.
- B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
- C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

- A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.
- B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

- A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. No shimming between machined surfaces is allowed.
- C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Repaint painted surfaces that are damaged prior to equipment acceptance.
- E. Do not cut or notch any structural member or building surface without specific approval of Engineer.

- F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.
- G. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.04 FIELD FINISHING

- A. In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

3.05 ADJUSTMENT AND CLEANING

- A. Perform required adjustments, tests, operation checks, and other startup activities.

3.06 LUBRICANTS

- A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.07 FILTERS

- A. Replace all filters prior to final completion.

3.08 SUPPLEMENTS

- A. The supplement listed below, following "End of Section", is part of this specification.
 - 1. Form: Manufacturer's Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER: _____ PRODUCT, MATERIAL, OR SERVICE
PROJECT NAME: _____ SUBMITTED: _____
PROJECT NO: _____

Comments: _____

I hereby certify that the above-referenced product, material, or service called for by the Contract for the named Project is furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the Contract requirements, and are in the quantity shown.

Date of Execution: _____, 20____
Manufacturer: _____
Manufacturer's Authorized Representative (*print*): _____

(Authorized Signature)

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
 - a. Record Documents: As required in General Conditions.
 - b. Approved Shop Drawings and Samples: As required in the General Conditions.
 - c. Special bonds, Special Guarantees, and Service Agreements.
 - d. Consent of Surety to Final Payment: As required in General Conditions.
 - e. Releases or Waivers of Liens and Claims: As required in General Conditions.
 - f. Releases from Agreements.
 - g. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 00, Payment Procedures.
 - h. Extra Materials: As required by individual Specification sections.
 - i. Warranties.

1.02 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
 - a. Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
 - b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.

4. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by Engineer to recommend whole or any part of Contractor's Application for Payment, either partial or final.
5. Contractor shall maintain a full size set of documents on the project site with markups of all changes to the project.

1.03 RELEASES FROM AGREEMENTS

- A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.
- B. In the event Contractor is unable to secure written releases:
 1. Inform Owner of the reasons.
 2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
 3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
 4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

1.04 SUBSTANTIAL COMPLETION

- A. Substantial completion shall be the date as certified by the Engineer when the construction of the Project, or a specified part thereof, is sufficiently completed, in accordance with the Contract Documents, so that the Project, or specified part, can be fully utilized for the purposes for which it was intended.
- B. Substantial completion of the UV System will not be granted until successful completion of the operational demonstration testing in Section 44 44 73, UV System.

- C. Before requesting inspection for Certification of Substantial Completion, complete the following. List exceptions in the request.
1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion is claimed as substantially complete. Include supporting documents for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the contract price.
 2. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the work is not complete.
 3. Advise Owner of pending insurance changeover requirements.
 4. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
 5. Obtain and submit releases enabling Owner unrestricted use of the work and access to services and utilities; include occupancy permits, operating certificate, and similar releases.
 6. Complete final cleanup requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.
 7. Provide all required demonstration and training sessions.
- D. Inspection Procedures: On receipt of a request for inspection, Engineer will either proceed with inspection or advise Contractor of unfilled requirements.
1. Engineer will prepare the Certificate of Substantial Completion following inspection, or advise Contractor of construction that must be completed or corrected before the certificate will be issued.
 2. Engineer will repeat inspection when requested and assured that the work has been substantially completed.
 3. Results of completed inspection will for the basis of requirements for final acceptance.
 4. Date of Substantial Completion will begin the warranty period unless noted otherwise.

1.05 FINAL ACCEPTANCE

- A. Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exception in the request.
1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit an updated final statement, accounting for final additional changes to the contract price.
 3. Submit a copy of Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance. The list shall be endorsed and dated by the Engineer.
 4. Submit consent of surety to final payment.
 5. Submit a final liquidated damages settlement statement.
 6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 7. Submit record drawings, maintenance manuals and similar final record information.
 8. Deliver tools, spare parts, extra stock and similar items.
 9. Complete commissioning and training of Owner's personnel.
 10. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups and similar elements.
 11. Complete final cleaning.
- B. Reinspection Procedure: Engineer will inspect the work upon receipt of notice that work, including inspection list items from earlier inspection, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Engineer.
1. Upon completion of reinspection, Engineer will prepare a certificate of final acceptance, or advise Contractor for work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
 2. If necessary, reinspection will be repeated.

1.06 REQUEST FOR FINAL PAYMENT

- A. Submit request for final payment in accordance with the Agreement and General Conditions, specified in Section 01 29 00, Payment Procedures.
- B. Request for final payment shall include:
1. Documents required for progress payments in Section 01 29 00, Payment Procedures.
 2. Documents required in the General Conditions.
 3. Releases or Waivers of Lien Rights:
 - a. When submitting releases or waivers of Lien rights, provide release or waiver by Contractor and each Subcontractor and Supplier that provided Contractor with labor, material or equipment.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- b. Provide list of Subcontractors and Suppliers for which release or waiver of Lien is required.
 - c. Each release or waiver of Lien shall be signed by an authorized representative of entity submitting release or waiver to Contractor, and shall include Subcontractor's or Supplier's corporate seal if applicable.
 - d. Release or waiver of Lien may be conditional upon receipt of final payment.
4. Consent of Surety.
 5. Documentation that all punch list items are complete.
 6. Warranties.
 7. Operational and Maintenance manuals.
 8. Record Drawings being maintained by the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
2. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
 - a. Color Coding:
 - 1) Green when showing information deleted from Drawings.
 - 2) Red when showing information added to Drawings.
 - 3) Blue and circled in blue to show notes.

2. Date entries.
3. Call attention to entry by “cloud” drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
 - a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
 - b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
 - d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
 - e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer’s written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
 - f. Conduit route plan, wiring diagrams, etc.
5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
 - a. Clearly identify the item by accurate note such as “cast iron drain,” “galv. water,” and the like.
 - b. Show, by symbol or note, vertical location of item (“under slab,” “in ceiling plenum,” “exposed,” and the like).
 - c. Make identification so descriptive that it may be related reliably to Specifications.

3.02 FINAL CLEANING

- A. At completion of the Work or of a part thereof and immediately prior to Contractor’s request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor’s notice of completion, clean entire Site or parts thereof, as applicable.
 1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner.
 2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
 4. Clean all windows.
 5. Clean and wax wood, vinyl, or painted floors.
 6. Broom clean exterior paved driveways and parking areas.
 7. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
 8. Rake clean all other surfaces.
 9. Remove snow and ice from access to buildings.
 10. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
 11. Leave water courses, gutters, and ditches open and clean.
- B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Detailed information for the preparation, submission, and Engineer's review of Operations and Maintenance (O&M) Data, as required by individual Specification sections.

1.02 DEFINITIONS

- A. Preliminary Data: Initial and subsequent submissions for Engineer's review.
- B. Final Data: Engineer-accepted data, submitted as specified herein.
- C. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.03 SEQUENCING AND SCHEDULING

- A. Equipment and System Data:
 - 1. Preliminary Data:
 - a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
 - b. Submit prior to shipment date.
 - 2. Final Data: Submit Instructional Manual Formatted data not less than 30 days prior to installation of equipment or system. Submit Compilation Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.
- B. Materials and Finishes Data:
 - 1. Preliminary Data: Submit at least 15 days prior to request for final inspection.
 - 2. Final Data: Submit within 10 days after final inspection.

1.04 DATA FORMAT

- A. Prepare preliminary data in the form of an instructional manual. Prepare final data on electronic media.

- B. Instructional Manual Format:
 - 1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
 - 2. Size: 8-1/2 inches by 11 inches, minimum. Binder width shall be minimum 1-inch and maximum 3-inch.
 - 3. Cover: Identify manual with typed or printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" and list:
 - a. Project title.
 - b. Designate applicable system, equipment, material, or finish.
 - c. Identity of separate structure as applicable.
 - D. Identify volume number if more than one volume as VOLUME NO. ___ OF ___.
 - e. Identity of general subject matter covered in manual. Identity of equipment number and Specification section.
 - 4. Spine:
 - a. OPERATING AND MAINTENANCE INSTRUCTIONS.
 - b. Name or type of material or equipment cover in the Manual.
 - C. Identify volume number if more than one volume as VOLUME NO. ___ OF ___.
 - d. Project title.
 - 5. Title Page:
 - a. Contractor name, address, and telephone number.
 - b. Subcontractor, Supplier, installer, or maintenance contractor's name, address, and telephone number, as appropriate.
 - 1) Identify area of responsibility of each.
 - 2) Provide name and telephone number of local source of supply for parts and replacement.
 - 6. Table of Contents:
 - a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
 - b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
 - 7. Paper: 20-pound minimum, white for typed pages.
 - 8. Text: Manufacturer's printed data, or neatly typewritten.
 - 9. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.

10. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

C. Data Compilation Format:

1. Compile all Engineer-accepted preliminary O&M data into a hard-copy, hard-bound set.
2. Each set shall consist of the following:
 - a. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
 - b. Cover: Identify each volume with typed or printed title "OPERATION AND MAINTENANCE DATA, VOLUME NO. ___ OF ___", and list:
 - 1) Project title.
 - 2) Contractor's name, address, and telephone number.
 - 3) If entire volume covers equipment or system provided by one Supplier include the following:
 - a) Identity of general subject matter covered in manual.
 - b) Identity of equipment number and Specification section.
 - c. Provide each volume with title page and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.
 - d. Table of contents neatly typewritten, arranged in a systematic order:
 - 1) Include list of each product, indexed to content of each volume.
 - 2) Designate system or equipment for which it is intended.
 - 3) Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
 - e. Section Dividers:
 - 1) Heavy, 80 pound cover weight, tabbed with numbered plastic index tabs.
 - 2) Fly-Leaf:
 - a) For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.
 - b) List with Each Product:
 - (1) Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.
 - (2) Identify area of responsibility of each.

- (3) Provide local source of supply for parts and replacement.
- c) Identity of separate structure as applicable.
- f. Assemble and bind material, as much as possible, in same order as specified in the Contract Documents.

D. Electronic Media Format:

- 1. Portable Document Format (PDF):
 - a. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format on CD.
 - b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
 - c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.
 - d. Each electronic copy shall include all information included in printed copy.
 - e. Submit each electronic copy on a separate compact disc (CD), unless another electronic data transfer method or format is acceptable to the Engineer.
 - f. File Format: The O&M Manuals will be placed into the Owner's Content Management System. All electronic files shall be compatible with this system.
 - g. Files shall be in "portable document format (PDF)." Files shall be entirely electronically searchable and created from the original document. scanned/Image PDF's will not be accepted.
 - h. Submit separate file for each separate document in the printed copy.
 - i. Within each file, provide bookmarks for the following:
 - 1) Each chapter and subsection listed in the printed copy document's table of contents.
 - 2) Each figure.
 - 3) Each table.
 - 4) Each appendix.
 - j. Also provide drawings and figures in one of the following formats: ".bmp", ".tif", ".jpg", or ".gif". Submit files in a separate directory on the CD.
 - k. Technical drawings will be provided in both AutoDesk SWG format and PDF format.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

1.05 SUBMITTALS

A. Informational:

1. Data Outline: Submit two copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
2. Preliminary Data:
 - a. Submit two copies for Engineer's review.
 - b. If data meets conditions of the Contract:
 - 1) One copy will be returned to Contractor.
 - 2) One copy will be forwarded to Resident Project Representative.
 - c. If data does not meet conditions of the Contract:
 - 1) All copies will be returned to Contractor with Engineer's comments (on separate document) for revision.
 - 2) Engineer's comments will be retained in Engineer's file.
 - 3) Resubmit two copies revised in accordance with Engineer's comments.
3. Final Data: Submit two copies in format specified herein.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content For Each Unit (or Common Units) and System:

1. Product Data:
 - a. Include only those sheets that are pertinent to specific product.
 - b. Clearly annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information.
 - c. Function, normal operating characteristics, and limiting conditions.
 - d. Performance curves, engineering data, nameplate data, and tests.
 - e. Complete nomenclature and commercial number of replaceable parts.
 - f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
 - g. Spare parts ordering instructions.
 - h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
2. As-installed, color-coded piping diagrams.

3. Charts of valve tag numbers, with the location and function of each valve.
4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
 - a. Format:
 - 1) Provide reinforced, punched, binder tab; bind in with text.
 - 2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
 - 3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
 - 4) Identify Specification section and product on Drawings and envelopes.
 - b. Relations of component parts of equipment and systems.
 - c. Control and flow diagrams.
 - d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
5. Instructions and Procedures: Within text, as required to supplement product data.
 - a. Format:
 - 1) Organize in consistent format under separate heading for each different procedure.
 - 2) Provide logical sequence of instructions for each procedure.
 - 3) Provide information sheet for Owner's personnel, including:
 - a) Proper procedures in event of failure.
 - b) Instances that might affect validity of guarantee or Bond.
 - b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
 - c. Operating Procedures:
 - 1) Startup, break-in, routine, and normal operating instructions.
 - 2) Test procedures and results of factory tests where required.
 - 3) Regulation, control, stopping, and emergency instructions.
 - 4) Description of operation sequence by control manufacturer.
 - 5) Shutdown instructions for both short and extended duration.
 - 6) Summer and winter operating instructions, as applicable.
 - 7) Safety precautions.
 - 8) Special operating instructions.
 - d. Maintenance and Overhaul Procedures:
 - 1) Routine maintenance.
 - 2) Guide to troubleshooting.
 - 3) Disassembly, removal, repair, reinstallation, and re-assembly.
6. Guarantee, Bond, and Service Agreement: In accordance with Section 01 77 00, Closeout Procedures.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

7. Complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bill of material shall indicate:
 - a. Manufacturer's name, address, telephone number, fax number, and Internet website address.
 - b. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
 - c. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
 - d. For each part or piece include the following information:
 - 1) Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
 - 2) Part name or description.
 - 3) Manufacturer's part number.
 - 4) Quantity of each part used in each assembly.
 - 5) Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.
8. Complete instructions for ordering replaceable parts, including reference number (such as shop order number or serial number) that will expedite the ordering process.
9. Manufacturer's recommended inventory levels for spare parts, extra clock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.
10. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out the other means of obliterating information that does not apply to the materials and equipment furnished.
11. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimension, lettering and text are completely legible on the reduction.

- B. Content for Each Electric or Electronic Item or System:
1. Description of Unit and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, nameplate data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Interconnection wiring diagrams, including control and lighting systems.
 2. Circuit Directories of Panelboards:
 3. Electrical service.
 4. Control requirements and interfaces.
 5. Communication requirements and interfaces.
 6. List of electrical relay settings, and control and alarm contact settings.
 7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
 8. As-installed control diagrams by control manufacturer.
 9. Operating Procedures:
 - a. Routine and normal operating instructions.
 - b. Startup and shutdown sequences, normal and emergency.
 - c. Safety precautions.
 - d. Special operating instructions.
 10. Maintenance Procedures:
 - a. Routine maintenance.
 - b. Guide to troubleshooting.
 - c. Adjustment and checking.
 - d. List of relay settings, control and alarm contact settings.
 11. Manufacturer's printed operating and maintenance instructions.
 12. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 13. Programmable Logic Controllers: If programmable logic controllers are furnished:
 - a. Submit complete logic listing in one consistent format.
 - b. Format Requirements:
 - 1) For ladder diagram logic, include complete cross-referencing of all logic elements. Annotate all elements with clearly understandable tags or descriptive labels.
 - 2) For function block diagram, label each function block with understandable tags or descriptive labels. Describe purposes and action of each function block.
 - 3) For sequential function chart, include extensive comments for each step to describe program step function.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- 4) For instruction list and structured text, include extensive comments for each program line to describe program line function.
 14. Submit complete programmable logic controller listing of all input/output address assignments, tag assignments, and pre-set constant values, with functional point description.
 15. Submit complete manufacturer's programming manuals.
- C. Maintenance Summary:
1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
 2. Format:
 - a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
 - b. Each Maintenance Summary may take as many pages as required.
 - c. Use only 8-1/2-inch by 11-inch size paper.
 - d. Complete using typewriter or electronic printing.
 3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
 4. Recommended Spare Parts:
 - a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
 - b. "Unit" is the unit of measure for ordering the part.
 - c. "Quantity" is the number of units recommended.
 - d. "Unit Cost" is the current purchase price.

1.07 DATA FOR MATERIALS AND FINISHES

- A. Content for Architectural Products, Applied Materials, and Finishes:
1. Manufacturer's data, giving full information on products:
 - a. Catalog number, size, and composition.
 - b. Color and texture designations.
 - c. Information required for reordering special-manufactured products.
 2. Instructions for Care and Maintenance:
 - a. Manufacturer's recommendation for types of cleaning agents and methods.
 - b. Cautions against cleaning agents and methods that are detrimental to product.
 - c. Recommended schedule for cleaning and maintenance.

- B. Content for Moisture Protection and Weather Exposed Products:
 - 1. Manufacturer's data, giving full information on products:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Details of installation.
 - 2. Instructions for inspection, maintenance, and repair.

PART 2 PRODUCTS

2.01 INSTRUCTOR MANUAL

- A. The Contractor shall prepare an Instructor Manual or each curriculum that Includes all of the information specified below and written at the journeyman level for electrician specialists, mechanical specialists and instrument technicians, and for water treatment plant operators, or other disciplines, depending upon the target audience.
- B. The Instructor Manual shall be consistent with the nomenclature and contents of the accepted Contractor's O&M Manuals. The O&M Manuals cannot be substituted for. the Instructor Manual.
- C. The purpose of the Instructor Manual is to define the concepts and information that will be taught to each target audience and to describe the methods and materials to be used during the training. The Instructor Manual is designed to provide specific guidance to the instructor regarding all aspects of the training program. The Instructor Manual shall include:
 - 1. Description of the equipment:
 - 2. Parts and equipment graphics.
 - 3. Safety procedures.
 - 4. Startup checks and procedures.
 - 5. Overview of routine operation, including startup and shutdown and operating parameters.
 - 6. Routine, preventive, and corrective maintenance procedures.
 - 7. Lubrication (schedule and type).
 - 8. Assembly and disassembly procedures.
 - 9. Troubleshooting procedures.
 - 10. Parts list.
 - 11. Special maintenance practices.
 - 12. Emergency shutdown.
- D. All manuals shall be presented in electronic format per the requirements of Specification Section 01 33 00, Submittal Procedures. All equipment shall be cross-referenced to the equipment tag identification numbers.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- E. Each Instructor Manual shall contain:
1. Instructor Manual cover page.
 2. Instructor Manual table of contents.
 3. Lesson Plan cover page.
 4. Lesson Plan summary.
 5. Lesson Plan text, including:
 - a. Identity of the target audience (a separate Lesson Plan is required for each target audience, such as mechanical O&M personnel, electronic/electrical O&M personnel, etc.).
 - b. Length of the training program and each topic to be covered.
 - c. Performance and/or training objectives.
 - d. Outline of the material to be covered.
 - e. Training strategies to be used and Interaction with the trainees.
 - f. Audio visual and/or support materials required, and when used or referred to during instruction.
 - g. A list of resource and/or reference materials.
 6. A copy of all training aids, including electronic files.
 7. A copy of trainee materials (handouts, reference materials, etc.) in electronic format.
- F. The Contractor shall submit the equipment manufacturer's lesson plans for acceptance by the Engineer no less than ninety (90) days prior to the date that the training is to take place.
- G. With the exception of cutaway models or other items expressly exempted by the Engineer, all training aids and trainee materials contained in the Instructor Manual or used in the delivery of training shall become the property of the Owner and may be duplicated by the Owner for its own use .
- H. The Contractor shall provide required acceptance and/or copyright releases obtained from those who own proprietary and/or copyrighted materials provided by the Contractor so that the materials can be reproduced by the Owner.

2.02 TRAINEE MANUAL

- A. Develop an Instruction program that includes individual training modules for each system and for equipment not part of a system, as required in the individual Specification Sections.
- B. The Contractor shall submit a Trainee Manual for each curriculum that includes all of the information specified below and written at the journeyman level for electrician specialists, mechanic specialists and instrument technicians, and for water treatment plant operators, or other disciplines, depending upon the target audience.

- C. The Trainee Manual shall be consistent with the nomenclature and content of the accepted Contractor O&M Manuals. The O&M Manual cannot be substituted for the Instructor Manual or Trainee Manual.

PART 3 EXECUTION

3.01 GENERAL

- A. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

3.02 SUPPLEMENTS

- A. The supplements listed below, following "End of Section", are part of this Specification.
 - 1. Forms: Maintenance Summary Form.

END OF SECTION

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

MAINTENANCE SUMMARY FORM

PROJECT: _____ CONTRACT NO.: _____

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

a. Name _____ Telephone No. _____

b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	Frequency	Lubricant (If Applicable)
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER’S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

SECTION 01 80 00
CERTIFIED PAYROLL COMPLIANCE AND REPORTING

PART 1 GENERAL

1.01 SUMMARY

- A. This specification covers all administrative requirements, payroll reporting procedures to be followed by Contractors performing work on City-sponsored public improvements projects, and all other miscellaneous and incidental costs associated with complying with the applicable sections of the City of Ann Arbor Code of Ordinances with regard to payment of prevailing wages and its Prevailing Wage Compliance policy.
- B. This specification is **not** intended to include the actual labor costs associated with the payment of prevailing wages as required. Those costs should be properly incorporated in all other items of work bid.

1.02 GENERAL

- A. The Contractor is expected to comply with all applicable sections of Federal and State prevailing wage laws, duly promulgated regulations, the City of Ann Arbor Code of Ordinances, and its Prevailing Wage Compliance Policy as defined within the contract documents. The Contractor shall provide the required certified payrolls, city-required declarations, and reports requested elsewhere in the contract documents within the timeline(s) stipulated therein.
- B. The Contractor shall also provide corrected copies of any submitted documents that are found to contain errors, omissions, inconsistencies, or other defects that render the report invalid. The corrected copies shall be provided when requested by the Supervising Professional.
- C. The Contractor shall also attend any required meetings as needed to fully discuss and ensure compliance with the contract requirements regarding prevailing wage compliance. The Contractor shall require all employees engaged in on-site work to participate in, provide the requested information to the extent practicable, and cooperate in the interview process. The City of Ann Arbor will provide the needed language interpreters in order to perform wage rate interviews or other field investigations as needed.
- D. Certified Payrolls may be submitted on City-provided forms or forms used by the Contractor, as long as the Contractor's forms contain all required payroll information. If the Contractor elects to provide their own forms, the forms shall be approved by the Supervising Professional prior to the beginning of on-site work.

1.03 UNBALANCED BIDDING

- A. The City of Ann Arbor will examine the submitted cost for this item of work prior to contract award. If the City determines, in its sole discretion, that the costs bid by the Contractor for complying with the contract requirements are not reasonable, accurately reported, or may contain discrepancies, the City reserves the right to request additional documentation that fully supports and justifies the price as bid. Should the submitted information not be determined to be reasonable or justify the costs, the City reserves the right to pursue award of the contract to the second low bidder without penalty or prejudice to any other remedies that it may have or may elect to exercise with respect to the original low-bidder.
- B. The Contract Completion date will not be extended as a result of the City's investigation of the as-bid amount for this item of work, even if the anticipated contract award date must be adjusted. The only exception will be if the Contractor adequately demonstrates that their costs were appropriate and justifiable. If so, the City will adjust the contract completion date by the number of calendar days commensurate with the length of the investigation, if the published Notice to Proceed date of the work cannot be met. The contract unit prices for all other items of work will not be adjusted regardless of an adjustment of the contract completion date being made.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 88 15
ANCHORAGE AND BRACING

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers requirements for anchorage and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the ICC 2015 International Building Code (IBC), for seismic, wind, gravity, soil, and operational loads.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Institute of Steel Construction (AISC) 360, Specification for Structural Steel Buildings.
 2. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Buildings and Other Structures.
 3. International Code Council (ICC): International Building Code (IBC).

1.03 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

- A. General:
1. Anchorage and bracing systems shall be designed by a qualified professional engineer registered in the State of Michigan.
 2. Design anchorage into concrete including embedment in accordance with ACI 318-14; Chapter 17 (or other industry standard approved by Engineer), and Project Specifications.
 - a. Unless otherwise noted, design for cracked concrete condition.

3. Design anchorage and bracing of architectural, mechanical, and electrical components and systems in accordance with this section, unless a design is specifically provided within Contract Documents or where exempted hereinafter.
4. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, and operational loading.
5. Anchor and brace piping and ductwork, whether exempt or not exempt for this section, so that lateral or vertical displacement does not result in damage or failure to essential architectural, mechanical, or electrical equipment.
6. Architectural Components: Includes, but are not limited to, nonstructural walls and elements, partitions, cladding and veneer, access flooring, signs, cabinets, suspended ceilings, and glass in glazed curtain walls and partitions.
7. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.
8. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities.
9. For components exempted from design requirements of this section, provide bolted, welded, or otherwise positively fastened attachments to supporting structure.

B. Design Loads:

1. Gravity: Design anchorage and bracing for self-weight and superimposed loads on components and equipment.
2. Operational:
 - a. For loading supplied by equipment manufacturer for IBC required load cases.
 - b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), water hammer, and other load-inducing conditions.
 - c. Locate braces to minimize vibration to or movement of structure.
 - d. For vibrating loads, use anchors meeting requirements of Section 05 05 19, Post-Installed Anchors, for anchors with designated capacities for vibratory loading per manufacturer's ICC-ES report.

C. Seismic Design Requirements:

1. Mechanical, Electrical, and Architectural items are exempt from seismic anchorage and bracing requirements in ASCE 7, Part 13.5 for architectural components and Part 13.6 for electrical and mechanical equipment.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

- a. List of architectural, mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
- b. Manufacturers' hardware product data.
- c. List of existing architectural, mechanical, and electrical equipment or components to be modified in Project requiring Contractor-designed anchorage and bracing in final retrofitted condition.
- d. Submittal will be rejected if proposed anchorage method would create excessive stress to supporting member. Revise anchorages and strengthen structural support to eliminate overstressed condition.

B. Informational Submittals:

1. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include IBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed by a civil or structural engineer registered in the State of Michigan.
2. Manufacturer's hardware installation requirements.

C. Deferred Submittals:

1. Submitted anchorage drawings and calculations are identified as IBC deferred submittals and will be submitted to and must be accepted by AHJ prior to installation of component, equipment, or distribution system.
2. Submit deferred Action Submittals such as Shop Drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.

1.06 SOURCE QUALITY CONTROL

- A. Contractor and supplier responsibilities to accommodate Owner-furnished shop fabrication related special inspections and testing are provided in Project's Statement of Special Inspections in Supplement located at the end of Section 01 45 33, Special Inspection, Observation, and Testing, and Section 01 45 33, Special Inspection, Observation, and Testing.

PART 2 PRODUCTS

2.01 GENERAL

- A. Design and construct attachments and supports transferring loads to structure of materials and products suitable for application and in accordance with design criteria shown on Drawings and nationally recognized standards.
- B. Provide anchor bolts for anchorage of equipment to concrete or masonry in accordance with Section 05 50 00, Metal Fabrications. Provide anchor bolts of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.
- C. Provide post-installed concrete anchors for anchorage of equipment to concrete in accordance with Section 05 05 19, Post-Installed Anchors. Provide post-installed anchors of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.
- D. Do not use expansion anchors, other than undercut anchors, for nonvibration isolated mechanical equipment rated over 10 horsepower.

PART 3 EXECUTION

3.01 GENERAL

- A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.
- B. Design, provide, and install overall seismic anchorage system to provide restraint in all directions, including vertical, for each component or system so anchored.
- C. Provide snubbers in each horizontal direction and vertical restraints for components mounted on vibration isolation systems where required to resist overturning.
- D. Anchor tall and narrow equipment such as motor control centers and telemetry equipment at base and within 12 inches from top of equipment, unless approved otherwise by Engineer.

3.02 INSTALLATION

- A. Do not install components or their anchorages or restraints prior to review and acceptance by Engineer and AHJ.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. In accordance with Section 05 50 00, Metal Fabrications and Section 05 05 19, Post-Installed Anchors.
- B. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

END OF SECTION

SECTION 01 91 14
EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

- A. Facility: Entire Project, or an agreed-upon portion, including all of its unit processes.
- B. Functional Test: Test or tests in presence of Engineer and Owner to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.
- C. Performance Test: Test or tests performed after any required functional test in presence of Engineer and Owner to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.
- D. Unit Process: As used in this section, a unit process is a portion of the facility that performs a specific process function, such as UV light disinfection and chloramines analysis.
- E. Facility Performance Demonstration:
 - 1. A demonstration, conducted by Contractor, with assistance of Owner, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with Owner and as accepted by Engineer.
 - 2. Such demonstration is for the purposes of (i) verifying to Owner entire facility performs as a whole, and (ii) documenting performance characteristics of completed facility for Owner's records. Neither the demonstration nor the evaluation is intended in any way to make performance of a unit process or entire facility the responsibility of Contractor, unless such performance is otherwise specified.
- F. Commissioning: Commissioning is the series of activities or processes necessary to ensure that equipment and systems are designed, installed, functionally tested, started up and capable of being operated and maintained to perform in conformity with the design intent for the facility improvements. Commissioning includes, but is not limited to factory testing, field testing, dry testing, wet testing with plant water, performance testing, Manufacturer's checkout, and operational demonstration.

1.02 SUBMITTALS

A. Informational Submittals:

1. Facility Startup and Performance Demonstration Plan.
2. Functional and performance test results.
3. Completed Unit Process Startup Form for each unit process.
4. Completed Facility Performance Demonstration/Certification Form.

1.03 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN

A. Develop a written plan, in conjunction with Owner's operations personnel; to include the following:

1. Step-by-step instructions for startup of each unit process and the complete facility.
2. Unit Process Startup Form (sample attached), to minimally include the following:
 - a. Description of the unit process, including equipment numbers/nomenclature of each item of equipment and all included devices.
 - b. Detailed procedure for startup of the unit process, including valves to be opened/closed, order of equipment startup, etc.
 - c. Startup requirements for each unit process, including water, power, chemicals, etc.
 - d. Space for evaluation comments.
3. Facility Performance Demonstration/Certification Form (sample attached), to minimally include the following:
 - a. Description of unit processes included in the facility startup.
 - b. Sequence of unit process startup to achieve facility startup.
 - c. Description of computerized operations, if any, included in the facility.
 - d. Contractor certification facility is capable of performing its intended function(s), including fully automatic operation.
 - e. Signature spaces for Contractor and Engineer.

1.04 QUALITY ASSURANCE

A. Contractor shall appoint a Performance Testing Manager who shall:

1. Manage, coordinate, and supervise Contractor's start-up, testing, and commissioning activities including but not limited to field testing, dry testing, wet testing with plant water, performance testing with process liquids and solids, manufacturer's checkout and the Operational Demonstration.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Assist in coordinating and documenting Site quality control Work specified in individual Specification Sections.
 3. Prepare, or review and approve, all submittals for the Work under this Section and related Work contained within the Contract Documents.
 4. Coordinate activities of subcontractors, manufacturers and suppliers relative to the start-up, testing, and commissioning activities.
- B. Performance Testing Manager shall be at the Site a minimum of eight hours per day during all testing and be available at all times, 24 hours per day, seven days per week to perform these duties.
- C. Performance Testing Manager shall supervise the Contractor's Operations Engineer and Operations Specialists who shall be dedicated to the start-up, testing, and commissioning Work.

1.05 TESTING SCHEDULE

- A. Provide a testing schedule that sets forth the planned sequence for performance testing and operational demonstration work. Testing schedule shall be part of the Progress Schedule and shall conform to requirements for Progress Schedule.
1. Detail the equipment and systems to be tested.
 2. Show planned start date, duration, and completion of each test.
 3. Testing schedule shall be submitted no later than eight weeks in advance of the date performance testing and operational demonstrations are to begin. Engineer will not witness performance testing and operational demonstration work until test schedule is accepted by Engineer.
 4. Testing schedule shall be updated weekly and resubmitted to Engineer. Updates shall indicate actual dates of performance testing and operational demonstration Work, indicating equipment, systems and treatment train for which testing is in progress, and that are satisfactorily completed in accordance with the Contract Documents.
- B. Following a successful Operational Demonstration, a summary report containing the following, at a minimum, shall be provided by the Contractor:
1. Equipment, systems and plant treatment trains started-up and commissioned.
 2. Start-up and commissioning dates.
 3. Equipment, systems and performance criteria tested, clearly showing requirements and field data that verifies requirements were met.
 4. Names of witnesses for start-up and commissioning.

5. Any repairs, corrections, or modifications required for the equipment or unit process systems to successfully complete start-up and commissioning.
6. Loop diagrams accurately depicting the installed condition of instrumentation and controls.
7. Any other important Operational Demonstration information.
8. Report Appendix containing the following, as a minimum:
 - a. A summary of all testing data used and calculations, including source, formulas with all terms defined.
 - b. Copies of all raw field data sheets, including those indicating sampling point locations, and notes.
 - c. Production and operational data.
 - d. Calibration sheets for equipment.
 - e. Copies of calibration records for instrumentation.

1.06 COMMISSIONING PLAN

- A. The Contractor shall be responsible for preparing, coordinating, and executing the Plan.
 1. The Contractor shall use the resources of the equipment and unit process systems suppliers in this work, particularly for specific equipment and unit process systems.
 2. An initial draft Plan for the Facility shall be completed and submitted by the Contractor to the Engineer for review at least 90 days prior to the expected commencement of commissioning. The Engineer will require 45 days to review the submittal and return with any exceptions noted. The Contractor shall incorporate the Engineer's comments into the revised Plan within 30 days of receiving comments, and reissue the Plan to the Engineer and Owner.
- B. The Contractor shall provide a dedicated field staff to support the Plan activities. A full-time Startup Manager shall be responsible for day to day activities and shall be the primary contact with the Engineer regarding Plan activities. Support staff shall include but not be limited to. designated mechanical, electrical and instrumentation and control Engineers and technicians, and operating staff.
 1. The Contractor may require assistance from the Owner's operating and maintenance staff in commissioning and performance testing activities specified herein. Activities requiring Owner's staff shall be specifically noted in the Plan.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

C. The Plan shall Define:

1. A chronological schedule of all testing and inspection activities.
2. A checklist of all inspection and testing activities broken down by location, discipline, system, and device or item.
3. All blank forms proposed by the Contractor for verification or recording of the functional completion testing, startup, commissioning and performance testing.
4. An index which cross references the forms to their intended application(s).
5. A list of all supplier certifications, including those required by the applicable technical specifications. Provisions shall also be included for retesting, in the event it is required.
6. A list of participants in functional completion testing, startup, commissioning, and performance testing.
7. A list of special test equipment required for functional completion testing, startup, commissioning, and performance testing.
8. Sources of the test media (water, power, air.) for functional completion testing.
9. The proposed method of delivery of the media to the equipment to be tested during functional completion testing, startup, commissioning, and performance testing.
10. Temporary or interim connections for the sequencing of multiple units during functional completion testing, startup, commissioning, and performance testing.

D. The Contractor shall designate, in the Plan, a Testing and Checkout Coordinator, to coordinate and manage the activities defined in the Plan.

1.07 ROLES AND RESPONSIBILITIES

- A. Contractor shall provide competent, qualified representatives of material, equipment, and system manufacturers to provide services specified, Including supervising installation, adjusting, starting-up, and testing of materials and equipment.
- B. The Contractor shall provide all outside services, materials, labor, supplies, test equipment and other items necessary to perform the Plant Testing, Startup and Commissioning specified herein.
- C. The Supplier's representative's activities required by this Section are in addition to the requirements for vendor training and other services specified elsewhere in the Contract Documents. Timing for the performance of these services is to be defined in the Contractor's Checkout Plan, specified herein, and shall not be concurrent.

- D. The Engineer will review and comment on the Contractor's deliverables, participate in the physical inspection activities, witness the shop and field testing, witness functional testing, maintain the permanent record of all testing results, and provide verification of conformance to the specifications. The Engineer's right to perform inspections, witness tests or monitor or assess the Work and activities does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents nor does it imply completion of the Work.

1.08 FUNCTIONAL COMPLETION TESTING

- A. Functional Completion Testing shall be completed as construction and installation of equipment is completed to demonstrate that the equipment is ready for equipment and systems startup.
- B. Functional Completion Testing shall be done in a coordinated manner based on the Plan prepared by the Contractor.
- C. The Owner's operating and maintenance staff shall be allowed to observe for the purposes of familiarization and training.
- D. Functional Completion Testing procedures and documentation forms shall be developed by the Contractor. The procedures shall include a listing of items inspected for Functional Completion Testing.
- E. If any equipment or unit process systems do not meet Functional Completion Testing requirements, it shall be the responsibility of the Contractor and/or equipment suppliers to make the necessary corrections or replacements and repeat the test
- F. The equipment and unit process systems shall not be started up or put into service until the Functional Completion Testing Is completed as evidenced by a completed Functional Completion Testing certificate for the equipment or subsystem.
- G. Modifications to the equipment and unit process systems required to meet Functional Completion Testing requirements shall be provided, and all retesting shall be performed at no additional cost to the Owner.
- H. A Functional Completion Testing Certificate shall be prepared by the Contractor for each piece of equipment or system and submitted to the Engineer.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

1.09 COMMISSIONING

- A. All equipment shall be commissioned.
- B. Commissioning activities for the project shall not be initiated until the requirements of Startup are completed for the equipment or unit process systems.
- C. The requirements of this section shall be satisfactorily completed prior to beginning Performance Testing for equipment and unit process systems.
- D. Commissioning shall be used by the Contractor and equipment or unit process suppliers to adjust, fine tune, modify and prepare the equipment or system for continuous operation and Performance Testing.
- E. Equipment shall not be operated without the guidance of qualified personnel having the knowledge and experience necessary to conduct proper operation thereof and obtain valid results.
- F. All required adjustments, tests, operation checks, and Startup and Commissioning activities shall be provided by qualified personnel.
- G. Contractor shall be responsible for planning, supervising, and executing the Startup and Commissioning of the equipment and unit process systems with the assistance of equipment or unit process systems suppliers in accordance with the Plan.
- H. The Contractor shall be responsible for commissioning under the direction of its Startup Manager.
- I. The Owner's operating and maintenance staff shall be allowed (o observe for the purposes of familiarization and training.
- J. For equipment or unit process systems that do not meet Commissioning requirements, it shall be the responsibility of the Contractor and/or equipment or unit process systems suppliers to make the necessary corrections or replacements and repeat Commissioning at no additional cost to the Owner.
- K. The equipment or unit process systems shall not be Performance Tested or otherwise placed into service until Commissioning is completed as evidenced by a completed Commissioning certificate for the equipment or unit process systems.

- L. Commissioning Certificates for each piece of equipment or unit process shall be completed and submitted by the Contractor to the Engineer and Owner for review.

1.10 PERFORMANCE TESTING AND OPERATIONAL DEMONSTRATION

- A. Contractor shall demonstrate the operation of all equipment and systems. Contractor shall provide all labor, materials, services, equipment, and incidentals required for Performance Testing and Operational Demonstrations as indicated in the Contract Documents. This Performance Testing and Operational Demonstrations shall be conducted, coordinated and recorded by the Contractor in accordance with the requirements specified herein and in cooperation with the Owner and Engineer. The UV System will not be considered Substantially Complete until the completion of the performance testing and operational demonstration.
- B. This Work is additional to any other installation, shop and factory testing, field testing, dry testing, wet testing, performance testing, balancing or adjustments required elsewhere in the Contract Documents.
- C. Conduct Performance Testing and Operational Demonstration testing for each item of process, mechanical, instrumentation and controls, electrical systems and equipment, and other systems and equipment, to demonstrate compliance with the performance requirements of the Contract Documents.
- D. Objectives of Performance Testing and Operational Demonstrations are to:
 - 1. Demonstrate to the satisfaction of the Owner and Engineer that structures, equipment and systems tested comply with all functional and performance requirements in the Contract Documents.
 - 2. Establish baseline operating conditions for Owner's use in establishing standard operating procedures and preventative maintenance programs.
 - 3. The Performance Testing shall maintain conformance with performance tolerances for a period of not less than 7 days. If a testing failure occurs (whether process, mechanical, electrical, instrumentation) during the 7 day testing period, the malfunction shall be repaired, and the 7 day testing period shall restart.
 - 4. The Operational Demonstrations shall maintain conformance with the performance tolerances for a period of not less than 30 days. If a testing failure occurs (whether process, mechanical, electrical, instrumentation) during the 30 day testing period, the malfunction shall be repaired, and the 30 day testing period shall restart.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

E. Utilities and Consumables:

1. Contractor shall provide the following: fuel, compressed air, temporary conduit, cable and wire, piping and appurtenances, and ail other items and Work required for completing Performance Testing and Operational Demonstrations.
2. Owner will provide the electricity, chemicals, and plant water for the initial Performance Testing and Operational Demonstrations. Contractor shall provide all temporary electrical equipment, including but not limited to conduit and cable, piping and appurtenances required to convey electricity, chemicals, and plant water to the required testing location. If re-testing is required, cost of utilities and consumables furnished by Owner for initial testing shall be paid by Contractor at Owner's cost or standard rates, as applicable.

F. Sequence: The following general sequence applies to Performance Testing and Operational Demonstrations:

1. Furnish submittals required prior to Performance Testing, in accordance with the Contract Documents.
2. Furnish acceptable operations and maintenance manuals in accordance with the Contract Documents.
3. Complete the Work associated with starting and placing equipment and systems in operation in accordance with the Contract Documents.
4. Training of operations and maintenance. Training must occur prior to the Operational Demonstration.
5. Proceed with Performance Testing in accordance with the Contract Documents, simulating the range of actual operating conditions to the greatest extent possible.
6. Complete site quality control Work specified in the Contract Documents for individual equipment items and systems. Field inspection, testing, and adjustments shall be signed off by approved representative of the Manufacturer, indicating that the equipment, components, systems, or unit processes meets the Manufacturer's requirements.
7. Following acceptance of the Performance Testing by the Engineer and Owner, Contractor shall initiate a 30-day Operational Demonstrations, as described herein.
8. Successful completion of Operational Demonstration is part of the requirements to achieve Substantial Completion of the pump station.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Facility Startup Meetings: Schedule, in accordance with requirements of Section 01 31 19, Project Meetings, to discuss test schedule, test methods, materials, chemicals and liquids required, facilities operations interface, and Owner involvement.
- B. Contractor's Testing and Startup Representative:
 - 1. Designate and furnish one or more personnel to coordinate and expedite testing and facility startup.
 - 2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.
- C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.
- D. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing work so as not to interfere with or delay testing and startup.
- E. Owner will:
 - 1. Provide water, power, chemicals, and other items as required for startup, unless otherwise indicated.
 - 2. Operate process units and facility with support of Contractor.
 - 3. Provide labor and materials as required for laboratory analyses.

3.02 EQUIPMENT TESTING

- A. Preparation:
 - 1. Complete installation before testing.
 - 2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
 - 3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01 43 33, Manufacturers' Field Services, when required by individual Specification sections.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

4. Equipment Test Report Form: Provide written test report for each item of equipment to be tested, to include the minimum information:
 - a. Owner/Project Name.
 - b. Equipment or item tested.
 - c. Date and time of test.
 - d. Type of test performed (Functional or Performance).
 - e. Test method.
 - f. Test conditions.
 - g. Test results.
 - h. Signature spaces for Contractor and Engineer as witness.
5. Cleaning and Checking: Prior to beginning functional testing:
 - a. Calibrate testing equipment in accordance with manufacturer's instructions.
 - b. Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
 - c. Lubricate equipment in accordance with manufacturer's instructions.
 - d. Turn rotating equipment by hand when possible to confirm that equipment is not bound.
 - e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
 - f. Check power supply to electric-powered equipment for correct voltage.
 - g. Adjust clearances and torque.
 - h. Test piping for leaks.
6. Ready-to-test determination will be by Engineer based at least on the following:
 - a. Acceptable Operation and Maintenance Data.
 - b. Notification by Contractor of equipment readiness for testing.
 - c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
 - d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
 - e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
 - f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
 - g. Equipment and electrical tagging complete.
 - h. Delivery of all spare parts and special tools.

B. Functional Testing:

1. Conduct as specified in individual Specification sections.

2. Notify Owner and Engineer in writing at least 14 days prior to scheduled date of testing.
3. Prepare Equipment Test Report summarizing test method and results.
4. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so required by individual Specification sections. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.

C. Performance Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Engineer and Owner in writing at least 14 days prior to scheduled date of test.
3. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements specified.
4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.
6. Prepare Equipment Test Report summarizing test method and results.
7. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming to Contract requirements. Such acceptance will be evidenced by Engineer's signature on Equipment Test Report.

3.03 STARTUP OF UNIT PROCESSES

- A. Prior to unit process startup, equipment within unit process shall be accepted by Engineer as having met functional and performance testing requirements specified.
- B. Startup sequencing of unit processes shall be in the following order:
 1. UVT analyzers.
 2. Flowmeters.
 3. UV disinfection system.
 4. Chloramine analyzers.
- C. Make adjustments, repairs, and corrections necessary to complete unit process startup.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- D. Startup shall be considered complete when, in opinion of Owner and Engineer, unit process has operated in manner intended for 5 continuous days without significant interruption. This period is in addition to functional or performance test periods specified elsewhere.
- E. Significant Interruption: May include any of the following events:
 - 1. Failure of Contractor to provide and maintain qualified onsite startup personnel as scheduled.
 - 2. Failure to meet specified functional operation for more than 2 consecutive hours.
 - 3. Failure of any critical equipment or unit process that is not satisfactorily corrected within 5 hours after failure.
 - 4. Failure of any noncritical equipment or unit process that is not satisfactorily corrected within 8 hours after failure.
 - 5. As determined by Engineer or Owner.
- F. A significant interruption will require startup then in progress to be stopped. After corrections are made, startup test period to start from beginning again.
- G. The Contractor's Performance Testing Manager and Manufacturer's Representative shall inspect equipment and systems prior to each start-up and verify their readiness for start-up. Conditions hazardous to equipment or personnel shall be corrected by the Contractor's Performance Testing Manager prior to start-up of equipment.
- H. Start-up operations shall not precede using temporary power or temporary instrumentation and control wiring. All electrical and control connections shall be permanent and complete, and all such electrical components and equipment fully functional.
- I. Use of repair parts during start-up operations shall not be permitted, except in such situations where the actual on-site verification of such repair parts' operability is specified.
- J. The Contractor's Performance Testing Manager shall verify that all initial copies of the maintenance and operating instructions have received, from the Engineer, an acceptable disposition as defined in Section 01 33 00, Submittal Procedures, and the only outstanding item is the field verification of the maintenance and operating instructions.

3.04 COMMISSIONING

- A. On successful completion of startup, the Contractor shall begin commissioning of the equipment and systems, wherein the equipment and systems are subjected to full operation. Adjustments shall be made as necessary and the equipment and system shall be optimized and brought into compliance with design criteria in preparation for performance testing and the Operational Demonstration specified within the Contract Documents.
- B. The various vendors, equipment suppliers and manufacturers shall provide on-site supervision and assistance for Commissioning services for the new facility.
- C. The Contractor shall coordinate all Commissioning activities for equipment and systems in accordance with the accepted commissioning plan.
- D. Commissioning shall show that the equipment and unit process systems are capable of continuous operation using process liquids and solids, chemicals, and utilities; and that the flows, operating parameters and performance requirements have been demonstrated for a minimum of seven days of continuous operation, or the period required in the equipment specifications, whichever is longer.
- E. If the commissioning fails, the Contractor will be responsible for redoing the commissioning at no additional costs to the Owner.
- F. Shutdowns that occur because of power outages, acts of God, or failure of support systems not part of this contract will not be a cause of failure of continuous operation during the operational Demonstration.

3.05 FACILITY PERFORMANCE DEMONSTRATION

- A. When, in the opinion of Engineer, startup of all unit processes has been achieved, sequence each unit process to the point that facility is operational.
- B. Demonstrate proper operation of required interfaces within and between individual unit processes.
- C. After facility is operating, complete performance testing of equipment and systems not previously tested.
- D. Document, as defined in Facility Startup and Performance Demonstration Plan, the performance of the facility including its computer system, until all unit processes are operable and under control of computer system.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- E. Certify, on the Facility Performance Demonstration/Certification Form, that facility is capable of performing its intended function(s), including fully automatic and computerized operation.
- F. Contractor shall perform Operational Demonstration of the work. Unless otherwise F specified, the Operational Demonstration shall be a continuous 30-day, (720 hours) period during which the work is operated and maintained in a continuously on-line, fully functional process status.
- G. The Operational Demonstrations shall encompass the entire work, or the portion thereof designated for Substantial Completion. The Operational Demonstrations shall include all the equipment and systems.
- H. Filling, draining, cleaning, stabilizing, adjusting, or other start-up activity time shall not be counted as Operational Demonstration time.
- I. During the entire 30 day Operational Demonstration period, the operation of equipment will be assumed by the Owner's personnel, under the direction of the Contractor. The Contractor shall provide labor and sufficient material to fully operate and maintain the work 24 hours per day, 7 days per week for the entire duration of the Operational Demonstrations.
- J. Prior to the Operational Demonstrations, all parts of the work designated for the operational demonstration shall have passed an required tests as specified. No testing shall be allowed during the Operational Demonstrations.
- K. During the Operational Demonstration period, Contractor shall obtain baseline operating data on UV equipment.
- L. All required maintenance and servicing prior to the date of Substantial Completion shall be performed by the Contractor at the specified interval and as necessary. All maintenance and servicing shall be noted in the Operational Demonstration Log.
- M. All outages of equipment or system(s) should be noted in the Operational Demonstration Log. Plant outages are considered a part of normal plant operation and will not Invalidate the Operational Demonstration. The Contractor is responsible for the safe and orderly shutdown and restart of equipment as necessary in the event of an outage.
- N. Contractor and Performance Testing Manager shall attend Operational Demonstration coordination meetings as called by the Engineer to review operating conditions of equipment and systems.

- O. If during the Operational Demonstration, any part of the work fails to fully conform to the requirements of the Contract Documents, the Operational Demonstration shall be considered to have failed, and the work shall not be considered to be Substantially Complete, and the Engineer shall so notify the Contractor in writing. If, during the Operation Demonstration, the provisions of the General Conditions are evoked to stop the work, the Operational Demonstration will also be considered to have failed.
- P. Re-testing Because of Disputed Testing Results or Procedures: In the case of an otherwise satisfactory Operational Demonstration, when there is doubt, dispute, or difference between Engineer and Contractor regarding testing results, methods, or equipment used in the Operational Demonstration testing, Engineer may order Contractor to repeat the testing. If repeat testing using such modified methods or equipment required by Engineer confirms the previous test, all costs of repeat test will be paid by Owner. Otherwise all costs, including costs of the Engineer, labor, testing agencies, and inspections, shall be paid by Contractor.
- Q. Post-test Inspection: After completing Operational Demonstration testing, check equipment for proper alignment and realign, as required. Check equipment for loose connections, unusual . movement, and other indication of improper operating characteristics. Disassemble and inspect equipment and devices that exhibit unusual or unacceptable operating characteristics. Repair or replace defective Work to conform to the Contract Documents at no additional cost to Owner.
- R. Upon failure of the Operational Demonstration, the Contractor shall promptly remedy any defects in the work and shall promptly reschedule and re-start the complete 30-day, (720 hours) Operational Demonstration time period. No Operational Demonstration time will be considered to have accrued to any part of the work by reason of a failed Operational Demonstration.
- S. During the Operational Demonstration, the Owner may require or permit the Operational Demonstration to be suspended:
 - 1. As provided in the General Conditions.
 - 2. Upon the written request of the Contractor, to correct or adjust the work, when in the judgment of the Engineer such required correction or adjustment is insufficient to deem the Operational Demonstration to have failed.
 - 3. If the Operational Demonstration is suspended for any reason except of failure, Operational Demonstration time shall accrue to the work from the time of the beginning of the Operational Demonstration to the time of the suspension.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

4. If the Operational Demonstration is suspended at the request of the Contractor, the Contractor shall continue operation and maintenance of the work without additional charges to the Owner, according to the extent required by the Contract Documents and the Owner. No Operational Demonstration time shall accrue to the Work during the period of suspension.
- T. Completion of the Operational Demonstration does not relieve the Contractor of its other requirements for Substantial Completion as required by the Contract Documents.

3.06 SUPPLEMENTS

- A. Supplements listed below, following “End of Section,” are a part of this Specification:
 1. Unit Process Startup Form.
 2. Facility Performance Demonstration/Certification Form.

END OF SECTION

UNIT PROCESS STARTUP FORM

Owner: _____ **PROJECT:** _____

Unit Process Description: (Include description and equipment number of all equipment and devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

Startup Requirements (Water, power, chemicals, etc.): _____

Evaluation Comments: _____

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

Owner: _____ **PROJECT:** _____

Unit Processes Description (List unit processes involved in facility startup):

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ **Date:** _____, 20__

Engineer: _____ **Date:** _____, 20__
(Authorized Signature)

**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
1. American National Standards Institute (ANSI): A10.6, Safety Requirements for Demolition Operations.
 2. Occupational Safety and Health Administration (OSHA), U.S. Code of Federal Regulations (CFR) Title 29 Part 1926—Occupational Safety and Health Regulations for Construction.
 3. Environmental Protection Agency (EPA), U.S. Code of Federal Regulations (CFR), Title 40:
 - a. Part 61—National Emission Standards for Hazardous Air Pollutants.
 - b. Part 82—Protection of Stratospheric Ozone.
 - c. Part 273—Standards for Universal Waste Management.
 4. Michigan Law – MCL 333.5451-5477 – Lead paint abatement.
 5. MIOSHA Part 603, R325.51992.

1.02 DEFINITIONS

- A. ACM: Asbestos-containing material.
- B. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof. Demolition also includes removal of pipes, manholes tanks, conduit, and other underground facilities, whether as a separate activity or in conjunction with construction of new facilities.
- C. LBP: Lead-Based Paint.
- D. LCM: Lead-containing materials.
- E. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.
- F. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on the Drawings.
- G. Renovation: Altering a facility or one or more facility components in any way.

- H. Salvage/Salvageable: Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner. Unless otherwise specified, title to items identified for demolition shall revert to Contractor.
- I. Universal Waste Lamp: In accordance with 40 CFR 273, the bulb or tube portion of an electric lighting device, examples of which include, but are not limited to, fluorescent, high-intensity discharge, neon, mercury vapor, high-pressure sodium, and metal halide lamps.
- J. Universal Waste Thermostat: A temperature control device that contains metallic mercury in an ampule attached to a bimetal sensing element, and mercury-containing ampules that have been removed from these temperature control devices in compliance with the requirements of 40 CFR 273.

1.03 SUBMITTALS

A. Action Submittals:

- 1. The Contractor shall submit pre-project submittals to the Owner and Owner's Representative at least five (5) working days prior to the pre-construction meeting, and shall address:
 - a. Copy of Asbestos Project Plan per State of Michigan and Federal requirements.
- 2. An asbestos abatement contractor certification as required to perform ACM abatement Work in the State of Michigan.

B. Informational Submittals:

- 1. Submit proposed Demolition Plan, in accordance with requirements specified herein, for approval before such Work is started.
- 2. Submit copies of any notifications, authorizations and permits required to perform the Work.
- 3. Submit a shipping receipt or bill of lading for all containers of ACM shipped.
- 4. Submit a shipping receipt or bill of lading for all universal waste shipped.
- 5. Daily Entry Logs documenting the names of all approved personnel entering or leaving any containment area where an asbestos contaminated, lead paint contaminated, or other potentially contaminated atmosphere exists.
- 6. All Air Sampling Data collected by Contractor. Results and sampling data shall be discussed with the Owner and Owner's Representative weekly.
- 7. The Contractor's Site Supervisor Daily Logs.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

1.04 REGULATORY AND SAFETY REQUIREMENTS

- A. When applicable, demolition Work shall be accomplished in strict accordance with 29 CFR 1926-Subpart T.
- B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor's safety requirements shall conform to ANSI A10.6.
- C. Furnish timely notification of this demolition project to applicable federal, state, regional, and local authorities in accordance with 40 CFR 61-Subpart M.
- D. Demolition of LCM or LBP shall comply with requirements and procedures outlined in Section 02 41 01, Lead Based Paint Abatement.

1.05 DEMOLITION PLAN

- A. Demolition Plan shall provide for safe conduct of the Work and shall include:
 - 1. Detailed description of methods and equipment to be used for each operation;
 - 2. The Contractor's planned sequence of operations, including coordination with other work in progress;
 - 3. Procedures for removal and disposition of materials specified to be salvaged.
 - 4. Disconnection schedule of utility services.
 - 5. ACM abatement plan.
 - 6. LCM/LBP abatement plan.
- B. Include statements affirming Contractor inspection of the existing roof deck, floors, walls, and framing members, and their suitability to perform as a safe working platform or, if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the Work.

1.06 SEQUENCING AND SCHEDULING

- A. The Work of this Specification shall not commence until Contractor's Demolition Plan has been approved by Owner or Engineer.
- B. Include the Work of this Specification in the progress schedule, as specified in Section 01 32 00, Construction Progress Documentation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Before beginning Work, visit site to verify existing conditions.
- B. Due to the age of the existing coating system(s), it is anticipated that heavy metals (i.e. lead) may be present in one or more of the existing pipe coating system(s). Existing pipe joints consist of ACM. The Contractor will need to complete preconstruction sampling prior to disturbance of existing coating system(s) and pipe joints. Refer to Section 02 41 01, Lead Paint Abatement, for additional requirements.
- C. Verify that demolition and alterations may be performed in accordance with design, pertinent codes and regulations.
- D. Bring questions regarding alterations to attention of Engineer.
- E. Coordinate work with Engineer to minimize inconvenience to Owner and occupants of building, if any.
- F. Discrepancies: Immediately notify Engineer. Do not proceed with Work in areas of discrepancy until fully resolved.

3.02 EXISTING FACILITIES TO BE DEMOLISHED

- A. Facilities:
 - 1. Pipeworks: Existing piping, valves, and pipe supports to be demolished as shown on Contract Drawings. Appropriate ACM and lead paint abatement measures shall be completed to meet State and Federal regulatory requirements.
- B. Concrete:
 - 1. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Repair exposed rebar ends and embeds as shown on Drawings.
 - 2. Where new concrete adjoins existing concrete, thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 3/16 inch. Rebar and small embeds at existing concrete may be required to be left to engage new concrete. Saturate surface with water for 24 hours prior to placing new concrete. The new Work shall tie into the existing construction as shown on Drawings.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

C. Patching:

1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as to texture and finish.
2. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work.
3. Patching shall be as specified and indicated, and shall include: Fill holes and depressions caused by previous physical damage or left as a result of removals in existing masonry and concrete walls with an approved patching material, applied in accordance with the manufacturer's printed instructions.

D. Electrical:

1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4 inch below final finished surface.
2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
3. Rework existing circuits, or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown are based upon limited field surveys. Verify existing conditions, make all necessary adjustments, and record the Work on the Record Drawings. This shall include, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers within panelboards as required to accomplish the finished work.
4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.
5. Raceways and cabling not scheduled for reuse.
6. Inaccessibly Concealed: Cut off and abandon in place.
7. Exposed or Concealed Above Accessible Ceilings: Remove.
8. Raceways and Cabling Scheduled for Future Use: Cap/seal and tag.
9. Relocating Equipment: Extend existing wiring or run new wiring from the source.
10. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover plate installed.
11. Where the concealed raceway is uncovered remove raceway (or extended to new location if appropriate).
12. Provide new typewritten panelboard circuit directory cards.

E. Universal Waste Lamps and Thermostats: Manage, contain, package, and label in strict accordance with 40 CFR 273.

3.03 PROTECTION

- A. Building Occupancy: Refer to Section 01 31 13, Project Coordination, for specific requirements related to concurrent occupancy of facilities to be partially demolished.
- B. Dust and Debris Control:
 - 1. Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.
- C. Existing Work:
 - 1. Survey the site and examine the Drawings and Specifications to determine the extent of the Work before beginning any demolition.
 - 2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Owner; any Contractor-damaged items shall be repaired or replaced as directed by Engineer.
 - 3. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural elements or increasing the strength of existing structural elements as may be required as a result of any Work performed under this Contract shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Engineer approval.
- D. Facilities:
 - 1. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.
 - 2. Floors, roofs, walls, columns, pilasters, and other structural elements that are designed and constructed to stand without lateral support or shoring, and are determined by Contractor to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Engineer.
 - 3. Protect all facility elements not scheduled for demolition.
 - 4. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

E. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
2. Provide temporary barricades and other forms of protection to protect Owner's personnel and the general public from injury due to demolition Work.
3. Provide protective measures as required to provide free and safe passage of Owner's personnel and the general public to occupied portions of the structure.

3.04 BURNING

- A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

3.05 RELOCATIONS

- A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Clean all items to be relocated prior to reinstallation, to the satisfaction of Engineer. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by Engineer.

3.06 TITLE TO MATERIALS

- A. Title to equipment and materials resulting from demolition is vested in the Contractor upon approval by Engineer of Contractor's Demolition Plan, and the resulting authorization by Engineer to begin demolition.

3.07 DISPOSITION OF MATERIAL

- A. Do not remove equipment and materials without approval of Contractor's Demolition Plan by the Engineer.
- B. Repair or replace, at the discretion of the Engineer, items damaged during removal or storage.
- C. Owner will not be responsible for the condition or loss of, or damage to, property scheduled to become Contractor's property after Engineer's authorization to begin demolition. Materials and equipment shall not be viewed by prospective purchasers or sold on the Site.

- D. Owner will not be responsible for the condition or loss of, or damage to, such property after Engineer's authorization to begin demolition.

3.08 REUSE OF MATERIALS AND EQUIPMENT

- A. Remove and store materials and equipment listed in Article Title Materials to be reused or relocated to prevent damage, and reinstall as the Work progresses.
- B. Properly store and maintain equipment and materials in same condition as when removed.
- C. Store equipment and material designated to be reused in a location designated by Owner.
- D. Equipment and material designated to be reused shall be cleaned, serviced and checked for proper operability before being put back into service.
- E. Engineer will determine condition of equipment and materials prior to removal.

3.09 UNSALVAGEABLE MATERIAL

- A. Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of off-site.
- B. Universal Waste Lamps and Thermostats: Dispose of in strict accordance with 40 CFR 273.

3.10 CLEANUP

- A. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

END OF SECTION

**SECTION 02 41 01
LEAD PAINT ABATEMENT**

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for working with lead-containing materials (LCM), during any of the following operations:
 - 1. Demolition of Lead-Containing Materials (LCM): Includes razing a building or any portion of a building or piece of equipment with LCM.
 - 2. Incidental Removal or Disturbance of Lead-Based Paint (LBP): This includes activities such as sanding and scraping for paint preparation activities.
 - 3. Removal of Lead-Based Paint (LBP): Complete removal of LBP from substrate.
- B. The Work of this Specification shall not commence until Contractor's Demolition Plan has been approved by Owner or Engineer.
- C. Include the Work of this Specification in the progress schedule, as specified in Section 01 32 00, Construction Progress Documentation.
- D. Refer to Section 02 41 00, Demolition, for additional requirements.
- E. Extent of known LCM is as follows: Coatings/paints on existing piping, valves, and pipe supports in Work areas defined on Contract Documents.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
 - 1. Occupational Safety and Health Administration (OSHA), U.S. Code of Federal Regulations (CFR) Title 29 Part 1926—Occupational Safety and Health Regulations for Construction.
 - 2. Michigan Law – MCL 333.5451-5477 – Lead paint abatement.
 - 3. MIOSHA Part 603, R325.51992.

1.03 DEFINITIONS

- A. The term “Lead-Based Paint” (LBP) is identified as paint or other surface coating such as varnish, sealer or stain containing lead in any detectable amount.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. The term "Incidental Removal or Disturbance of Lead-Based Paint" indicates one or more of the following operations:
 - 1. Scraping, hand sanding, or otherwise removing loose LBP from existing surfaces scheduled to remain in place.
- C. The term "Demolition of LCM" refers to cutting, drilling, abrading, demolishing, or otherwise disturbing building elements coated with LBP or containing lead.
- D. The term "Lead-Containing Materials" (LCM) is identified as construction debris coated with lead-based paint or other materials containing lead.
- E. The term "Critical Barrier" indicates the perimeter of the enclosure within which lead disruption/removal work takes place. Critical Barriers may include existing floor, wall, and ceiling structures, as well as constructed partitions, closures and seals.
- F. The term "Project Site" indicates the limits of the Project Site as indicated on drawings or by provisions of this specification.
- G. The term "Work Area" indicates the area within the Critical Barrier.
- H. The term "Action Level" means exposure to an airborne concentration of lead of 30 micrograms per cubic meter of air calculated as an 8-hour time-weighted average (TWA).
- I. The term "Exposure Assessment" means a determination of employee exposures for a given task measured by air monitoring. The Assessment must meet the criteria for objective data as outlined in the MIOSHA/OSHA Lead in Construction Standard (MIOSHA Part 603, R325.51992 and 29 CFR 1926.62).
- J. The term "OSHA PEL" stands for the Permissible Exposure Limit established by the Occupational Safety and Health Administration for lead exposure. The OSHA PEL refers to an airborne concentration of lead of 50 micrograms per cubic meter of air calculated as an 8-hour time-weighted average (TWA).
- K. The abbreviation "TCLP" stands for Toxicity Characteristic Leaching Procedure and refers to one of the tests to determine if waste is considered a Hazardous Waste or non-hazardous solid waste.
- L. The term "Hazardous Waste" refers to a listed waste or any solid or liquid waste with one or more of the following characteristics: toxic, corrosive, flammable, explosive, combustible, oxidizer, pyrophoric, unstable (reactive) or water - reactive.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- M. The term “Non-Hazardous Waste” refers to any solid or liquid waste not exhibiting characteristics of Hazardous Waste.

1.04 SUBMITTALS

- A. Written Compliance Plan: Submit to Owner or Engineer a Written Compliance Plan incorporating all requirements in the MIOSHA Lead in Construction Standard. Also indicate type of containment and method of liquid waste capture to be established if water is utilized for removal.
- B. Health and Safety Requirements: Submit to Owner or Engineer the following information for each employee that will conduct lead disturbance on the job site:
 - 1. Respiratory Protection Program.
 - 2. Proof of current fit test for respirator that will be worn on Project Site.
 - 3. Proof of medical surveillance for respirator usage and lead work.
 - 4. Proof of lead awareness or higher level of training.

1.05 QUALITY ASSURANCE

- A. Personnel involved in the disturbance of LCM shall be trained in accordance with the requirements of the MIOSHA Lead in Construction Standard, including:
 - 1. The content of the MIOSHA Lead in Construction Standard and its appendices;
 - 2. The specific nature of the operations which could result in exposure to lead above the action level;
 - 3. The purpose, proper selection, fitting, use, and limitations of respirators;
 - 4. The purpose and a description of the medical surveillance program, and the medical removal protection program including information concerning the adverse health effects associated with excessive exposure to lead (with particular attention to the adverse reproductive effects on both males and females and hazards to the fetus and additional precautions for employees who are pregnant);
 - 5. The engineering controls and work practices associated with the employee’s job assignment including training of employees to follow relevant good work practices;
 - 6. The contents of any compliance plan in effect;
 - 7. Instructions to employees that chelating agents should not routinely be used to remove lead from their bodies and should not be used at all except under the direction of a licensed physician; and
 - 8. The employee’s right of access to records under 29 CFR 1910.20.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 HEALTH AND SAFETY REQUIREMENTS

- A. Engage one of the following Environmental Consulting firms to perform environmental / industrial hygiene testing as required:
 - 1. Nova Environmental (734)-930-0995
 - 2. Cardno ATC (248)-669-5140
 - 3. TEK Environmental (810)-355-1580

- B. When performing lead based paint removal:
 - 1. Conduct an initial exposure assessment at the start of the project to determine employee exposure to lead in air as required in MIOSHA Lead in Construction Standard.
 - 2. Collect a minimum of one area air sample per day outside of the work zone in an adjacent interior space to ensure that the action level is not exceeded outside of the work area. A minimum of 1,200 liters of air shall be collected for each air sample.
 - 3. Upon completion of removal and clean-up operations, collect a minimum of two air samples within the work area to ensure that airborne lead concentrations are below the action level prior to allowing general occupancy of the space. A minimum of 1,200 liters of air should be collected for each air sample.
 - 4. Provide a copy of the Environmental Consulting firm report and analytical testing results to Owner.

- C. Job requirements: When the Contractor does not have an Exposure Assessment or the Assessment is determined to be insufficient, the Contractor must conduct personal air monitoring in accordance with the MIOSHA Lead in Construction Standard and follow the requirements below which are outlined by job task until monitoring determines otherwise:
 - 1. Manual demolition, scraping, sanding, heat gun application, power tool cleaning with HEPA dust collection system, spray painting with LCM:
 - a. Use of 1/2 mask respirator with HEPA filters.
 - b. PPE.
 - c. Medical surveillance.
 - d. Use of changing room.
 - e. Use of handwashing facilities.
 - f. Provision of lead awareness training.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Using lead mortar, lead burning, rivet busting, power tool cleaning without HEPA collection, cleaning up with dry expendable abrasives, removing or relocating enclosure:
 - a. Loose fitting PAPR with HEPA or supplied air respirator.
 - b. PPE.
 - c. Medical surveillance.
 - d. Use of changing room.
 - e. Use of handwashing facilities.
 - f. Provision of lead awareness training.
3. Abrasive blasting, welding, using cutting torch, burning:
 - a. Supplied air respirator or SCBA.
 - b. PPE
 - c. Medical surveillance.
 - d. Use of changing room.
 - e. Use of handwashing facilities.
 - f. Provision of lead awareness training.

3.02 PREPARATION

- A. General: Prepare Work Areas in a manner that will protect Owner's personnel and property, and the visiting public, from contact with LCM. Prior to beginning work, confirm starting date and time with Owner. Do not begin work that will disturb LCM without Owner's approval.
- B. Preparing Building Exteriors: Ensure adequate measures are in place to limit airborne lead content below the Action Level of 30 ug/m^3 (micrograms per cubic meter) adjacent to the Work Area.
 1. Erect barricades and install warning tape or signs as necessary to prevent inadvertent exposure of passersby to LCM in all forms, including, but not necessarily limited to dust, particles, and fumes.
 2. Completely cover grounds and vegetation with minimum 8-mil thick polyethylene sheets with joints between sheets lapped and taped; with one edge taped to adjacent building surfaces below area of work; and with free ends secured in position with stakes, tie-down lines or weights. Cover sufficient ground area to capture wind-blown chips, dust and particles.
- C. Preparing Building Interiors: Ensure adequate measures are in place to protect building occupants from exposure to airborne lead dust, particles, fumes or other LCM exceeding the Action Level of 30 ug/m^3 (micrograms per cubic meter) lead content in air. Adequate measures shall include, but are not necessarily limited to, construction of Critical Barriers and/or establishment of negative pressure within Work Area.
 1. Seal off openings and penetrations into the Work Area. Provide temporary dust barriers consisting of at least polyethylene plastic sheet

on wood studs. Lap and tape joints of plastic sheeting to prevent dust, particles, fumes, and other forms of lead debris from leaving the enclosed area.

2. Discontinue building ventilation within the Work Area and seal off ventilation supply and return or exhaust diffusers, grilles or openings.
3. Post warning signs at all entrances to the Work Area that state the following, as required in MIOSHA Lead in Construction Standard:
 - a. WARNING
 - b. LEAD WORK AREA
 - c. POISON
 - d. NO SMOKING OR EATING

3.03 WORK PRACTICES

- A. General: Perform any removal, demolition or disturbance of LCM in compliance with the following requirements:
 1. Restrict access to Work Area to essential personnel.
 2. Use moist-removal methods and/or HEPA vacuuming where applicable. Do not over-saturate the Work Area.
 3. Any debris generated must be cleaned up immediately before it can be tracked into other areas.
 4. Remove contaminated clothing and personal protective equipment before leaving the Work Area, or Work Area enclosure, as applicable.
 5. If the Action Level is exceeded outside the Work Area, discontinue work and modify Critical Barrier, or perform other modifications of methods or materials as required to reduce the lead contamination below the Action Level.
 6. Prohibit eating, drinking, and smoking in the Work Area.
- B. Incidental Removal of LBP: Remove paint from building surfaces by hand scraping and sanding; or through the use of fluid-applied chemical strippers designed to dry into a solid polymeric sheet and peel off with paint encapsulated. Hand-scraping and sanding must be used in conjunction with moist-removal methods using misted water. Leave moist paint dust and chips in place to air dry before collection.
 1. Wet methods (including power-washing) that use amounts of water that can drip, spill, or leak onto the ground, or onto or into other adjacent surfaces are prohibited unless approved by Owner.
 2. Dry removal methods (including sand blasting, power sanding, and other methods relying on high velocity mechanical abrasion) that create airborne fine particulate waste materials are prohibited unless specifically reviewed and approved by owner.
 3. Prior to torch-cutting building elements containing LBP, remove paint within four inches of centerline of cut in accordance with requirements of this Section.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.04 DISPOSAL

- A. Lead Painted Demolition Debris and Lead Paint Chips: In order to determine proper disposal of waste removed from the site, perform Toxicity Characteristic Leaching Procedure (TCLP) testing of LCM waste. If TCLP testing shows the waste to be nonhazardous, the waste can be disposed of as normal construction demolition debris. If waste is classified as Hazardous dispose of material as hazardous waste at an accepting landfill.
1. When storing waste containers on-site, ensure that soil, ground water, and drains or sewers within the storage area are protected from possible contamination. Keep containers secure and tightly closed at all times, except when adding waste.
 2. Keep lead waste segregated from other waste. Do not co-mingle waste. **DO NOT MIX LIQUID AND SOLID WASTE.**
 3. Place appropriate labels on all containers. Provide all information required on the label; mark labels using indelible ink.

3.05 CLEAN UP

- A. Upon completion of LCM or LBP removal and disposal operations, clean all surfaces within the Work Area before it can be tracked into other areas, including, but not necessarily limited to the following:
1. Siding.
 2. Steel support structures.
 3. Floors and ground.
 4. Walls.
 5. Window sills.
 6. Trim.
 7. Ledges and projections.
- B. For projects within building interior spaces, use a HEPA filtered vacuum for removal/elimination of dust, particulates, and debris.
1. Brushing, brooming and other dry methods that generate airborne dust are prohibited.
- C. Remove and dispose of wash water and HEPA filters as Hazardous Waste.
- D. Field Testing: The Owner may visually inspect and/or test the Project Site for evidence of remaining lead contamination. Return to Project Site and, at no additional cost to Owner, re-clean areas found to be contaminated.

END OF SECTION

SECTION 03 30 10
STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 GENERAL

- A. Work shall conform to requirements of ACI 301-10, Specifications for Structural Concrete, unless otherwise specified.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Concrete Institute (ACI):
 - a. 117, Specifications for Tolerances for Concrete Construction and Materials.
 - b. 301-10, Specifications for Structural Concrete.
 - c. 308.1-11, Specification for Curing Concrete.
 - d. SP-66, Detailing Manual.
 2. ASTM International (ASTM):
 - a. A497/A497M, Standard Specification for Steel Welded Reinforcement, Deformed, for Concrete.
 - b. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - c. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - d. C33/C33M, Standard Specification for Concrete Aggregates.
 - e. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - f. C94/C94M, Standard Specification for Ready-Mixed Concrete.
 - g. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
 - h. C150/C150M, Standard Specification for Portland Cement.
 - i. C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - j. C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
 - k. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - l. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
 - m. C595/C595M, Standard Specification for Blended Hydraulic Cements.

- n. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- o. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- p. C920, Specification for Elastomeric Joint Sealants.
- q. C989, Standard Specification for Slag Cement for Use in Concrete and Mortars.
- r. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
- s. C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- t. C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
- u. C1218/C1218M, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
- v. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
- w. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
- x. C 1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
- y. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
- z. C1602/C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
- aa. D226, Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- bb. D227, Specification for Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing.
- cc. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- dd. D1056, Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
- ee. D1751, Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- ff. D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- gg. D2240, Standard Test Method for Rubber Property – Durometer Hardness.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- hh. E329, Standard Specification for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.
- 3. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.
 - b. Recommended Practice for Placing Reinforcing Bars.
- 4. National Ready Mixed Concrete Association (NRMCA).
- 5. NSF International (NSF): 61, Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

- A. Contractor's Licensed Design Engineer: Individual representing Contractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.
- B. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.
- C. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.
- D. New Concrete: Concrete less than 60 days old.
- E. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.

1.04 DESIGN REQUIREMENTS

- A. Design formwork to provide specified concrete finishes.

1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Formwork and Formwork Accessories: Unless otherwise specified, conform to requirements of ACI 301.
 - b. Reinforcing steel prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66 Detailing Manual:
 - 1) Bending lists.
 - 2) Placing drawings.
2. Mix Design:
 - a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
 - b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
 - c. Manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services, for the following:
 - 1) Portland cement.
 - 2) Fly ash.
 - 3) Slag cement.
 - 4) Aggregates, including specified class designation for coarse aggregate.
 - 5) Admixtures.
 - 6) Concrete producer has verified compatibility of constituent materials in design mix.
 - d. Test Reports:
 - 1) Cement: Chemical analysis report.
 - 2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
 - 3) Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
 - e. Aggregates:
 - 1) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
 - 2) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
 - 3) Test Reports:
 - a) Alkali Aggregate Reactivity: Aggregate shall be classified as non-potentially reactive in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- f. Admixtures: Manufacturer's product data sheets for each admixture used in proposed mix designs.
3. Product Data: Specified ancillary materials.
4. Concrete repair techniques.

B. Informational Submittals:

1. Manufacturer's application instructions for bonding agent and bond breaker.
2. Manufacturer's Certificate of Compliance to specified standards:
 - a. Bonding agent.
 - b. Bond breaker.
 - c. Repair materials.
3. Statement of Qualification:
 - a. Batch Plant: Certification as specified herein.
 - b. Mix designer.
 - c. Installer.
 - d. Mix designer.
 - e. Testing agency.
4. Field Test Reports: Tightness test results.
5. Concrete Delivery Tickets:
 - a. For each batch of concrete before unloading at Site.
 - b. In accordance with ASTM C94/C94M, including requirements 14.2.1 through 14.2.10.
 - c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
3. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 - a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

- b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Unload, store, and handle bars in accordance with CRSI publication "Placing Reinforcing Bars."

PART 2 PRODUCTS

2.01 FORMWORK

- A. Form Materials:
 - 1. For exposed areas, use hard plastic finished plywood, overlaid waterproof particle board, or steel in "new and undamaged" condition, of sufficient strength and surface smoothness to produce specified finish.
 - 2. For unexposed areas, use new shiplap or plywood.
- B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.
- C. Form Ties:
 - 1. Material: Steel.
 - 2. Spreader Inserts:
 - a. Conical or spherical type.
 - b. Design to maintain positive contact with forming material.
 - c. Furnish units that will leave no metal closer than 1.5 inches to concrete surface when forms, inserts, and tie ends are removed.
 - 3. Wire ties not permitted.

2.02 CONCRETE

- A. Materials:
 - 1. Cementitious Materials:
 - a. Cement:
 - 1) Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.
 - 2) Blended Hydraulic Cement:
 - a) Unless otherwise specified, conform to requirements of ASTM C595/C595M.

- b) Portland cement used in blended hydraulic cement; conform to requirements of ASTM C150/C150M.
 - 3) Furnish from one source.
 - b. Supplementary Cementitious Materials (SCM):
 - 1) Fly Ash (Pozzolan): Class F and Class C fly ash in accordance with ASTM C618, except as modified herein:
 - a) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
 - 2) Slag Cement: In accordance with ASTM C989, Grades 100 or 120.
 2. Aggregates: Unless otherwise permitted, furnish from one source for each aggregate type used in a mix design.
 - a. Aggregates:
 - 1) In accordance with ASTM C33/C33M, except as modified herein.
 - a) Class Designation: 4S unless otherwise specified.
 - b) Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
 - c) Alkali Silica Reactivity: See Article Concrete Mix Design.
 - 2) Fine Aggregates:
 - a) Clean, sharp, natural sand.
 - b) ASTM C33/C33M.
 - c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
 - (1) Limit material finer than 75- μ m (No. 200) sieve to 3 percent mass of total sample.
 - (2) Limit coal and lignite to 0.5 percent.
 - 3) Coarse Aggregate:
 - a) Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
 - b) Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.
 3. Admixtures: Unless otherwise permitted, furnish from one manufacturer.
 - a. Characteristics:
 - 1) Compatible with other constituents in mix.
 - 2) Contain at most, only trace amount chlorides in solution.
 - 3) Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
 - b. Air-Entraining Admixture: ASTM C260/C260M.
 - c. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
 - d. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - e. Accelerating Admixture: ASTM C 494/C 494M, Type C.

- f. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
 - g. Plasticizing Admixture: ASTM C1017/C1017M, Type I or Type II.
 - h. Do not use calcium chloride as an admixture.
 - i. Admixtures with no standard, ASTM or other, designation may be used where permitted.
4. Water: Mixing water for concrete shall be potable water, unless alternative sources of water are permitted.
- a. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
 - 1) Chloride Content: 1,000 ppm.
 - 2) Sulfate Content as SO₄: 3,000 ppm.
 - 3) Alkalis as (Na₂O + 0.658 K₂O): 600 ppm.
 - 4) Total Solids by Mass: Less than 50,000 ppm.

B. Concrete Mix Design:

- 1. General:
 - a. See Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
 - b. Prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.
 - c. Selection of constituent materials and products in mix design are optional, unless specified otherwise.
 - d. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, water-reducing admixture, or plasticizing admixture in pumped concrete, and in concrete with a water-cementitious materials ratio below 0.50 unless otherwise permitted, use water-reducing admixture and high-range, water-reducing admixture, or plasticizing admixture in columns, piers, pilasters, and walls.
 - e. Use water-reducing admixture or high-range, water-reducing admixture, or plasticizing admixture to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
 - f. Use water-reducing and retarding admixture when anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- g. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.
 - h. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies such as use of supplementary cementitious materials, aggregate packing, and self-consolidating concrete.
2. Potential alkali-aggregate reactivity of concrete:
- a. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).
 - b. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C1260/C1260M or ASTM C1567.
 - 1) Aggregates that indicate expansion greater than 0.10 percent at 16 days after casting shall not be used unless they have been shown to be non-deleteriously reactive in accordance with ASTM C1293, with less than 0.04 percent expansion at 1 year for cement-aggregate combinations or less than 0.04 percent expansion at 2 years for combinations with pozzolan or slag.
 - 2) Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content of cement used in test for potential alkali-aggregate reactivity.
 - c. Use low alkali cement and incorporate pozzolans into the concrete mixture as necessary to satisfy testing for potential alkali reactivity.
3. Proportions:
- a. Design mix to meet aesthetic, durability, and strength requirements.
 - b. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent of weight of total cementitious materials.
4. Slump or Slump Flow:
- a. Unless otherwise specified, Contractor shall select a target slump or slump flow at the point of delivery of concrete mixtures for each application.
 - b. Selected target slump shall not exceed 9 inches.
 - c. Selected target slump flow shall not exceed 30 inches.
 - d. Concrete shall show no signs of visible segregation.
 - e. The target slump or slump flow value shall be enforced for the duration of Project.
 - f. Determine the slump by ASTM C143/C143M.
 - g. Slump tolerances shall meet the requirements of ACI 117.
 - h. Determine slump flow by ASTM C1611/C1611M.
 - i. Slump flow tolerances shall meet the requirements of ASTM C94/C94M.

- j. Unless otherwise permitted, target slump value is 4 inches at point of delivery, for concrete without high-range, water-reducing admixture.
- k. Design mixes that include a high-range, water-reducing admixture shall have a minimum slump of 2 inches prior to addition of admixture. Unless otherwise permitted, slump shall be 8 inches maximum at point of delivery, for concrete with a high-range, water-reducing admixture.
- l. Slump tolerance shall meet requirements of ACI 117.

C. Concrete Mixing:

- 1. General: In accordance with ACI 301, except as modified herein.
- 2. Truck Mixers:
 - a. For every truck, test slump or slump flow of samples taken per ASTM C94/C94M, paragraph 12.5.1.
 - b. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer, unless causing condition is corrected and satisfactory performance is verified by additional slump tests.

2.03 REINFORCING STEEL

- A. Deformed Steel Reinforcing Bars: ASTM A615/A615M, Grade 60. Welding of reinforcing bars is not permitted.
- B. Fabrication: Follow CRSI Manual of Standard Practice.

2.04 FIBROUS REINFORCING

- A. Micro-Fibers:
 - 1. 100 percent virgin polypropylene self-fibrillating fibers.
 - 2. Multi-design gradation.
 - 3. Fibrillated bundles to allow uniform distributed angular fibrils (fiber strands) when mixed into concrete.
 - 4. Specific Gravity: 0.91 minimum.
 - 5. Reprocessed olefin materials are not allowed.
 - 6. Type III fibers conforming to ASTM C1116, Part 4.1.3.
 - 7. Fiber Length: 0.50 inch to 1.0 inch.
 - 8. Manufacturers and Products:
 - a. Euclid Chemical Company, Cleveland OH; Fiberstrand F.
 - b. Propex Concrete Systems Corporation, Chattanooga, TN; Fibermesh 300.

2.05 ANCILLARY MATERIALS

- A. Bonding Agent: Unless otherwise specified, in accordance with the following:
1. ASTM C881/C881M, Type V.
 2. Two-component, moisture insensitive, 100 percent solids epoxy.
 3. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
 4. Manufacturers and Products:
 - a. BASF Building Systems Inc., Shakopee, MN; Masterinject 1500.
 - b. Euclid Chemical Co., Cleveland, OH; Euco # 352 Epoxy System LV.
 - c. Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
 - d. Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.
- B. Bond Breaker:
1. Nonstaining type, providing positive bond prevention.
 2. Manufacturers and Products:
 - a. Dayton Superior Corporation, Kansas City, KS; EDOCO Clean Lift Bond Breaker.
 - b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.
- C. Tie Wire:
1. Black, soft-annealed 16-gauge wire.
 2. Nylon-, epoxy-, or plastic-coated wire.
- D. Bar Supports and Spacers:
1. Use precast concrete bar supports and side form spacers, unless noted otherwise. Do not use other types of supports or spacers.
 2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
- E. Premolded Joint Filler:
1. Bituminous Type: ASTM D994 or ASTM D1751.
 2. Sponge Rubber:
 - a. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum.
 - b. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK515IHD.

3. Self-Expanding Cork:
 - a. ASTM D1752, Type III.
 - b. Manufacturer and Product: WR Meadows, Inc., Hampshire, IL; Self-expanding cork. (800) 342-5976.

F. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.
2. Manufacturers and Products:
 - a. BASF Construction Chemicals, Shakopee, MN; Kure 1315.
 - b. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
 - c. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
 - d. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.
 - e. Dayton Superior; Safe Cure and Seal 1315 EF.

G. Evaporation Retardant:

1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
2. Manufacturers and Products:
 - a. BASF Construction Chemicals, Shakopee, MN; Confilm.
 - b. Euclid Chemical Co., Cleveland, OH; Eucobar.

H. Nonshrink Grout:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
 - a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
 - b. Temperatures of 40 degrees F, 80 degrees F, and 100 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 yard to 9 yard loads in ready-mix truck.
8. Manufacturers and Products:
 - a. BASF Building Systems, Inc., Shakopee, MN; Master Flow 928.
 - b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
 - c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
 - d. Dayton Superior Corp., Kansas City, KS; Sure Grip High Performance Grout.

I. Repair Material:

1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
3. Obtain Manufacturer's Certificate of Compliance that products selected are appropriate for specific applications.
4. Repair mortar shall be Site mixed.
5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
6. Manufacturers and Products:
 - a. BASF Building Systems Inc., Shakopee, MN; EMACO S-Series products.
 - b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop-Series.

2.06 SOURCE QUALITY CONTROL

- A. Source Quality Control Inspection: Engineer shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and Subcontractors, providing products included in this section.

PART 3 EXECUTION

3.01 FORMWORK

A. Form Construction:

1. Construct forms and provide smooth-form finish.
2. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
3. Make joints tight to prevent escape of mortar and to avoid formation of fins.
4. Brace as required to prevent distortion during concrete placement.
5. On exposed surfaces, locate form ties in uniform pattern or as shown.
6. Construct so ties remain embedded in the member with no metal within 1 inch of concrete surface when forms, inserts, and tie ends are removed.

B. Form Removal:

1. Nonsupporting forms (walls and similar parts of Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
 - a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
 - b. Curing and protection operations are maintained.

2. Remove forms with care to prevent scarring and damaging the surface.
3. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

3.02 PLACING REINFORCING STEEL

- A. Unless otherwise specified, place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars.
- B. Splices and Laps:
 1. Lap splice reinforcing: Refer to Structural General Notes in Drawings for additional information.
 2. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 CONCRETE PLACEMENT INTO FORMWORK

- A. Inspection: Notify Engineer and Special Inspector at least one work day in advance before starting to place concrete.
- B. Placement into Formwork:
 1. Reinforcement: Secure in position before placing concrete.
 2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
 3. Placement frequency shall be such that lift lines will not be visible in exposed and architectural concrete finishes.
 4. Use placement devices, for example, chutes, pouring spouts, and pumps as required to prevent segregation.
 5. Vertical Free Fall Drop to Final Placement:
 - a. Forms 8 Inches or Less Wide: 5 feet.
 - b. Forms Wider than 8 Inches: 8 feet, except as specified.
 6. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value.
 - a. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.
 7. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
 8. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.

C. Conveyor Belts and Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Wipe clean with device that does not allow mortar to adhere to belt.
4. Cover conveyor belts and chutes.

D. Retempering: Not permitted for concrete where cement has partially hydrated.

E. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

F. Retempering: Not permitted for concrete where cement has partially hydrated.

3.04 CONSOLIDATION AND VISUAL OBSERVATION

- A. Provide at least one standby vibrator in operable condition at placement Site prior to placing concrete.

3.05 CONCRETE BONDING

A. Construction Joints at Existing Concrete:

1. Thoroughly clean and roughen existing concrete surfaces to roughness profile of 1/4 inch.
2. Saturate surface with water for 24 hours prior to placing new concrete.

3.06 PREMOLDED JOINT FILLER INSTALLATION

- A. Sufficient in width to completely fill joint space where shown.
- B. Drive nails approximately 1 foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.
- C. Secure premolded joint filler in forms before concrete is placed.

3.07 FINISHING FORMED SURFACES

- A. Provide surface finish 2.0 (SF-2.0) in accordance with ACI 301 and as herein specified.
- B. Tie Holes: Unless otherwise specified, fill with specified repair material.
 - 1. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.
- C. Repair defective areas of concrete.
 - 1. Cut edges perpendicular to surface at least 1/2 inch deep. Do not feather edges. Soak area with water for 24 hours.
 - 2. Patch with specified repair material.
 - 3. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from Engineer prior to use.
 - 4. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Engineer.
 - 5. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
 - 6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Engineer.
- D. Inject cracks that leak.

3.08 FINISHING UNFORMED SURFACES

- A. General:
 - 1. Do not use "jitterbugs" or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
 - 2. Do not dust surfaces with dry materials nor add water to surfaces.
 - 3. Cure concrete as specified.

3.09 EXPOSED METAL OBJECTS

- A. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1 inch and then cutting or removing metal object.
- B. Repair area of chipped-out concrete as specified for defective areas.

3.10 BLOCKOUTS AT PIPES OR OTHER PENETRATIONS

- A. Where shown, install in accordance with requirements of Drawings.

3.11 PROTECTION AND CURING

- A. Protect and cure concrete in accordance with requirements of ACI 301 and as follows:
1. Cure formed surfaces with curing compound applied in accordance with manufacturer's written instructions as soon as forms are removed and finishing is completed.
 2. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.12 NONSHRINK GROUT

- A. General: Mix, place, and cure non-shrink grout in accordance with grout manufacturer's written instructions.

3.13 FIELD QUALITY CONTROL

- A. General:
1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
 2. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
 3. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
 - a. For Each Concrete Mixture: Provided results of air content tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture except that testing should be performed at point of placement every 4 hours.
 4. Evaluation will be in accordance with ACI 301 and Specifications.
 5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
 6. Frequency of testing may be changed at discretion of Engineer.
 7. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M, and shrinkage specimens (ASTM C157/C157M) at placement (discharge) end of line.

8. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing by 7 additional days.
3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Engineer.

C. High Range Water Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on Job.

1. Segregation Test Objective: Concrete shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump or slump flow test.
2. Test Procedure: Make slump or slump flow test and check for excessive slump or slump flow, and observe to see if mortar or moisture flows from slumped concrete.
3. Reject concrete if mortar or moisture separates and flows out of mix.

3.14 SUPPLEMENTS

- A. Requirements of concrete mix designs following “End of Section,” are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:
 1. Concrete Mix Design, Class 4500F0S1P1C1.

END OF SECTION

CONCRETE MIX DESIGN, CLASS 4500F0S1P1C1

- A. Mix Locations: Typical.
- B. Exposure Categories and Classifications: F0S1P1C1.
- C. Mix Properties:
 - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.42.
 - 2. Minimum concrete compressive strength (f'c) shall be 4,500 psi at 28 days.
 - a. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0
3§	4.5

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is $\pm 1-1/2$ percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on sieved fraction passing 1-1/2-inch sieve in accordance with ASTM C231/C231M.

- 3. Provide cementitious materials in accordance with one of the following:
 - a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
 - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
 - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.

- 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
 - 3) ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
 4. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
 - a. Limits are stated in terms of chloride ions in percent by weight of cement.
 - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
 5. Fiber Reinforcement:
 - a. Provide polypropylene micro-fibers in design mix.
 - b. Add fiber-reinforcement to mix in concrete plant; 1.5 pounds (minimum) per cubic yard.
- D. Refer to PART 1 through PART 3 of this section for additional requirements.

SECTION 05 05 19
POST-INSTALLED ANCHORS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.
 - b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
 - c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
 2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
 3. American National Standards Institute (ANSI).
 4. ASTM International (ASTM):
 - a. A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A143, Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - c. A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - d. A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - e. A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
 - f. A380, Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - g. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
 - h. A563, Specification for Carbon and Alloy Steel Nuts.
 - i. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - j. A967, Specification for Chemical Passivation Treatments for Stainless Steel Parts.
 - k. E488, Standard Test Methods for Strength of Anchors in Concrete Elements.
 - l. F436, Specification for Hardened Steel Washers.
 - m. F468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.

- n. F568M, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.
 - o. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - p. F594, Specification for Stainless Steel Nuts.
 - q. F1554, Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
6. International Code Council Evaluation Service (ICC-ES):
- a. Evaluation Reports for Concrete and Masonry Anchors.
 - b. AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
 - c. AC70, Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements.
 - d. AC106, Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
 - e. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
 - f. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.
7. Specialty Steel Industry of North America (SSINA):
- a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.
- C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.
- D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

B. Informational Submittals:

- 1. Concrete and Masonry Anchors:
 - a. Manufacturer's product description and installation instructions.
 - b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
 - c. Adhesive Anchor Installer Certification.
- 2. Passivation method for stainless steel members.

1.04 QUALITY ASSURANCE

- A. Qualifications: Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package stainless steel items in a manner to provide protection from carbon impregnation.
- B. Protect hot-dip galvanized finishes from damage as a result of metal banding and rough handling.

PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel:	
Threaded Rods	F593, AISI Type 316, Condition CW
Nuts*	F594, AISI Type 316, Condition CW
Carbon Steel:	
Threaded Rods	F1554, Grade 36 or F568M Class 5.8
Flat and Beveled Washers (Hardened)	F436
Nuts*	A194/A194M, Grade 2H
Galvanized Steel:	
All	A153/A153M
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.	

- B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated in Fastener Schedule at end of this section.

2.02 POST-INSTALLED CONCRETE ANCHORS

A. General:

1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown in Fastener Schedule at end of this section.
2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.

B. Torque-Controlled Expansion Anchors (Wedge Anchors):

1. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; Kwik-Bolt –TZ (KB-TZ) Anchors (ESR-1917).

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1 , +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
- c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-1771 and ESR-3037).

C. Undercut Anchors:

- 1. Manufacturers and Products:
 - a. USP Structural Connectors, Burnsville, MN; DUC Undercut Anchor (ESR-1970).
 - b. Hilti, Inc., Tulsa, OK; HDA Undercut Anchor (ESR-1546).
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; TORQ-CUT Self-Undercutting Anchor (ESR-2705).
 - d. DeWalt/Powers Fasteners, Brewster, NY; Atomic+ Undercut Anchor (ESR-3067).

D. Self-Tapping Concrete Screw Anchors:

- 1. Manufacturers and Products:
 - a. DeWalt/Powers Fasteners, Brewster, NY; Wedge-Bolt+ (ESR-2526).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Vertigo+ Rod Hanger Screw Anchor (ESR-2989).
 - c. DeWalt/Powers Fasteners, Brewster, NY; Snake+ Flush Mount Screw Anchor (ESR-2272).
 - d. Hilti, Inc., Tulsa, OK; HUS-EZ Screw Anchor (ESR-3027).
 - e. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713).

E. Adhesive Anchors:

- 1. Threaded Rod:
 - a. Diameter as shown on Drawings.
 - b. Length as required to provide minimum depth of embedment indicated and thread projection required.
 - c. Clean and free of grease, oil, or other deleterious material.
- 2. Adhesive:
 - a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
 - b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.

3. Packaging and Storage:
 - a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
 - b. Store adhesive on pallets or shelving in a covered storage area.
 - c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
 - d. Dispose of When:
 - 1) Shelf life has expired.
 - 2) Stored other than in accordance with manufacturer's instructions.
4. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT RE 500 V3 (ESR-3814), or HIT-HY 200 (ESR-3187).
 - b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchors (ESR-2508), or AT-XP Adhesive Anchors (IAPMO UES-263).
 - c. DeWalt/Powers Fasteners, Brewster NY; Pure 110+ Epoxy adhesive anchor system (ESR-3298).

F. Adhesive Threaded Inserts:

1. Type 316 stainless steel, internally threaded inserts.
2. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-RN Insert with HIT-RE 500-V3 or HIT-HY 200 adhesive.

2.03 POST-INSTALLED MASONRY ANCHORS

- A. General: AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown in Fastener Schedule at end of section.
- B. Current ICC Evaluation Report indicating acceptance for anchors at structural applications in masonry.
- C. Manufacturers and Products:
 1. Hilti, Inc., Tulsa, OK; Kwik-Bolt-3 (KB-3) (ESR-1385), for grout-filled masonry, HIT-HY 70 (ESR-2682) for grout filled CMU, hollow CMU, or unreinforced masonry.
 2. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 (IAPMO ER 240) for grout filled CMU, Titen-HD (ESR-1056) for grout filled or hollow CMU, AT-XP (IAPMO ER-281) for grout filled CMU.

3. DeWalt/Powers Fasteners, Brewster NY; Power-Stud+ SD1 (ESR-2966) for grout-filled masonry, Wedgebolt+ (ESR-1678) for grout-filled masonry.

PART 3 EXECUTION

3.01 CONCRETE AND MASONRY ANCHORS

- A. Begin installation only after concrete or masonry to receive anchors has attained design strength.
- B. Locate existing reinforcing with Ground Penetrating Radar or other method approved by Engineer prior to drilling. Coordinate with Engineer to adjust anchor locations where installation would result in hitting reinforcing.
- C. Install in accordance with written manufacturer's instructions.
- D. Provide minimum embedment, edge distance, and spacing as indicated on Drawings.
- E. Use only drill type and bit type and diameter recommended by anchor manufacturer.
- F. Clean hole of debris and dust per manufacturer's requirements.
- G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify Engineer for direction on how to proceed.
- H. Adhesive Anchors:
 1. Unless otherwise approved by Engineer and adhesive manufacturer:
 - a. Do not install adhesive anchors when temperature of concrete or masonry is below 40 degrees F or above 100 degrees F.
 - b. Do not install prior to concrete attaining an age of 21 days.
 - c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
 - d. Do not disturb anchor during recommended curing time.
 - e. Do not exceed maximum torque as specified in manufacturer's instructions.
 2. For hollow-unit masonry, install screen tube in accordance with manufacturer's instructions.

- I. Prestressed Concrete: Do not use drilled-in anchors in prestressed or post-tensioned concrete members without Engineer’s prior approval unless specifically shown on Drawings.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

3.03 MANUFACTURER’S SERVICES

- A. Adhesive Anchors: Conduct Site training of installation personnel for proper installation, handling, and storage of adhesive anchor system. Notify Engineer of time and place for sessions.

3.04 FASTENER SCHEDULE

- A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Post-Installed Anchors for Metal Components to Cast-in-Place Concrete (such as, Ladders, Handrail Posts, Electrical Panels, Platforms, and Equipment)		
Interior Dry, Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel	Verify product acceptability and manufacturer’s requirements if anchor installation will occur in an overhead application
2. Anchors in Grout-Filled Concrete Masonry Units		
Interior Dry, Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel adhesive anchors	

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CITY OF ANN ARBOR, MI

Service Use and Location	Product	Remarks
3. Anchors in Hollow Concrete Masonry Units		
Interior Dry, Exterior, Interior Wet, and Corrosive Areas	Stainless steel adhesive anchors	Adhesive anchors shall be installed with screen tubes.
4. All Others		
All service uses and locations	Stainless steel fasteners	

- B. Antiseizing Lubricant: Use on all stainless steel threads.
- C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Galvanizers Association (AGA):
 - a. Inspection of Hot-Dip Galvanized Steel Products.
 - b. Quality Assurance Manual.
 2. American Iron and Steel Institute (AISI): Stainless Steel Types.
 3. American Ladder Institute (ALI): A14.3, Ladders - Fixed - Safety Requirements.
 4. American National Standards Institute (ANSI).
 5. American Welding Society (AWS):
 - a. D1.1/D1.1M, Structural Welding Code - Steel.
 6. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - d. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - e. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - f. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - g. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - h. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - i. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - j. A325, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- k. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- l. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- m. A489, Standard Specification for Carbon Steel Lifting Eyes.
- n. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- o. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- p. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- q. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- r. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- s. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
- t. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
- u. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
- v. A992/A992M, Standard Specification for Structural Steel Shapes.
- w. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
- x. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- y. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- z. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
- aa. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
- bb. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- cc. D1056, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- dd. F436, Standard Specification for Hardened Steel Washers.
- ee. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
- ff. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- gg. F594, Standard Specification for Stainless Steel Nuts.
- hh. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
- ii. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 7. NSF International (NSF): 61, Drinking Water System Components—Health Effects.
- 8. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.27, Fixed Ladders.
- 9. Specialty Steel Industry of North America (SSINA):
 - a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.
- B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- C. Exterior Area: Location not protected from weather by building or other enclosed structure.
- D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.
- E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Metal fabrications, including welding and fastener information.

B. Informational Submittals:

1. Pre-engineered Ladders: Letter of certification that ladder meets OSHA 29 CFR 1910.27 requirements.
2. Galvanized coating applicator qualifications.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.
- B. Package stainless steel items to provide protection from carbon impregnation.
- C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.
- D. Store fabricated items in dry area, not in direct contact with ground.

PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Steel Wide Flange Shapes	A992/992M
Other Steel Shapes and Plates	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Steel Pipe	A500, Grade B
Hollow Structural Sections (HSS)	A500/A500M, Grade C
Aluminum:	
Aluminum Plates	B209, Alloy y6061-T6

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

Item	ASTM Reference
Aluminum Structural Shapes	B308/B308M, Alloy 6061-T6
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (316L for welded connections)
Shapes	A276, AISI Type 304 (304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections)
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Group 2, Condition SH
Nuts	F594, AISI Type 316, Condition CW
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	A325, Type 1 bolts, with A563 nuts
Anchor Bolts and Rods	F1554, Grade 36, with weldability supplement S1.
Threaded Rods	A36/A36M
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Thrust Ties for Steel Pipe:	
Threaded Rods	A193/A193M, Grade B7
Nuts	A194/A194M, Grade 2H
Plate	A283/A283M, Grade D
Aluminum Bolts and Nuts	F468, Alloy 2024-T4

- B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:

1. Headed type, unless otherwise shown on Drawings.
2. Material type and protective coating as shown in Fastener Schedule at end of this section.

2.03 POST-INSTALLED CONCRETE AND MASONRY ANCHORS

A. See Section 05 05 19, Post-Installed Anchors.

2.04 LADDERS

A. Fabricate ladders with rails, rungs, landings, and cages to meet applicable requirements of OSHA, CFR Part 1910.27, and ALI A14.3.

1. Design ladder for concentrated load of 200 pounds imposed by user concentrated at points that will cause maximum stress in structural member being considered.
2. Include weight of ladder and attached appurtenances together with live load in design of rails and fastenings.
3. Self-closing gates at landings.

B. Aluminum Pre-Engineered Pipe Ladder:

1. Rungs:
 - a. Aluminum extrusions of Alloy 6063-T6.
 - b. Nonslip grip surface, 1-inch wide flat top, and semicircular bottom with mill finish.
2. Side Rails: ASTM B429/B429M, Alloy 6063-T6, 1-1/2 inches, Schedule 40 pipe with anodized finish, AA M32-C22-A41.
3. Ladder Attachments: Stainless steel.
4. Gate springs and hardware: Stainless steel.
5. Welded, pop riveted, or glued construction is not acceptable.
6. Fabricate to longest length as practical but not to exceed 24 feet.
7. Furnish support attachments to side rails at 6 feet maximum spacing.
8. Manufacturer: Thompson Fabricating Co. Inc., Tarrant, AL.

2.05 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

1. Use steel shapes, unless otherwise noted.
2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures—Allowable Stress Design.

C. Welding:

1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
4. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.

3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
 4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
 5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
 6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
 7. Galvanized steel sheets in accordance with ASTM A653/A653M.
 8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.
- F. Electrolytic Protection: Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
- G. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.
- H. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.06 SOURCE QUALITY CONTROL

- A. Visually inspect all fabrication welds and correct deficiencies.
1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

- A. General:
1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
 2. Install rigid, substantial, and neat in appearance.
 3. Install manufactured products in accordance with manufacturer's recommendations.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.

3.02 CAST-IN-PLACE ANCHOR BOLTS

- A. Locate and hold anchor bolts in place with templates at time concrete is placed.
- B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.
- C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.03 ELECTROLYTIC PROTECTION

- A. Galvanized Steel:
 1. Coat surfaces of galvanized steel fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
 2. Do not apply protective coating to galvanized steel anchor bolts unless indicated otherwise.
 3. Allow coating to dry before installation of the material.
 4. Protect coated surfaces during installation.
 5. Should coating become marred, prepare and touch up in accordance with paint manufacturer's written instructions.

3.04 PAINTING

- A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.
- B. Repair of Damaged Hot-Dip Galvanized Coating:
 1. Conform to ASTM A780/A780M.
 2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
 3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
 4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

3.05 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas	Stainless steel headed anchor bolts.	
Exterior and Interior Wet Areas	Stainless steel headed anchor bolts	
Submerged and Corrosive Areas	Stainless steel headed anchor bolts.	
2. Anchor Bolts Cast Into Concrete for Equipment Bases		
Interior Dry Areas	Stainless steel headed anchor bolts.	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel headed anchor bolts	
3. Post-Installed Anchors: See Section 05 05 19, Post-Installed Anchors		
4. Connections for Structural Steel Framing		
Exterior and Interior Wet and Dry Areas	High-strength steel bolted connections	Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members.
5. All Others		
Exterior and Interior Wet and Dry Areas	Stainless steel fasteners	

B. Antiseizing Lubricant: Use on stainless steel threads.

END OF SECTION

SECTION 05 52 19
STEEL RAILINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Iron and Steel Institute (AISI): As applicable.
2. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - c. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - d. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - e. E894, Standard Test method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
 - f. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
3. International Code Council (ICC):
 - a. 2015 International Building Code (IBC).
 - b. Evaluation Services Reports, as applicable.
4. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.02 DEFINITIONS

- A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.
- B. Railings: This term shall include guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.
- C. Special Inspection: As defined by the ICC IBC.
- D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
 - b. Manufacturer's literature and catalog data of railing and components.
 - c. Design Data: Where proposed design of post base connections is different than details shown on Drawings, submit calculations or test data for alternate railing anchorages using ICC IBC design loads.
 - d. Submit proposed details for gate latch and stop for approval.
2. Samples:
 - a. Rail sections, 6 inches long, showing each type of proposed connection, proposed finish, and workmanship.
 - b. Each fitting, including wall brackets, castings, toeboard, and rail expansion joints.

B. Informational Submittals:

1. Manufacturer's assembly and installation instructions.
2. Special Inspection: Manufacturer's instructions for Special Inspection of post-installed concrete anchors.
3. Test Reports: Test data for anchorages may supplement design data submitted for alternate anchorage details. Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with the ICC IBC.

1.04 QUALITY ASSURANCE

- #### A. Qualifications: Calculations required for alternate anchorage designs (if proposed) shall be stamped by a registered civil or structural engineer licensed in the state where the Project will be constructed.

1.05 DELIVERY, STORAGE, AND HANDLING

- #### A. Railings adequately packaged and wrapped to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.

PART 2 PRODUCTS

2.01 STEEL RAILINGS

A. Pipe Railings/Round HSS:

1. Hot-dip galvanized carbon steel, ASTM A500/A500M Grade B.
2. Outside Diameter: 1.900-inch.
3. Wall Thickness:
 - a. Rail: 0.145-inch, minimum.
 - b. Post: 0.200-inch, minimum.

B. Accessories, including railing components, flanges, wall brackets, anchor plates, shall conform to the following:

1. Post Bolted Baseplate: Carbon steel ASTM A36/A36M, hot-dip galvanized.
2. Wall Brackets:
 - a. Malleable iron, round top, and galvanized.
 - b. Manufacturers and Products:
 - 1) The Wagner Companies; No. 1766.
 - 2) Julius Blum & Co., Inc.; No. 1382.
3. Rail Terminals (including Wall Returns):
 - a. Round, galvanized steel, welded to rail, with two 5/16-inch holes for 1/4-inch fasteners.
 - b. Manufacturer: The Wagner Companies.
4. Railing System Gate:
 - a. As specified herein for galvanized steel pipe.
 - b. Gate Hardware: Hot-dipped galvanized steel or AISI Type 304 stainless steel.
5. Toeboards and Accessories:
 - a. ASTM A36/A36M steel, hot-dip galvanized.
 - b. Toeboards: Provide slotted holes for expansion and contraction where required.
 - c. Fasteners: Galvanized steel or stainless steel.

C. Miscellaneous Fasteners: Galvanized steel or stainless steel.

2.02 FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): Galvanized steel or stainless steel.
2. Flat Washers: Molded nylon.

- B. Bolts and Nuts for Bolting Railing to Metal Beams: Hot-dipped galvanized ASTM A325 bolts.
- C. Concrete Anchors:
 - 1. Post-installed anchors shall be in accordance with Section 05 05 19, Post-Installed Anchors, unless otherwise specified herein.
 - 2. Bolt Diameter: 1/2 inch, minimum.

2.03 FABRICATION OF WELDED STEEL RAILINGS

- A. Shop Assembly:
 - 1. Post spacing and railing details shall be as shown on Drawings.
 - 2. Post to Baseplate Connection: Field fit-up is required as shown on Drawings.
 - 3. Alternate Post to Baseplate Connection:
 - a. Field measure elevation of concrete at each post location and determine exact post length so baseplate is on concrete surface.
 - b. Rails shall be in straight alignment when rails to posts and posts to baseplates are welded.
 - c. Field weld posts to baseplates.
 - 4. Remove burrs from cut edges.
 - 5. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with finished surfaces smooth.
 - 6. Cover exposed ends of steel pipe by welding 1/8-inch minimum thickness steel plate in place or use prefabricated fittings.
 - 7. Welding:
 - a. Thoroughly fuse without undercutting or overlap.
 - b. Remove splatter, grind exposed welds to blend, and contour surfaces to match those adjacent.
 - c. Grind welds prior to hot-dip galvanizing of railing sections.
 - 8. Furnish explosion prevention holes at closed ends of pipes.
 - 9. Form and assemble joints exposed to weather to prevent water and moisture from penetrating.
- B. Shop/Factory Finishing: After fabrication hot-dip galvanize steel components, other than stainless steel components, in accordance with ASTM A123/A123M.
- C. Tolerances:
 - 1. Cut pipe square within 2 degrees and lengths within 1/8 inch.

2. Welding: Miter and cope intersections of posts and rails within 2 degrees, fit to within 0.020 inch, and perform continuous welds around joints.

D. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

3.01 GENERAL

- A. Where required, provide railing posts longer than needed and field cut to dimensions required in order to satisfy vertical variations on actual structure.
- B. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.
- C. Modification to supporting structure is not permitted where railing is to be attached.

3.02 RAILING INSTALLATION

- A. Expansion Joints:
 1. Maximum intervals of 25 feet on center and at structural movement joints.
 2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
 3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
 4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span movement joints in structural walls and floors supporting the posts.
- B. Posts and Rails:
 1. Surface Mounted and Side Mounted Posts:
 - a. Bolt post baseplate connectors firmly in place.
 - b. Install to account for small variation in leveling grouts and shims between adjacent posts.
 2. Set posts plumb and aligned to within 1/8 inch in 12 feet.
 3. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
 4. Install posts and rails in same plane.

5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
 6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
 7. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.
- C. Wall Brackets: Support wall rails on brackets as shown on Drawings.
- D. Toeboard:
1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or on stairways unless shown otherwise.
 2. Accurately measure in field for correct length; after railing post installation, cut and secure to posts.
 3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
 4. Install plumb and aligned to within 1/8 inch in 12 feet.
- E. Railing System Gate: Install in accordance with manufacturer's installation instructions.

3.03 FIELD FINISHING

- A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces as specified in Section 09 90 00, Painting and Coating.
- B. Treatment of Field Welds for Galvanized Steel Railings: Touch up welds by application of two coats high-zinc dust content paint to dry film thickness of 2 mils.

3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Post-installed anchors supporting railing systems require special inspection.
- B. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.05 CLEANING

- A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.
- B. Do not use acid solution, steel wool, or other harsh abrasive.

END OF SECTION

SECTION 05 53 00
METAL GRATINGS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - c. A1011/A1011M, 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.
 2. National Association of Architectural Metal Manufacturers (NAAMM):
 - a. MBG 531, Metal Bar Grating Manual.

1.02 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings:
 - a. Grating: Show dimensions, weight, size, and location of connections to adjacent grating, supports, and other Work.
 - b. Grating Anchorage: Show details of anchorage to supports to prevent displacement from traffic impact.
 - c. Product data for grating, grating clips, anchors, accessories, and other manufactured products specified herein.
 - d. Manufacturer's specifications, including coatings, surface treatment, and finishes.
- B. Informational Submittals:
1. Special handling and storage requirements.
 2. Installation instructions.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Insofar as is practical, factory assemble items.

- B. Package and clearly tag parts and assemblies that are, due to necessity, shipped unassembled.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 - 1. Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
 - 2. HARSCO Industrial IKG, Houston, TX.
 - 3. Ohio Gratings, Inc., Canton, OH.

2.02 GRATING MATERIALS

- A. Carbon Steel:
 - 1. Bearing Bars, Banding, and Rectangular Cross Bars: ASTM A1011/A1011M commercial steel Type II for hot rolled carbon steel sheet and strip, or ASTM A36/A36M.
 - 2. Cross Bars made from Wire Rods: Not permitted.
 - 3. Finish: Galvanized after fabrication.

2.03 METAL BAR GRATING

- A. General Requirements:
 - 1. Maximum Service Load:
 - a. Medium Duty (Type B): 200 psf uniformly distributed load.
 - 2. Maximum Deflection: Span/240 or 1/4 inch, whichever is less.
 - 3. Bearing Bar Spacing:
 - a. Medium Duty: 15/16 inch maximum, center-to-center.
 - 4. Cross Bar Spacing: 4 inches maximum, center-to-center.
 - 5. Bearing Bars, Cross Bars and Banding: Minimum thickness as specified in NAAMM MBG 531 or as shown on Drawings.
- B. Grating Materials: Galvanized steel welded, rectangular bar grating fabricated by electro-forging cross bars to bearing bars pressure-locked rectangular bar grating fabricated by pressing rectangular crossbars into slots in rectangular bearing bars.
- C. Surface: Plain.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

D. Stair Treads:

1. Material and Type: Same as grating material and grating type as furnished for connecting walkway or work surface.
2. Nosings: Integral ribbing and serrated edge on one long axis of tread, or nonslip abrasive on each tread along one long edge.
3. Carrier Plate or Angle: Furnish at each end for connection to stair stringers.

2.04 ACCESSORIES

A. Grating Clamps:

1. Use at flanged beam and bolted angle frame supports.
2. Removable from above grating walkway surface.
3. Provide hat bracket, recessed bolt, and bottom clamp of same material as grating.
4. Manufacturers and Products:
 - a. Direct Metals Company, LLC, Kennesaw, GA; Grating Clamp.
 - b. Grating Fasteners, Inc., Harvey, LA; G-Clip.

2.05 FABRICATION

A. General:

1. In accordance with NAAMM MBG 531.
2. Conceal fastenings where practical.
3. Cutouts:
 - a. Fabricate in grating sections for penetrations indicated.
 - b. Arrange to permit grating removal without disturbing items penetrating grating.
 - c. Edge band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
4. Do not notch bearing bars at supports to maintain elevation.
5. Field measure areas to receive grating. Verify dimensions of new fabricated supports and fabricate to dimension required for specified clearances.
6. Section Length: Sufficient to prevent section from falling through clear opening when oriented in the span direction and one end is touching either the concrete or the vertical leg of grating support.
7. Minimum Bearing: 1 inch for grating depth up to 2-1/4 inches and 2 inches for grating depth greater than 2-1/4 inches.
8. Banding and Toe Plates: Same material as grating and welded to bearing bars in accordance with requirements of NAAMM MBG 531.

- B. Metal Bar Grating: A single grating section shall be not less than 1.5 feet or greater than 3 feet in width or weigh more than 150 pounds.
- C. Supports: Coordinate dimensions and fabrication with grating to be supported.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Until grating sections are securely fastened in place, area shall be appropriately barricaded or flagged to alert people working in the area of potential fall hazard.
- B. Install manufactured products in accordance with manufacturer's recommendations.
- C. Install supports such that grating sections have a solid bearing on both ends, and that grating sections will not rock or wobble under design loads.
- D. Install grating supports plumb and level as applicable.
- E. Field locate and install fasteners to fit grating layout.
- F. Anchor grating securely to supports using minimum of four fastener clips per grating section.
- G. Each grating section shall be easily removable and replaceable.
- H. Completed installation shall be rigid and neat in appearance.
- I. Protect painted and galvanized surfaces during installation.
- J. Repair damaged coatings as specified in Section 09 90 00, Painting and Coating.

END OF SECTION

**SECTION 07 92 00
JOINT SEALANTS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. C661, Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
 - b. C920, Standard Specification for Elastomeric Joint Sealants.
 - c. C1193, Standard Guide for Use of Joint Sealants.

1.02 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings: Surface preparation instructions. Indicate where each product is proposed to be used.
 2. Samples: As required for color selection.
- B. Informational Submittals:
1. Installation instructions.
 2. Documentation showing applicator qualifications.

1.03 QUALITY ASSURANCE

- A. Applicator Qualifications: Minimum of 5 years' experience installing sealants in projects of similar scope.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Ambient Temperature: Between 40 degrees F and 80 degrees F (4 degrees C and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

PART 2 PRODUCTS

2.01 SEALANT MATERIALS

- A. Characteristics:
1. Uniform, homogeneous.

2. Free from lumps, skins, and coarse particles when mixed.
 3. Nonstaining, nonbleeding.
 4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
 5. Immersible may be substituted for nonimmersible.
- B. Color: Unless specifically noted, match color of the principal material adjoining area of application. Color as selected by Owner or Engineer.
- C. Type 5—One-part Polyurethane, Immersible:
1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
 2. Capable of being continuously immersed in water.
 3. Manufacturers and Products for Nonsag:
 - a. Sika Chemical Corp.; Sikaflex-1a.
 - b. Tremco; Vulkem 116.
 4. Manufacturers and Products for Self-leveling:
 - a. BASF; MasterSeal, SL-1.
 - b. Tremco; Vulkem 45.
 - c. Sika Chemical Corp.; Sikaflex 1c SL.
- D. Type 11—Fire Penetration Seal:
1. Manufacturers and Products:
 - a. 3M Corp.; Fire Barrier Caulk CP25 and Putty 303.
 - b. General Electric; Pensil Sealant or Foam.
 - c. Unifrax Corporation; Fyre Putty.
 - d. Hilti USA; CP 604.

2.02 BACKUP MATERIAL

- A. Nongassing, extruded, closed-cell round polyurethane foam or polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.
- B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16 inch wide.
- C. Manufacturers and Products:
1. BASF; Sonneborn, Sonolastic Closed-cell Backing Rod.
 2. Tremco; Closed-cell Backing Rod.
 3. Pecora Corporation; Green Rod.

2.03 ANCILLARY MATERIALS

- A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Primer: Nonstaining type recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 GENERAL

- A. Use of more than one material for the same joint is not allowed unless approved by sealant manufacturer.
- B. Install joint sealants in accordance with ASTM C1193.
- C. Horizontal and Sloping Joints up to 1 Percent Maximum Slope: Use self-leveling (Grade P) joint sealant.
- D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use nonsag (Grade NS) joint sealant.
- E. Follow manufacturer's recommendation for joints larger than 1 inch.

3.02 PREPARATION

- A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.
- B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.
 - 1. Mask adjacent surfaces where necessary to maintain neat edge.
 - 2. Starting of work will be construed as acceptance of subsurfaces.
 - 3. Apply primer to dry surfaces as recommended by sealant manufacturer.
- C. Verify joint shaping materials and release tapes are compatible with sealant.
- D. Examine joint dimensions and size materials to achieve required width/depth ratios.
- E. Follow manufacturer's instructions for mixing multi-component products.

3.03 INSTALLATION

- A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.
 - 1. Install backup material as recommended by sealant manufacturer.
 - 2. Where possible, provide full length sections without splices; minimize number of splices.
 - 3. Tape sealant may be used as joint filler if approved by sealant manufacturer.
- B. Use bond breaker where recommended by sealant manufacturer.
- C. Seal joints around window, door and louver frames, expansion joints, control joints, and elsewhere as indicated.
- D. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.
- E. Joints: Tool slightly concave after sealant is installed.
 - 1. When tooling white or light color sealant, use a water wet tool.
 - 2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

3.04 CLEANING

- A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.
- B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

3.05 JOINT SEALANT SCHEDULE

- A. Use sealant Type 5 for building joints and elsewhere as indicated.
- B. Use sealant Type 11 to seal voids and holes around penetrations through fire-rated elements.

END OF SECTION

**SECTION 09 90 00
PAINTING AND COATING**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA): D102, Coating Steel Water Storage Tanks.
2. Environmental Protection Agency (EPA).
3. NACE International (NACE): SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
4. NSF International (NSF): 61, Drinking Water System Components - Health Effects.
5. Occupational Safety and Health Act (OSHA).
6. The Society for Protective Coatings (SSPC):
 - a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
 - b. PA 10, Guide to Safety and Health Requirements for Industrial Painting Projects.
 - c. SP 1, Solvent Cleaning.
 - d. SP 5, White Metal Blast Cleaning.
 - e. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
 - f. SP 10, Near-White Blast Cleaning.
 - g. SP 13, Surface Preparation of Concrete.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. Mil: Thousandth of an inch.
6. PDS: Product Data Sheet.
7. PSDS: Paint System Data Sheet.
8. PVC: Polyvinyl Chloride.
9. SFPGPC: Square Feet per Gallon per Coat.
10. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Data Sheets:
 - 1) For each product, furnish a Product Data Sheet (PDS), the manufacturer's technical data sheets, and paint colors available (where applicable). The PDS form is appended to the end of this section.
 - 2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
 - 3) Technical and performance information that demonstrates compliance with specification.
 - 4) Furnish copies of paint system submittals to the coating applicator.
 - 5) Indiscriminate submittal of only manufacturer's literature is not acceptable.
2. Samples: As required for color selections.

B. Informational Submittals:

1. Applicator's Qualification: List of references substantiating experience.
2. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services.
3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer's written verification that submitted material is suitable for the intended use.
5. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible.
6. Manufacturer's written instructions and special details for applying each type of paint.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 5 years' experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Perform surface preparation and painting in accordance with recommendations of the following:
 - a. Paint manufacturer's instructions.
 - b. SSPC PA 10.
 - c. Federal, state, and local agencies having jurisdiction.

C. Mockup:

1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
2. After Engineer approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

B. Status of Existing Coatings:

1. The following information on existing coatings or substrate conditions is provided for information only, and is generally believed to be accurate, but is not guaranteed. Perform tests as required to verify applicability of this information to the Work.
 - a. It is believed that the existing paint is lead based paint. Some paint samples tested positive for lead.
 - b. See Section 02 41 00, Lead Paint Abatement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.
- B. Minimum of 5 years' verifiable experience in manufacture of specified product.
- C. Each of the following manufacturers is capable of supplying the products specified herein:
 1. Tnemec.
 2. Carboline.
 3. No alternates.

2.02 PAINT MATERIALS

- A. General:
 1. Manufacturer's highest quality products suitable for intended service.
 2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
 3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

Product	Definition
Acrylic Latex, Semigloss	100% acrylic latex
Bituminous Paint	Single-component, coal-tar pitch based

Product	Definition
Epoxy Filler/Surfacer	100% solids epoxy trowel grade filler and surfacer, nonshrinking, suitable for application to concrete. Approved for potable water contact and conforming to NSF 61, where required
Epoxy Primer—Ferrous Metal	Anticorrosive, converted epoxy primer containing rust-inhibitive pigments
High Build Epoxy	Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat
NSF Epoxy	Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish

2.03 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.04 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.

B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.

2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

D. Pipe:

1. Ductile Iron Pipe:
 - a. Use SSPC standards as a guide for desired prepared surface. Follow recommendations of pipe and coating manufacturers for means and methods to achieve SSPC-equivalent surface.
 - b. The surface preparation and application of the primer shall be performed by pipe manufacturer.
 - c. For high performance (epoxy) coatings, follow additional recommendations of pipe and coating manufacturers.
 - d. Prior to blast cleaning, grind smooth surface imperfections, including, but not limited to delaminating metal or oxide layers.
2. Steel Pipe:
 - a. Surface preparation and application of primer shall be performed by pipe manufacturer.
 - b. For pipe with epoxy lining, do not place end cap seals until pipe lining material has sufficiently dried.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation work and coating application work.
- B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer's absence.
- C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

- A. Factory Finished Items:
 1. Schedule inspection with Engineer before repairing damaged factory-finished items delivered to Site.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.
- B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.
- B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
- D. Mask openings in motors to prevent paint and other materials from entering.
- E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

- A. Field Abrasive Blasting:
 1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
 2. Refer to coating systems for degree of abrasive blasting required.
 3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.
- B. Metal Surface Preparation:
 1. Where indicated, meet requirements of SSPC Specifications summarized below:
 - a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.

- b. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
 - c. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
 - d. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
 - e. SP-16, Brush Blasting of Non-Ferrous Metals: A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).
- 2. The words “solvent cleaning”, “hand tool cleaning”, “wire brushing”, and “blast cleaning”, or similar words of equal intent in these Specifications or in paint manufacturer’s specification refer to the applicable SSPC Specification.
 - 3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers’ recommendations for wet blast additives and first coat application shall apply.
 - 4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
 - 5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
 - 6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
 - 7. Welds and Adjacent Areas:
 - a. Prepare such that there is:
 - 1) No undercutting or reverse ridges on weld bead.
 - 2) No weld spatter on or adjacent to weld or any area to be painted.
 - 3) No sharp peaks or ridges along weld bead.
 - b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

8. Preblast Cleaning Requirements:
 - a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
 - b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
 - c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
 9. Blast Cleaning Requirements:
 - a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
 - b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
 - c. Use only dry blast cleaning methods.
 - d. Do not reuse abrasive, except for designed recyclable systems.
 - e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
 10. Post-Blast Cleaning and Other Cleaning Requirements:
 - a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
 - b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.
- C. Concrete Surface Preparation:
1. Do not begin until 30 days after concrete has been placed.
 2. Meet requirements of SSPC SP 13.
 3. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.
 4. Brush-off blast clean to remove loose concrete and laitance, and provide a tooth for binding. Upon approval by Engineer, surface may be cleaned by acid etching method. Approval is subject to producing desired profile equivalent to No. 80 grit flint sandpaper. Acid etching of vertical or overhead surfaces shall not be allowed.

5. Secure coating manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.
6. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

D. Plastic and FRP Surface Preparation:

1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.
2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

B. Acid Etching:

1. After precleaning, spread the following solution by brush or plastic sprinkling can: One part commercial muriatic acid reduced by two parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.
2. Application:
 - a. Rate: Approximately 2 gallons per 100 square feet.
 - b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained.
 - c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.
 - d. After bubbling subsides (10 minutes), hose down remaining slurry with high pressure clean water.
 - e. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- f. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.
3. Ensure surface is completely dry before application of coating.
4. Apply acid etching to obtain a “grit sandpaper” surface profile. If not, repeat treatment.

C. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas accordance with AWWA D102.
2. The intention of these Specifications is for new metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise.
3. Apply coatings in accordance with these Specifications and paint manufacturers’ printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
4. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
5. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
6. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
7. Keep paint materials sealed when not in use.
8. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied
9. Painting of piping shall not occur with water moving through the piping. Painting of all piping must be approved by the Engineer before the piping is insulated. Any piping covered by a support or hanger shall be painted before placement on the support or in the hanger. no unpainted sections of pipe shall be allowed.

- B. Porous Surfaces, Such As Concrete and Masonry:
 - 1. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects.
 - 2. Prime Coat: May be thinned to provide maximum penetration and adhesion.
 - a. Type and Amount of Thinning: Determined by paint manufacturer and dependent on surface density and type of coating.
- C. Film Thickness and Coverage:
 - 1. Number of Coats:
 - a. Minimum required without regard to coating thickness.
 - b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
 - 2. Application Thickness:
 - a. Do not exceed coating manufacturer's recommendations.
 - b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
 - 3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
 - a. Perform with properly calibrated instruments.
 - b. Recoat and repair as necessary for compliance with specification.
 - c. Coats are subject to inspection by Engineer and coating manufacturer's representative.
 - 4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
 - 5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
 - 6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

- A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.
- B. Additional requirements are included in the Piping Schedule.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

C. System No. 1 Submerged Metal—Potable Water:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	Epoxy Filler/Surfacer	1 coat as required to fill voids and smooth surface; apply to 100 percent of surface.
	NSF Epoxy	3 coats, 3 MDFTPC

1. Use on submerged metal surfaces, including pipe sleeves.

D. System No. 4 Exposed Metal—Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	High Build Epoxy	1 coat, 4 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on exposed metal surfaces, located inside or outside of structures, including piping and supports, existing piping in Transfer Pump Room, monorail and beams above transfer pump motors, structural steel, and miscellaneous metal.
2. Remove existing paint down to metal substrate, see Section 02 41 00, Lead Paint Abatement.
3. See Paragraph 3.03 for protection of mechanical and electrical equipment.

E. System No. 22 Concrete Wall and Ceiling:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Concrete Surface Preparation and completely remove existing paint down to concrete substrate	Epoxy Filler/Surfacer	1 coat as required to fill voids and smooth surface; apply to 100 percent of surface.
	High Build Epoxy	1 coat, 160 SFPG
	High Build Epoxy, Gloss	1 coat, 160 SFPG

1. Use on concrete walls and ceilings in the Transfer Pump Room.
2. Remove existing paint down to concrete substrate, see Section 02 41 00, Lead Paint Abatement.
3. See Paragraph 3.03 for protection of mechanical and electrical equipment.

F. System No. 25 Exposed FRP, PVC:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Plastic and FRP Surface Preparation	Acrylic Latex, Semigloss	2 coats, 320 SFPGPC

1. Use on exposed-to-view PVC and CPVC surfaces, and FRP surfaces without integral UV-resistant gel coat, including PVC piping and supports.

G. System No. 27 Aluminum and Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Prime in accordance with manufacturer's recommendations	
	Bituminous Paint	1 coat, 10 MDFT

1. Use on aluminum surfaces embedded or in contact with concrete or masonry and for dissimilar metal insulation.

3.08 COLORS

- A. Provide as designated herein. Choice of colors required. Multiple colors will be required for different items. Number of colors: Twelve (max). Colors as selected by Owner or Engineer. Number of colors depends on service.
- B. Transfer Pump Room walls and ceiling are to be painted in 2 colors selected by Owner.
- C. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.
- D. Equipment Colors:
 1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
 2. Paint non-submerged portions of equipment the same color as the piping it serves, except as itemized below:
 - a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
 - b. Fire Protection Equipment and Apparatus: OSHA Red.
 - c. Radiation Hazards: OSHA Purple.
 - d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

E. Pipe Identification Painting:

1. The paint schedules that follow have been developed for Tnemec colors. If Carboline products are to be used, submit schedules describing Carboline's equal colors for review and approval.
2. Color code non-submerged metal piping, except electrical conduit. Paint fittings and valves the same color as pipe, except equipment isolation valves.
3. Pipe Color Coding:

Service or Item	Tnemec Color
Potable Water: High Service, Transfer, & Wash Water (includes manhole covers)	Clear Sky EN17
Plant Pressure	PL12
Non-Potable Water: River, Filter Infl. & Effl. (Includes manhole covers)	Frosted Mint GB48
Sludge (includes pipes, equipment and manhole covers)	Chipmunk YB23
Natural Gas	Safely Yellow SC01
Fire Service Water	Safety Red SC09
Compressed Air	Safety Green SC07
Steam	Safety Purple SC08
Used Wash Water	Light Gray IN01
Carbon Dioxide	White WH01
Valve handles and handrails indoors	Safety Orange SC03
Fluoride	Hunter Green PL20
Ammonia	Lemonade YB16
Sodium Hydroxide	Kastrel Blue GR18
Handrails and Platforms outside	Beige YB38
Shafts for basins and flocs	porta-pox series Beige YB38
Exterior tanks, containments, reservoir vents, fence	Foliage EN13
New door frames	Terra Cotta EN13
New black doors	Black IN06
Hot Water	Mountain Shadow GB07
-	Blue Summit PL11

4. Pipe Supports: Match piping color.

3.09 FIELD QUALITY CONTROL

- A. Inspector's Services: The Contractor shall hire Dixon Engineering or Nelson Tank (third party satisfactory to the Owner), at no additional expense to the Owner, to perform field inspections of items 1-4 below and prepare the field inspection reports described in item 5 below:
1. Verify coatings and other materials are as specified.
 2. Verify surface preparation and applications are as specified.
 3. Visually inspect all welds prior to coating.
 4. Verify DFT of each coat and total DFT of each coating systems are as specified using wet film and dry film gauges.
 5. Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
 6. Report:
 - a. Submit written reports describing inspections made and actions taken to correct nonconforming work.
 - b. Report nonconforming work no corrected.
 - c. Submit copies of report to Owner and Contractor.
- B. Testing:
1. Thickness and Continuity Testing:
 - a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
 - b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.
 - c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.
 - d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.
- C. Inspection: Leave staging and lighting in place until Inspector or Engineer has inspected surface or coating. Replace staging removed prior to approval by Inspector or Engineer. Provide additional staging and lighting as requested by Inspector or Engineer.
- D. Unsatisfactory Application:
1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
2. Remove rust and contaminants from metal surface. Provide surface cleanliness and profile in accordance with surface preparation requirements for specified paint system.
3. Feather edges and repair in accordance with recommendations of paint manufacturer.
4. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.10 MANUFACTURER'S SERVICES

- A. In accordance with Section 01 43 33, Manufacturers' Field Services, coating manufacturer's representative shall be present at Site as follows:
1. On first day of application of any coating system.
 2. A minimum of two additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
 3. As required to resolve field problems attributable to or associated with manufacturer's product.
 4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.11 CLEANUP

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.
- B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.
- C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.12 SUPPLEMENTS

- A. The supplements listed below, following “End of Section,” are a part of this specification:
1. Paint System Data Sheet (PSDS).
 2. Product Data Sheet (PDS).

END OF SECTION

PAINT SYSTEM DATA SHEET

Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats, Coverage

PAINT PRODUCT DATA SHEET

Complete and attach manufacturer's Technical Data Sheet to this PDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning: _____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

SECTION 10 14 00
SIGNAGE

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
 2. Occupational Safety and Health Act (OSHA).

1.02 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings:
 - a. Drawings showing layouts, actual letter sizes and styles, and Project-specific mounting details.
 - b. Manufacturer's literature showing letter sizes and styles, sign materials, and standard mounting details.
- B. Informational Submittals: Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 SIGN TYPES

- A. Metal Sign (Type B):
1. Material: Baked enamel finished 20-gauge (minimum) steel or 18-gauge (minimum) aluminum signs.
 2. Manufacturers:
 - a. Seton Identification Products.
 - b. Nutheme Illustrated Safety Co.

2.02 IDENTIFICATION LABELS

- A. Pipe Labels:
1. Labels: Self-adhesive tape, with separate directional flow arrow banding tape.
 2. Material: Pressure sensitive vinyl.
 3. Letters and Arrows: Black or white contrasting with the background.

4. Color Field and Letter Height: ASME A13.1.
5. Message: Piping system name as indicated on Piping Schedule.
6. Manufacturers and Products:
 - a. Brady Signmark; B-946 Self-Sticking Vinyl Pipe Markers and Directional Flow Arrow Tape.
 - b. Seton Identification Products; Opti-Code Markers and Arrows-On-A-Roll Tape.

B. Equipment Labels:

1. Applies to equipment with assigned tag numbers, where specified.
2. Letters: White, 3/4 inch minimum high.
3. Background: Black.
4. Materials: Aluminum or stainless steel with a baked-on finish suitable for use on wet, oily, exposed, abrasive, and corrosive areas.
5. Furnish 1-inch margin with holes at each end of label, for mounting. On fiberglass labels, furnish grommets at each hole.
6. Size:
 - a. 2 inches minimum and 3 inches maximum high, by 14 inches minimum and 18 inches maximum long.
 - b. Furnish same size base dimensions for all labels.
7. Message: Equipment names and tag numbers as used in sections where equipment is specified.
8. Manufacturers:
 - a. Brady Signmark.
 - b. Seton Identification Products.

2.03 ANCILLARY MATERIALS

- A. Fasteners: Stainless steel screws or bolts of appropriate sizes.

PART 3 EXECUTION

3.01 INSTALLATION—GENERAL

- A. In accordance with manufacturer's recommendations.
- B. Mount securely, plumb, and level.

3.02 SIGNS

A. General:

1. Fasten to walls or posts, or hang as scheduled.
2. Anchor in place for easy removal and reinstallation with ordinary hand tools.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

B. Information and Safety Signs:

1. Install facing traffic. Locate for high visibility with minimum restriction of working area around walkways and equipment.
2. Install as scheduled.

3.03 IDENTIFICATION LABELS

A. Pipe Labels:

1. Locate at connections to equipment, valves, or branching fittings at wall boundaries.
2. At intervals along piping not greater than 18 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe.
3. At exposed piping not normally in view, such as above suspended ceilings and in closets and cabinets.
4. Supplementary Labels: Provide to Owner those listed on Piping Schedule that do not receive arrows.
5. Apply to pipe after painting in vicinity is complete, or as approved by Engineer.
6. Install in accordance with manufacturer's instructions.

B. Equipment Labels:

1. Locate and install on equipment or concrete equipment base.
2. Anchor to equipment or base for easy removal and replacement with ordinary hand tools.

3.04 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is a part of this specification.

1. Sign Schedule: Tabulation of characteristics and mounting information for information and safety signs numbered on Drawings. Provide items as scheduled. Meet requirements of Occupational Safety and Health Act (OSHA).

END OF SECTION

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

Sign Schedule														
Sign									Lettering					Other Requirements
Number ¹	Sign Type ²	Detail Reference ³	Size		Color	Mounting			Height	Style	Color	Message	Faces	
			Width	Height		Location	Method	Height to Top						
C-1	B	1014-002	20"	14"	Yellow	Wall	Screws or Bolts	5'-6"	1" min.	Helvetica	Black	CAUTION EQUIPMENT STARTS AUTOMATICALLY	1	
D-1	B	1014-001	20"	14"	White	Wall	Screws or Bolts	5'-6"	1" min.	Helvetica	Black	DANGER HIGH VOLTAGE	1	

¹Numbers refer to a particular sign type with a particular message.
²Letters refer to Sign Types specified in this section.
³Numbers refer to Design Details that show sign layout.

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. National Fire Protection Association (NFPA): 10, Standard for Portable Fire Extinguishers.
 2. Occupational Safety and Health Administration (OSHA).
 3. Underwriters Laboratories Inc. (UL): Fire Protection Equipment Directory.

1.02 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10 and 2015 Michigan Building Code.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.

1.03 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings:
 - a. Fire Extinguishers: Manufacturer's product data for each item, including sizes, ratings, UL listings, or other certifications, and mounting information.
 - b. Product Data: Extinguisher operational features, color and finish, and anchorage details.
- B. Informational Submittals:
1. Manufacturer's Installation Instructions: Special criteria and wall opening coordination requirements.
 2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 3. Operation and Maintenance Data: Submit test, refill or recharge schedules and recertification requirements.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 61 00, Common Product Requirements: Environmental conditions affecting products onsite.
- B. Do not install extinguishers when ambient temperatures are capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.01 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. JL Industries.
 - 2. Larsen's Manufacturing Co.
 - 3. Nystrom Products Co.
 - 4. Potter Roemer.
- B. General:
 - 1. Conform to NFPA 10 for fire extinguishers.
 - 2. Furnish fire extinguishers and cabinets from one manufacturer.
 - 3. UL listed, charged and ready for service.
- C. Multipurpose Hand Extinguisher (F.EXT-1):
 - 1. Tri-class dry chemical extinguishing agent.
 - 2. Pressurized, red enameled steel shell cylinder.
 - 3. Activated by top squeeze handle.
 - 4. Agent propelled through hose or opening at top of unit.
 - 5. For use on A, B, and C class fires.
 - 6. Minimum UL Rating: 4A-60B:C, 10-pound capacity.

2.02 ACCESSORIES

- A. Extinguisher Brackets: For hand extinguishers not located in cabinets, furnish heavy-duty brackets with clip-together strap for wall mounting.
- B. Graphic Identification: Provide graphic identification marking for each fire extinguisher type. OSHA approved pictorial markings to indicate the extinguisher uses and non-uses on a single label.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- C. Fasteners: Furnish necessary screws, bolts, brackets, and other fastenings of suitable type and size to secure items of fire and safety equipment in position.
 - 1. Metal expansion shields for machine screws at concrete and masonry.
 - 2. Stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install where indicated or directed and in accordance with manufacturer's recommendations.
- B. Secure brackets rigidly to structure.
- C. Provide adequate backing for mounting surfaces.
- D. Place extinguishers on wall brackets.

3.02 PORTABLE FIRE EXTINGUISHERS

- A. Provide at locations shown or as directed by Engineer.
- B. Mount hangers securely in position, following manufacturer's recommendations.
- C. Install wall brackets, maximum 48 inches from finished floor to top of extinguisher handle.

END OF SECTION

SECTION 26 05 01
ELECTRICAL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of State Highway Transportation Officials (AASHTO).
 2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. A240/A240M, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
 - c. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - d. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - e. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 3. Electronic Industries Association (EIA/TIA): 569, Commercial Building Standard for Telecommunications Pathways and Spaces.
 4. Federal Specifications (FS):
 - a. W-C-596, Connector, Electrical, Power, General Specification for.
 - b. W-S-896, Switch, Toggle (Toggle and Lock), Flush Mounted (General Specification).
 5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - b. PC62.41.1, Draft Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - c. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
 - d. 114, IEEE Standard Test Procedure for Single-Phase Induction Motors.
 6. International Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

7. National Electrical Contractor's Association, Inc. (NECA): 1, Standard Practices for Good Workmanship in Electrical Contracting.
8. National Electrical Manufacturers Association (NEMA):
 - a. C80.1, Rigid Steel Conduit-Zinc Coated.
 - b. C80.3, Electrical Metallic Tubing-Zinc Coated.
 - c. C80.6, Intermediate Metal Conduit-Zinc Coated (IMC).
 - d. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - e. CC1, Electrical Power Connectors for Substations.
 - f. ICS 1, Industrial Control and Systems: General Requirements.
 - g. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - h. ICS 2.3, Industrial Control and Systems: Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers.
 - i. MG 1, Motors and Generators.
 - j. PB 1, Panelboards.
 - k. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - l. ST 20, Dry Type Transformers for General Applications.
 - m. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - n. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - o. WC 55, Instrumentation Cables and Thermocouple Wire.
 - p. WC 70, Standard for Non-Shielded Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy.
 - q. WC 71, Standard for Non-Shielded Cables Rated 2001-5000 Volts for use in the Distribution of Electrical Energy.
 - r. WC 74, 5-46 KV Shielded Power Cable for use in the Transmission and Distribution of Electric Energy.
 - s. WD 1, General Color Requirements for Wiring Devices.
9. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
10. Underwriters Laboratories, Inc. (UL):
 - a. 1, Flexible Metal Conduit.
 - b. 6, Electrical Rigid Metal Conduit—Steel.
 - c. 13, Power-Limited Circuit Cables.
 - d. 44, Thermoset Insulated Wires and Cables.
 - e. 62, Flexible Cord and Fixture Wire.
 - f. 67, Panelboards.
 - g. 98, Enclosed and Dead-Front Switches.
 - h. 198C, High Interrupting Capacity Fuses, Current Limiting Types.
 - i. 198E, Class R Fuses.
 - j. 360, Liquid-Tight Flexible Steel Conduit.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- k. 486A, Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- l. 486C, Splicing Wire Connectors.
- m. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
- n. 508, Industrial Control Equipment.
- o. 510, Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
- p. 514B, Fittings for Cable and Conduit.
- q. 651, Schedule 40 and 80 PVC Conduit.
- r. 674, Electric Motors And Generators for use in Division 1 Hazardous (Classified) Locations.
- s. 797, Electrical Metallic Tubing.
- t. 854, Service-Entrance Cables.
- u. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
- v. 943, Ground-Fault Circuit Interrupters.
- w. 1059, Terminal Blocks.
- x. 1242, Intermediate Metal Conduit.
- y. 1277, Electrical Power and Control Tray Cables with Optional Optical-Fibre Members.
- z. 1449, Transient Voltage Surge Suppressors.
- aa. 1561, Dry-Type General Purpose and Power Transformers.
- bb. 2111, Overheating Protection for Motors.

1.02 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction.
- B. MCOV: Maximum Allowable Continuous Operating Voltage.
- C. MOV: Metal Oxide Varistor.
- D. SASD: Silicon Avalanche Suppressor Diode.
- E. SPD: Surge Protection Device.
- F. SVR: Surge Voltage Rating.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Boxes and device plates.
 - 2. Junction and pullboxes.
 - 3. Wiring devices.

4. Panelboards and mini-power centers.
5. Circuit breakers and switches.
6. Motor-rated switches.
7. Control devices, terminal blocks, and relays.
8. Support and framing channels.
9. Nameplates and nameplate schedule.
10. Unit heaters and thermostats.
11. SPD equipment.
12. Conduit, fittings, and accessories.
13. Wireways.
14. Conductors, cable, and accessories.
15. Motors: Nameplate data, detailed information on any special features.
16. Grounding materials.
17. Motor Controls: Arrangement drawings, ratings, schematic and wiring diagrams, bill of materials, nameplate schedule, manufacturer information on components.
18. Local Control Panels: Arrangement drawings, schematic and wiring diagrams, bill of materials, nameplate schedule, manufacturer information on components.
19. Luminaires.
20. Lighting controls.
21. Conduit layout drawings showing proposed conduits routes. Conduit layout drawings shall be approved by the Owner before installation.

B. Informational Submittals:

1. Factory test reports.
2. Field test reports.
3. Signed permits indicating Work is acceptable to regulatory authorities having jurisdiction.
4. Operation and Maintenance Data:
 - a. As specified in Section 01 78 23, Operation and Maintenance Data.
 - b. Provide for all equipment, as well as each device having features that can require adjustment, configuration, or maintenance.
 - c. Minimum information shall include manufacturer's preprinted instruction manual, one copy of the approved submittal information for the item, tabulation of any settings, and copies of any test reports.

1.04 APPROVAL BY AUTHORITY HAVING JURISDICTION

- A. Execute the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc., shall conform to those standards and shall have an applied UL listing mark or label.
- C. Equipment assemblies and materials are “listed” for intended purpose.

1.05 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:
 - 1. Fuses, 0 Volt to 600 Volts: Six of each type and each current rating installed.

PART 2 PRODUCTS

2.01 GENERAL

- A. Products shall comply with all applicable provisions of NFPA 70.
- B. Like Items of Equipment: End products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer’s service.
- C. Equipment Finish: Manufacturer’s standard finish color, except where specific color is indicated.

2.02 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.
- B. Cast Metal:
 - 1. Box: Cast ferrous metal.
 - 2. Cover: Gasketed, weatherproof, and cast ferrous metal with stainless steel screws.
 - 3. Hubs: Threaded.
 - 4. Lugs: Cast Mounting.
 - 5. Manufacturers and Products, Nonhazardous Locations:
 - a. Crouse-Hinds; Type FS or FD.
 - b. Appleton; Type FS or FD.
 - 6. Manufacturers and Products, Hazardous Locations:
 - a. Crouse-Hinds; Type GUA or EAJ.
 - b. Appleton; Type GR.

2.03 JUNCTION AND PULL BOXES

- A. Outlet Boxes Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.
- B. Conduit Bodies Used as Junction Boxes: As specified under Article Conduit and Fittings.
- C. Large Sheet Steel Box:
 - 1. NEMA 250, Type 1.
 - 2. Box: Code-gauge, galvanized steel.
 - 3. Cover: Full access, screw type.
 - 4. Machine Screws: Corrosion-resistant.

2.04 WIRING DEVICES

- A. Switches:
 - 1. NEMA WD 1 and FS W-S-896.
 - 2. Industrial grade, totally enclosed, ac type, with quiet tumbler switches and screw terminals.
 - 3. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
 - 4. Rating: 20 amps, 120/277 volts.
 - 5. Color: Owner selected.
 - 6. Automatic grounding clip and integral grounding terminal on mounting strap.
 - 7. Manufacturers and Products:
 - a. Leviton; 1221 Series.
 - b. Bryant; 4901 Series.
 - c. Hubbell; 1221 Series.
- B. Receptacle, Single and Duplex:
 - 1. NEMA WD 1 and FS W-C-596.
 - 2. Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.
 - 3. High strength, thermoplastic base color.
 - 4. Color: Owner selected.
 - 5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
 - 6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
 - 7. One-piece mounting strap with integral ground contact (rivetless construction).

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

8. Manufacturers and Products:
 - a. Arrow Hart; 5262 Series.
 - b. Leviton; 5262/5362 Series.
 - c. Bryant; 5262/5362 Series.
 - d. Hubbell; 5262/5362 Series.

C. Receptacle, Ground Fault Circuit Interrupter:

1. Duplex, listed Class A to UL Standard 943, tripping at 5 mA.
2. Color: Ivory.
3. Rating: 125 volts, NEMA WD 1, Configuration 5-15R, 15 amps.
4. Size: For 2-inch by 4-inch outlet boxes.
5. Standard Model: NEMA WD 1, with screw terminals and provisions for testing.
6. Feed-Through Model: NEMA WD 1, with feed-through screw terminals and provisions for testing.
7. Impact resistant nylon face.
8. Manufacturers:
 - a. Bryant.
 - b. Hubbell.
 - c. Leviton.

2.05 DEVICE PLATES

A. General: Sectional type plates not permitted.

B. Metal:

1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
2. Finish: ASTM A167, Type 302/304, satin.
3. Mounting Screw: Oval-head, finish matched to device.

C. Cast Metal:

1. Material: Malleable ferrous metal.
2. Screw: Oval-head stainless steel.

D. Engraved:

1. Character Height: 3/16 inch.
2. Filler: Black.

- E. Weatherproof:
 - 1. For Receptacles, Damp Locations:
 - a. Gasketed, cast-aluminum, with individual cap over each receptacle opening.
 - b. Mounting Screw and Cap Spring: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; Type WLRD-1.
 - 2) Appleton; Type FSK-WRD.
 - 2. For Receptacles, Wet Locations:
 - a. Impact-resistant, nonmetallic, single-gang, horizontal-mounting, providing, while in-use, NEMA 3R rating.
 - b. Stainless steel mounting and hinge hardware.
 - c. Lockable, paintable.
 - d. Color: Gray.
 - e. Manufacturers:
 - 1) Carlon.
 - 2) Leviton.
 - 3. For Switches:
 - a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
 - b. Mounting Screw: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; DS-181 or DS-185.
 - 2) Appleton; FSK-1VTS or FSK-1VS.

2.06 LIGHTING AND POWER DISTRIBUTION PANELBOARD

- A. NEMA PB 1, NFPA 70, and UL 67.
- B. Panelboards and Circuit Breakers: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- C. Short-Circuit Current Equipment Rating: Fully rated; series connected unacceptable.
- D. Rating: Applicable to a system with a minimum available short-circuit current of 22,000 amperes rms symmetrical amperes rms symmetrical at 480Y/277 volts.
- E. Cabinet:
 - 1. NEMA 250, Type 12.
 - 2. Material: Code-gauge, hot-dip galvanized sheet steel with reinforced steel frame. Stainless steel mounting hardware.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3. Wiring Gutter: Minimum 4-inch square; both sides, top and bottom.
4. Front: Fastened with adjustable clamps.
 - a. Trim Size: As required by mounting.
 - b. Finish: Manufacturer's standard.
5. Interior:
 - a. Factory assembled; complete with circuit breakers.
 - b. Spaces: Cover openings with easily removable metal cover.
6. Door Hinges: Concealed.
7. Locking Device:
 - a. Flush type.
 - b. Doors Over 30 Inches in Height: Multipoint.
 - c. Identical keylocks, with two milled keys each lock.
8. Circuit Directory: Metal frame with transparent plastic face and enclosed card on interior of door. Final panel legends to be typed at the end of the project.

F. Bus Bar:

1. Material: Copper full sized throughout length.
2. Neutral: Insulated, rated same as phase bus bars with at least one terminal screw for each branch circuit.
3. Ground: Copper, installed on panelboard frame, bonded to box with at least one terminal screw for each circuit.
4. Lugs and Connection Points:
 - a. Suitable for either copper or aluminum conductors.
 - b. Solderless main lugs for main, neutral, and ground bus bars.
 - c. Subfeed or through-feed lugs as shown.

G. Circuit Breakers:

1. UL 489.
2. Thermal-magnetic, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle.
3. Type: Bolt-on circuit breakers in all panelboards.
4. Multipole circuit breakers designed to automatically open all poles when an overload occurs on one pole.
5. Tandem or dual circuit breakers are prohibited in normal single-pole spaces.

H. Manufacturers:

1. General Electric Co.
2. Square D Co.

2.07 MINI-POWER CENTER (MPC)

- A. General: Transformer, primary and secondary main circuit breakers, and secondary panelboard section enclosed in NEMA 250, Type 3R enclosure.
- B. Transformer:
 - 1. Type: Dry, self-cooled, encapsulated.
 - 2. Insulation: Manufacturer's standard, with UL 1561 temperature rise.
 - 3. Full capacity, 2-1/2 percent voltage taps, two above and two below normal voltage.
 - 4. Primary Voltage: 480, three-phase.
 - 5. Secondary Voltage: 208/120 volts, three-phase, four-wire.
- C. Panelboard: UL 489, fully-rated.
 - 1. Type: Thermal-magnetic, quick-make, quick-break, indicating, with noninterchangeable molded case circuit breakers.
 - 2. Number and Breaker Ampere Ratings: Refer to Panelboard Schedule.
- D. Construction: One assemble mounted in a single frame.
- E. Manufacturers:
 - 1. Siemens.
 - 2. General Electric Co.
 - 3. Square D Co.

2.08 MOTOR CONTROL CENTER CIRCUIT BREAKER, INDIVIDUAL,
0 TO 600 VOLTS

- A. UL 489 listed for use at location of installation.
- B. Minimum Interrupt Rating: 42,000 amps rms symmetrical at 480 volts.
- C. Thermal-magnetic, quick-make, quick-break, indicating type showing ON/OFF and TRIPPED indicating positions of operating handle.
- D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- E. Locking: Provisions for padlocking handle.
- F. Interlock: Enclosure and switch shall interlock to prevent opening cover with breaker in the ON position.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- G. Manufacturers:
 - 1. General Electric Co.
 - 2. Square D Co.

2.09 PUSHBUTTONS, INDICATING LIGHTS, AND SELECTOR SWITCHES

- A. Type: Heavy-duty, oiltight. Provide contact arrangements, colors, inscriptions, and functions as shown.
- B. Contact Rating: NEMA ICS 2, Type A600.
- C. Unless otherwise shown, provide the following features:
 - 1. Selector Switch Operating Lever: Standard.
 - 2. Indicating Lights: Push-to-test, transformer-type.
 - 3. Pushbutton Color:
 - a. ON or START: Black.
 - b. OFF or STOP: Red.
 - 4. Pushbuttons and selector switches lockable in OFF position where indicated.
- D. Legend Plate:
 - 1. Material: Plastic.
 - 2. Engraving: Indicating specific function, or as shown.
 - 3. Letter Height: 7/64 inch.
- E. Manufacturers and Products:
 - 1. General Electric Co.; Type CR 104P.
 - 2. Square D Co.; Type T.

2.10 TERMINAL BLOCKS

- A. Type: UL 1059. Compression screw clamp, with current bar providing direct contact with wire and yoke, with individual rail mounted terminals. Marking system shall permit use of preprinted or field-marked tags.
- B. Yokes and Clamping Screws: Zinc-plated, hardened steel.
- C. Rating: 600V ac.
- D. Manufacturers:
 - 1. Weidmuller, Inc.
 - 2. Ideal.

2.11 MAGNETIC CONTROL RELAYS

- A. NEMA ICS 2, Class A600 (600 volts, 10 amperes continuous, 7,200VA make, 720VA break), machine tool type with field convertible contacts.
- B. Manufacturer and Model:
 - 1. General Electric; Type CR120B.
 - 2. Or approved equal.

2.12 TIME DELAY RELAY

- A. Industrial Relay Rated: 150 volts, 5 amps continuous, (3600 VA make, 360 VA break).
- B. Solid-state electronic, field convertible ON/OFF delay.
- C. Two Form-C contacts (minimum).
- D. Repeat accuracy plus or minus 2 percent.
- E. Timer Adjustment: Multiple adjustable ranges, including 1 second to 600 seconds, unless otherwise shown.
- F. Manufacturers:
 - 1. Omron.
 - 2. General Electric Co.

2.13 ELAPSED TIME METERS

- A. Type: Synchronous motor driven, 0 to 99,999.9 hours range, nonreset, suitable for semiflush, panel mounting.
- B. Manufacturers:
 - 1. General Electric Co.
 - 2. Veeder-Root.

2.14 SUPPORT AND FRAMING CHANNELS

- A. Stainless Steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12 gauge.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Unistrut Corp.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2.15 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment: Adhesive.
- C. Color: Owner directed.
- D. Engraving:
 - 1. Devices and Equipment: Name or tag shown, or as required.
 - 2. Panelboards:
 - a. Designation.
 - b. Service voltage.
 - c. Phases.
 - 3. Minimum Requirement: Label metering and power distribution equipment, local control panels, junction boxes, motor controls, transformers, field devices, floats and panelboards.
- E. Letter Height:
 - 1. Pushbuttons, Selector Switches, and Other Devices: Owner selected.
 - 2. Equipment and Panelboards: Owner selected.

2.16 SURGE PROTECTIVE DEVICE (SPD) EQUIPMENT

- A. General:
 - 1. Units shall be suitable for the service voltage and configuration (phases and wires) shown.
 - 2. Protection Modes:
 - a. Normal, differential, and common.
 - b. Bipolar or bi-directional.
 - 3. Ratings: Short-circuit current rating shall equal or exceed that of protected distribution equipment. Surge Voltage Rating (SVR) shall not exceed those specified under UL 1449 for the associated nominal system voltage. Maximum Allowable Continuous Operating Voltage (MCOV) shall be at least 115 percent of the nominal system voltage.
 - 4. Unit shall be UL-listed.
 - 5. Provide status indicators for unit ON-LINE and unit operation NORMAL.
 - 6. Provide common alarm contact output.
 - 7. Provide fusible disconnect switch (integral with TVSS unit, where available) where not shown connected via branch circuit device of protected distribution equipment.

8. Minimum Enclosure Rating: NEMA 250, Type 2. Provide Type 4/4X for outdoor or wet locations.
 9. Field replaceable modules.
 10. Field replaceable fuses.
- B. Type 1 SPD:
1. Requirements: High surge current device designed for location/exposure Category C3, per IEEE C62.41. Provide surge current rating per phase as shown. Unit shall utilize symmetrically balanced Metal Oxide Varistor (MOV) technology.
 2. Manufacturer and Product: Transtector; Model Aegis SP.
- C. Type 2 SPD:
1. Requirements: Designed for critical loads at service equipment (Category C3/B3) or distribution panelboard (Category C2/B3) locations. Unit shall utilize voltage-matched Silicon Avalanche Suppressor Diode (SASD) technology. Unit shall utilize modular, plug-in suppressor design.
 2. Manufacturer and Product: Transtector, Model LEA PV200 (DS).
- D. Type 3 SPD:
1. Requirements: Designed for noncritical loads at distribution panelboards with location/exposure Category C3. Unit shall utilize symmetrically balanced Metal Oxide Varistor (MOV) technology. Unit shall utilize modular, plug-in suppressor design.
 2. Manufacturer and Product: Transtector; Model SPD.

2.17 CONDUIT AND FITTINGS

- A. Rigid Galvanized Steel Conduit (RGS):
1. Meet requirements of NEMA C80.1 and UL 6.
 2. Material: Hot-dip galvanized, with chromated protective layer.
- B. Flexible Metal, Liquid-Tight Conduit:
1. UL 360 listed for 105 degrees C insulated conductors.
 2. Material: Galvanized steel, with an extruded PVC jacket.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

C. Fittings:

1. Provide bushings, grounding bushings, conduit hubs, conduit bodies, couplings, unions, conduit sealing fittings, drain seals, drain/breather fittings, expansion fittings, and cable sealing fittings, as applicable.
2. Rigid Galvanized Steel and Intermediate Metal Conduit:
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, galvanized.
3. Flexible Metal, Liquid-Tight Conduit:
 - a. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
 - b. Insulated throat and sealing O-rings.

2.18 METAL WIREWAYS

- A. Meet requirements of UL 870.
- B. Type: Steel-enclosed, with removable, hinged cover.
- C. Rating: Indoor.
- D. Finish: Gray, baked enamel.
- E. Manufacturers:
 1. Copper B-Line.
 2. Hoffman.

2.19 CONDUIT ACCESSORIES

- A. Expansion Fittings:
 1. Products and Manufacturers:
 - a. O-Z/Gedney.
 - b. Thomas & Betts.
 - c. Or approved equal.
- B. Identification Devices:
 1. Raceway Tags:
 - a. Material: Permanent, polyethylene.
 - b. Shape: Round.
 - c. Raceway Designation: Pressure stamped, embossed, or engraved.
 - d. Tags relying on adhesives or taped-on markers not permitted.

- C. Raceway Band:
 - 1. Slip-on Type:
 - a. Provide heat-shrinkable, black, medium-wall polyolefin tubing with factory-applied adhesive/sealant. Select product size based upon raceway outside diameter.
 - b. Manufacturer and Product: 3M; Type IMCSN, medium wall cable sleeve.
 - 2. Wrap-around Type:
 - a. Provide 4-inch width, 20-mil thickness, nonprinted black PVC corrosion protection tape with primer.
 - b. Manufacturer and Product: 3M; Type Scotchrap 51 with Scotchrap Pipe Primer.

2.20 CONDUCTORS AND CABLES

- A. Conductors 600 Volts and Below:
 - 1. Conform to applicable requirements of NEMA WC 71, WC 72, and WC 74.
 - 2. Conductor Type:
 - a. 120- and 277-Volt Lighting, No. 10 AWG and Smaller: Solid copper.
 - b. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
 - c. All Other Circuits: Stranded copper.
 - 3. Insulation: Type THHN/THWN, except for sizes No. 6 and larger, with XHHW-2 insulation.
 - 4. Flexible Cords and Cables:
 - a. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
 - b. Conform to physical and minimum thickness requirements of NEMA WC 70.
- B. 600-Volt Rated Cable:
 - 1. General:
 - a. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 20,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
 - b. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- c. Suitable for installation in open air, in cable trays, or conduit.
 - d. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
 - e. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.
2. Type TSP, No. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.
- a. Outer Jacket: 45 mils nominal thickness.
 - b. Individual Pair Shield: 1.35 mils, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
 - c. Dimension: 0.31-inch nominal outside diameter.
 - d. Conductors:
 - 1) Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - 2) 20 AWG, seven-strand tinned copper drain wire.
 - 3) Insulation: 15 mils nominal PVC.
 - 4) Jacket: 4 mils nominal nylon.
 - 5) Color Code: Pair conductors black and red.
 - e. Manufacturers: Okonite Co.

C. Accessories:

1. Tape:
- a. General Purpose, Flame Retardant: 7 mils, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
 - b. Flame Retardant, Cold and Weather Resistant: 8.5 mils, vinyl plastic, Scotch Brand 88.
 - c. Arc and Fireproofing:
 - 1) 30 mils, elastomer.
 - 2) Manufacturers and Products:
 - a) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - b) Plymount; Plyarc 53, with Plyglas 77 glass cloth tapebinder.
2. Identification Devices:
- a. Sleeve-type, permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturer and Products: Raychem; Type D-SCE or ZH-SCE.

3. Connectors and Terminations:
 - a. Nylon, Self-Insulated Crimp Connectors:
 - 1) Manufacturers and Products:
 - a) Thomas & Betts; Sta-Kon.
 - b) Burndy; Insulug.
 - c) ILSCO.
4. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. Plated steel, square wire springs.
 - b. UL Standard 486C.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
5. Cable Lugs:
 - a. In accordance with NEMA CC 1.
 - b. Rated 600 volts of same material as conductor metal.
 - c. Uninsulated Crimp Connectors and Terminators:
 - 1) Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - 2) Manufacturers and Products:
 - a) Thomas & Betts; Color-Keyed.
 - b) Burndy; Hydent.
 - c) ILSCO.
 - d. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - 1) Manufacturers and Products:
 - a) Thomas & Betts; Locktite.
 - b) Burndy; Quiklug.
 - c) ILSCO.
6. Cable Ties:
 - a. Nylon, adjustable, self-locking, and reusable.
 - b. Manufacturer and Product: Thomas & Betts; TY-RAP.
7. Heat Shrinkable Insulation:
 - a. Thermally stabilized, crosslinked polyolefin.
 - b. Manufacturer and Product: Thomas & Betts; SHRINK-KON.

2.21 GROUNDING

- A. Ground Conductors: As specified in Article Conductors and Cable.
- B. Connectors:
 1. Exothermic Weld Type:
 - a. Outdoor Weld: Suitable for exposure to elements or direct burial.
 - b. Indoor Weld: Use low-smoke, low-emission process.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- c. Manufacturers:
 - 1) Erico Products, Inc.; Cadweld and Cadweld Exolon.
 - 2) Thermoweld.
- 2. Compression Type:
 - a. Compress-deforming type; wrought copper extrusion material.
 - b. Single indentation for conductors 6 AWG and smaller.
 - c. Double indentation with extended barrel for conductors 4 AWG and larger.
 - d. Single barrels prefilled with oxide-inhibiting and anti-seizing compound.
 - e. Manufacturers:
 - 1) Burndy Corp.
 - 2) Thomas & Betts.
 - 3) ILSCO.
- 3. Mechanical Type:
 - a. Split-bolt, saddle, or cone screw type; copper alloy material.
 - b. Manufacturers:
 - 1) Burndy Corp.
 - 2) Thomas & Betts.

2.22 LOW VOLTAGE MOTOR CONTROL

A. General:

- 1. Make adjustments as necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate equipment actually provided.
- 2. Controllers: NEMA ICS 2, Class A.

2.23 LOCAL CONTROL PANELS

A. Enclosure:

- 1. NEMA 250, Type 12, or as shown.
- 2. Minimum Metal Thickness: 14 gauge.
- 3. Doors: Rubber gasketed with continuous hinge.
- 4. Finish: Gray.
- 5. Size panels to adequately dissipate heat generated by equipment mounted in or on panel.
- 6. Mount internal and door-mounted devices as shown.
- 7. Manufacturer:
 - a. Hoffman.
 - b. H. F. Cox.

B. Functions: As shown on schematic diagram(s).

- C. Wiring:
 - 1. Power and Control Wiring:
 - a. 600-volt class, insulated, stranded copper.
 - b. Size: Minimum 14 AWG enclosed in either sheet metal raceway or plastic wiring duct.
 - 2. Signal Circuit Wiring: Twisted shielded pairs minimum No. 16 AWG, separated at least 6 inches from power wiring.
 - 3. Device Identification: Provide engraved plastic nameplates, adhesive attachment, white letters on black background.

2.24 LUMINAIRES AND ACCESSORIES

- A. Specific requirements relating to fixture type, lamp type, and mounting hardware are provided in the Luminaire Schedule on Drawings

PART 3 EXECUTION

3.01 GENERAL

- A. Install materials and equipment in accordance with manufacturer's instructions and recommendations.
- B. Work shall comply with all applicable provisions of NECA 1.
- C. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- D. No spaces allowed below the floor line.

3.02 DEMOLITION

- A. General Demolition:
 - 1. Where shown, de-energize and disconnect nonelectrical equipment for removal by others.
 - 2. Where shown, de-energize, disconnect, and remove electrical equipment.
 - 3. Remove affected circuits and raceways back to serving panelboard or control panel. Where affected circuits are consolidated with others, remove raceways back to first shared conduit or box. Where underground or embedded raceways are to be abandoned, remove raceway to 1 inch below surface of structure or 12 inches belowgrade and restore existing surface.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.03 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation.
- B. Cap conduit runs during construction with manufactured seals.
- C. Close openings in boxes or equipment during construction.
- D. Energize space heaters furnished with equipment.

3.04 OUTLET AND DEVICE BOXES

- A. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
- B. Size:
 - 1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
 - a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
 - 2. Ceiling Outlet: Minimum 4-inch octagonal sheet steel device box, unless otherwise required for installed fixture.
 - 3. Switch and Receptacle: Minimum 2-inch by 4-inch sheet steel device box.
- C. Locations:
 - 1. Drawing locations are approximate.
 - 2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
 - 3. Light Switch: Install on lock side of doors.
- D. Mounting Height:
 - 1. General:
 - a. Dimensions given to centerline of box.
 - b. Where specified heights do not suit building construction or finish, mount as directed by Engineer.
 - 2. Switches: 48 inches above floor.
 - 3. Receptacles:
 - a. Industrial Areas, Workshops: 48 inches above floor.
- E. Install plumb and level.

- F. Flush Mounted:
 - 1. Install with concealed conduit.
 - 2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
- G. Support boxes independently of conduit by attachment to building structure or structural member.
- H. Box Type (Steel Raceway System):
 - 1. Indoor Dry Locations:
 - a. Exposed Rigid Conduit or IMC: Cast metal.
 - 2. Indoor Wet Locations:
 - a. Exposed Raceways: Cast metal.

3.05 JUNCTION AND PULL BOXES

- A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
- B. Install pull boxes where necessary in raceway system to facilitate conductor installation.
- C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.
- D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
- E. Use conduit bodies as junction and pull boxes where no splices are required and their use is allowed by applicable codes.
- F. Installed boxes shall be accessible.
- G. Do not install on finished surfaces.
- H. Install plumb and level.
- I. Support boxes independently of conduit by attachment to building structure or structural member.
- J. At or Belowgrade:
 - 1. Install boxes for belowgrade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
4. Use boxes and covers suitable to support anticipated weights.

K. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

L. Mounting Hardware:

1. Outdoor or Noncorrosive Indoor Wet Areas: Stainless steel.
2. Corrosive Areas: Stainless steel.

M. Location/Type:

1. Indoor and Outdoor, Wet: NEMA 250, Type 4.
2. Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X, stainless steel.
3. Underground Conduit: Concrete.
4. Corrosive: NEMA 250, Type 4X, stainless steel.
5. Outdoor, Where Indicated Weatherproof (WP): NEMA 250, Type 3R.
6. Industrial Use in Areas Not Otherwise Classified: NEMA 250, Type 12, unless otherwise shown.

N. Install Drain/breather fittings in NEMA 250, Type 4 and Type 4X enclosures.

3.06 WIRING DEVICES

A. Switches:

1. Mounting Height: See Article Outlet and Device Boxes.
2. Install with switch operation in vertical position.
3. Install single-pole, two-way switches such that toggle is in up position when switch is on.

B. Receptacles:

1. Install with grounding slot up, except where horizontal mounting is shown, in which case install with neutral slot up.

2. Weatherproof Receptacles:
 - a. Install in cast metal box.
 - b. Install such that hinge for protective cover is above receptacle opening.
3. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for “downstream” conventional receptacles.

3.07 DEVICE PLATES

- A. Securely fasten to wiring device; ensure a tight fit to box.
- B. Flush Mounted: Install with all four edges in continuous contact with finished wall surfaces without use of mats or similar materials. Plaster fillings will not be acceptable.
- C. Surface Mounted: Plate shall not extend beyond sides of box, unless plates have no sharp corners or edges.
- D. Install with alignment tolerance to box of 1/16 inch.
- E. Engrave with designated titles.
- F. Types (Unless Otherwise Shown):
 1. Outdoor: Weatherproof.
 2. Indoor:
 - a. Flush Mounted Boxes: Metal.
 - b. Surface Mounted, Metal Boxes: Cast.

3.08 PANELBOARDS AND MINI-POWER CENTERS

- A. Install securely, plumb, in-line and square with walls.
- B. Install top of cabinet 6 feet above floor, unless otherwise shown.
- C. Provide typewritten circuit directory for each panelboard.
- D. Cabinet Location/Type:
 1. Industrial Use in Areas Not Otherwise Classified: NEMA 250, Type 12, unless otherwise shown.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.09 TERMINAL BLOCKS

- A. Install for termination of control circuits entering or leaving equipment and local control panels.

3.10 SUPPORT AND FRAMING CHANNELS

- A. Install where required for mounting and supporting electrical equipment and raceway systems.
- B. Channel Type:
 - 1. Interior, Wet or Dry Corrosive Locations: Type 316 stainless steel.
 - 2. Outdoor, Corrosive Locations: Type 316 stainless steel.

3.11 NAMEPLATES

- A. Provide identifying nameplate on all equipment.

3.12 SURGE PROTECTION DEVICE (SPD) EQUIPMENT

- A. Install in accordance with manufacturer's instructions, including lead length, overcurrent protection, and grounding.

3.13 CONDUIT AND FITTINGS

- A. General:
 - 1. Crushed or deformed raceways not permitted.
 - 2. Maintain raceway entirely free of obstructions and moisture.
 - 3. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
 - 4. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
 - 5. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
 - 6. Group raceways installed in same area.
 - 7. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
 - 8. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
 - 9. Block Walls: Do not install raceways in same horizontal course with reinforcing steel.
 - 10. Install watertight fittings in outdoor, underground, or wet locations.

11. Paint threads and cut ends, before assembly of fittings and galvanized conduit, installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
12. Metal conduit to be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
13. Do not install raceways in concrete equipment pads, foundations, or beams.
14. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
15. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
16. Install conduits for fiber optic cables, telephone cables, and Category 5 data cables in strict conformance with the requirements of EIA/TIA 569.

B. Installation in Cast-in-Place Structural Concrete:

1. Minimum cover 2 inches, including all fittings.
2. Conduit placement shall not require changes in reinforcing steel location or configuration.
3. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.
4. Conduit larger than 1 inch shall not be embedded in concrete slabs, walls, foundations, columns or beams, unless approved by Engineer.
5. Slabs and Walls:
 - a. Trade size of conduit not to exceed one-fourth of the slab or wall thickness.
 - b. Install within middle two-fourths of slab or wall.
 - c. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
 - d. Separate conduit 2 inches and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
 - e. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1 inch.
 - f. Separate conduit by a minimum six times the outside dimension of expansion and deflection fittings at expansion joints.
 - g. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.
6. Columns and Beams:
 - a. Trade size of conduit not to exceed one-fourth of beam thickness.
 - b. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

C. Conduit Application:

1. Diameter:
 - a. Interior Minimum: 3/4 inch.
2. Indoor, Exposed: Rigid galvanized steel.
3. Indoor, Concealed (Not Embedded in Concrete): Rigid galvanized steel.

D. Connections:

1. For motors-, wall-, or ceiling-mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:
 - a. General: Flexible metal, liquid-tight conduit.
 - b. Wet or Corrosive Areas: Flexible metal liquid-tight.
 - c. Length: 18 inches minimum, 36 inches maximum, sufficient to allow movement or adjustment of equipment.
2. Lighting Fixtures in Dry Areas: Flexible metal, liquid-tight conduit.
3. Transition From Underground or Concrete Embedded to Exposed: Rigid galvanized steel conduit.

E. Penetrations:

1. Make at right angles, unless otherwise shown.
2. Notching or penetration of structural members, including footings and beams, not permitted.
3. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating using fire penetration seal as specified in Section 07 92 00, Joint Sealants.
4. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack.
5. Entering Structures:
 - a. General: Seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the entrance of gases or liquids from one area to another.
 - b. Concrete Roof or Membrane Waterproofed Wall or Floor: Provide watertight seal.
 - c. Heating, Ventilating, and Air Conditioning Equipment:
 - 1) Penetrate equipment in area established by manufacturer.
 - 2) Terminate conduit with flexible metal conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.
 - 3) Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.

- d. Corrosive-Sensitive Areas:
 - 1) Seal all conduit passing through chlorine and ammonia room walls.
 - 2) Seal conduit entering equipment panelboards and field panels containing electronic equipment.
 - 3) Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
- e. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
- f. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
 - 1) Provide Schedule 40 galvanized pipe sleeve or watertight entrance seal device.
 - 2) Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint on each side.

F. Support:

- 1. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 8 feet. Do not support from piping, pipe supports, or other raceways.
- 2. Multiple Adjacent Raceways: Provide ceiling trapeze.
- 3. Application/Type of Conduit Strap:
 - a. Steel Conduit: Zinc-coated steel, pregalvanized steel, or malleable iron.
 - b. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
- 4. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
 - a. Wood: Wood screws.
 - b. Hollow Masonry Units: Toggle bolts.
 - c. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
 - d. Steelwork: Machine screws.
 - e. Location/Type of Hardware:
 - 1) Dry, Noncorrosive Areas: Stainless steel.
 - 2) Wet, Noncorrosive Areas: Stainless steel.
 - 3) Corrosive Areas: Stainless steel.

G. Bends:

- 1. Install concealed raceways with a minimum of bends in the shortest practical distance.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
 3. Install with symmetrical bends or cast metal fittings.
 4. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
 5. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
 6. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run and raceways are same size.
 7. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.
- H. Expansion and Deflection Fittings: Provide on all raceways at structural expansion joints and in long tangential runs.
- I. Termination at Enclosures:
1. Cast Metal Enclosure: Provide manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.
 2. Nonmetallic, Cabinets, and Enclosures: Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
 3. Sheet Metal Boxes, Cabinets, and Enclosures:
 - a. Rigid Galvanized Conduit:
 - 1) Provide one lock nut each on inside and outside of enclosure.
 - 2) Install grounding bushing.
 - 3) Provide bonding jumper from grounding bushing to equipment ground bus or ground pad; if neither ground bus nor pad exists, connect jumper to lag bolt attached to metal enclosure.
 - 4) Install insulated bushing on ends of conduit where grounding is not required.
 - 5) Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
 - 6) Utilize sealing locknuts or threaded hubs on outside of NEMA 3R and NEMA 12 enclosures.
 - 7) Terminate conduits with threaded conduit hubs at NEMA 4 and 4X boxes and enclosures.
 - b. Flexible Metal Conduit: Provide two-screw type, insulated, malleable iron connectors.

4. Free-Standing Enclosures:
 - a. Terminate metal conduit entering bottom with grounding bushing; provide a grounding jumper extending to equipment ground bus or grounding pad.
 - b. Secure on four sides.

J. Empty Raceways:

1. Provide permanent, removable cap over each end.
2. Provide nylon pull cord.
3. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

K. Identification Devices:

1. Raceway Tags:
 - a. Identify origin and destination.
 - b. Install at each terminus, near midpoint, and at minimum intervals of every 50 feet of exposed raceway, whether in ceiling space or surface mounted.
 - c. Provide corrosion-resistant wire for attachment.

L. Raceway Band: Install wherever metallic conduit emerges from concrete slabs. Center band at slab surface and install according to manufacturer's instructions.

1. Slip-on Type: Clean conduit surface at installation location. Cut tubing to 4-inch minimum lengths and slip onto raceway prior to slab placement and termination of conduit. Heat-shrink onto conduit.
2. Wrap-around Type: Use where slip-on access to conduit is not possible. Clean conduit surface at installation location. Apply primer. Apply wraps to provide two layers of tape. Neatly finish tape end to prevent unraveling.

3.14 METAL WIREWAYS

- A. Install in accordance with manufacturer's instructions.
- B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

3.15 CONDUCTORS AND CABLES

- A. Conductor storage, handling, and installation shall be in accordance with manufacturer's recommendations.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. Do not exceed manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- C. Conduit system shall be complete prior to drawing conductors. Lubricate prior to pulling into conduit. Lubrication type shall be as approved by conductor manufacturer.
- D. Terminate all conductors and cables, unless otherwise shown.
- E. Do not splice conductors.
- F. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches.
- G. Wiring within Equipment and Local Control Panels: Remove surplus wire, dress, bundle, and secure.
- H. Power Conductor Color Coding:
 - 1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 inches to 2 inches wide.
 - 2. No. 8 AWG and Smaller: Provide colored conductors.
 - 3. Colors:
 - a. Neutral Wire: White.
 - b. Live Wires, 120/240-Volt, Single-Phase System: Black, red.
 - c. Live Wires, 120/208-Volt, Three-Phase System: Black, red, or blue.
 - d. Live Wires, 277/480-Volt, Three-Phase System: Brown, orange, or yellow.
 - e. Ground Wire: Green.
- I. Circuit Identification:
 - 1. Circuits Appearing in Circuit Schedules: Identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
 - 2. Circuits Not Appearing in Circuit Schedules: Assign circuit name based on device or equipment at load end of circuit. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

3. Method: Identify with sleeves. Taped-on markers or tags relying on adhesives not permitted.

J. Connections and Terminations:

1. Install wire nuts only on solid conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control circuit conductors.
3. Tape insulate all uninsulated connections.
4. Install crimp connectors and compression lugs with tools approved by connector manufacturer.

3.16 GROUNDING

- A. Grounding shall be in compliance with NFPA 70 and as shown.
- B. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.
- C. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- D. Shielded Instrumentation Cables:
 1. Ground shield to ground bus at power supply for analog signal.
 2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
 3. Do not ground instrumentation cable shield at more than one point.
- E. Equipment Grounding Conductors: Provide in all conduits containing power conductors and control circuits.

3.17 LOW VOLTAGE MOTOR CONTROL

- A. Install equipment in accordance with NEMA ICS 2.3 and manufacturer's instructions and recommendations.
- B. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers. Adjust to approximately 11 times motor rated current.
- C. Select and install overload relay heaters or adjust electronic overload protection after the actual nameplate full-load current rating of motor has been determined.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.18 LUMINAIRES AND ACCESSORIES

- A. Install in accordance with manufacturer's recommendations.
- B. Install plumb and level at mounting heights shown.
- C. Provide proper hangers, pendants, and canopies as necessary for complete installation.
- D. Install symmetrically with suspended ceiling pattern in finished areas.
- E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.
- F. Building Exterior: Provide flush-mounted back box and concealed conduit, unless otherwise shown.

3.19 FIELD QUALITY CONTROL

- A. Tests shall be performed in accordance with the requirements of Section 01 91 14, Equipment Testing and Facility Startup.
- B. General:
 - 1. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.
 - 2. Test instrument calibration shall be in accordance with NETA ATS.
 - 3. Perform inspection and electrical tests after equipment has been installed.
 - 4. Perform tests with apparatus de-energized whenever feasible.
 - 5. Inspection and electrical tests on energized equipment are to be:
 - a. Scheduled with Engineer prior to de-energization.
 - b. Minimized to avoid extended period of interruption to the operating plant equipment.
- C. Tests and inspection shall establish that:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances.
 - 2. Installation operates properly.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and NFPA 70.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- D. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- E. Adjust mechanisms and moving parts for free mechanical movement.
- F. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- G. Verify nameplate data for conformance to Contract Documents.
- H. Realign equipment not properly aligned and correct unlevelness.
- I. Properly anchor electrical equipment found to be inadequately anchored.
- J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.
- K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- L. Provide proper lubrication of applicable moving parts.
- M. Investigate and repair or replace:
 - 1. Electrical items that fail tests.
 - 2. Active components not operating in accordance with manufacturer's instructions.
 - 3. Damaged electrical equipment.
- N. Electrical Enclosures:
 - 1. Remove foreign material and moisture from enclosure interior.
 - 2. Vacuum and wipe clean enclosure interior.
 - 3. Remove corrosion found on metal surfaces.
 - 4. Repair or replace, as determined by Engineer, door and panel sections having damaged surfaces.
 - 5. Replace missing or damaged hardware.
- O. Provide certified test report(s) documenting the successful completion of specified testing. Include field test measurement data.
- P. Test the following equipment and materials:
 - 1. Conductors: Insulation resistance, No. 4 and larger only.
 - 2. Panelboards, switches, and circuit breakers.
 - 3. Motor controls.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

4. Grounding electrodes.
5. Motors.

Q. Controls:

1. Test control and signal wiring for proper termination and function.
2. Test local control panels and other control devices for proper terminations, configuration and settings, and functions.
3. Demonstrate control, monitoring, and indication functions in presence of Owner and Engineer.

R. Balance electrical load between phases on panelboards and mini-power centers after installation.

S. Voltage Testing:

1. When installation is complete and facility is in operation, check voltage at point of termination of electric utility supply system to Project.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. If unbalance exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make written request to electric utility to correct condition.
4. If corrections are not made, obtain written statement from a responsible electric utility official that voltage variations and/or unbalance are within their normal standards.

T. Equipment Line Current:

1. Check line current in each phase for each piece of equipment.
2. If electric utility makes adjustments to supply voltage magnitude or balance, make line current check after adjustments are made.

3.20 ELECTRICAL SYSTEMS ANALYSIS

A. Short Circuit Study:

1. Prepare in accordance with IEEE 399.
2. Extent of existing system to be included in study is limited to system elements that affect new system and equipment.
3. Available fault current from the utility shall be 25,000 amps at 4,800 volts.
4. Verify equipment and protective devices are within their ratings.

B. Arc Flash Study:

1. Perform an Arc Flash Study after the Short Circuit Study has been completed.
2. Prepare in accordance with NFPA 70E, OSHA 29CFR, Part 1910 Subpart S, and IEEE 1584.
3. Provide arc flash warning labels for new equipment in accordance with NFPA 70 and NFPA 70E.
 - a. Warning labels shall be printed in color on thermally bonded adhesive backed, UV and weather resistant labels.

END OF SECTION

SECTION 33 13 00
DISINFECTION OF WATER UTILITY
DISTRIBUTION FACILITIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
 - a. B300, Hypochlorites.
 - b. B301, Liquid Chlorine.
 - c. B302, Ammonium Sulfate.
 - d. B303, Sodium Chlorite.
 - e. C651, Disinfecting Water Mains.
 - f. C652, Disinfection of Water Storage Facilities.
 - g. C653, Disinfection of Water Treatment Plants.
2. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
3. Standard Methods for the Examination of Water and Wastewater, as published by American Public Health Association, American Water Works Association, and the Water Environment Federation.

1.02 SUBMITTALS

A. Informational Submittals:

1. Plan describing and illustrating conformance to appropriate AWWA standards and this Specification.
2. Procedure and plan for cleaning system.
3. Procedures and plans for disinfection and testing.
4. Proposed locations within system where Samples will be taken.
5. Type of disinfecting solution and method of preparation.
6. Certification that employees working with concentrated chlorine solutions or gas have received appropriate safety training.
7. Method of disposal for highly chlorinated disinfecting water.
8. Independent Testing Agency: Certification that testing agency is qualified to perform chlorine concentration testing bacteriological testing.

9. Certified Bacteriological Test Results:
 - a. Facility tested is free from coliform bacteria contamination.
 - b. Forward results directly to Engineer and Owner.

1.03 QUALITY ASSURANCE

- A. Independent Testing Agency: Certified in the State of Michigan, with 10 years' experience in field of water sampling and testing. Agency shall use calibrated testing instruments and equipment, and documented standard procedures for performing specified testing.

1.04 SEQUENCING

- A. Commence disinfection after completion of following: Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER FOR DISINFECTION AND TESTING

- A. Clean, uncontaminated, and potable.
- B. Owner will supply potable quality water. Contractor shall convey in disinfected pipelines or containers.

PART 3 EXECUTION

3.01 GENERAL

- A. Conform to AWWA C651 for pipes and pipelines C652 for tanks and reservoirs C653 for water treatment plants and filters, except as modified in these Specifications.
- B. Contractor's Equipment: Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.
- C. Disinfect the following items installed or modified under this Project, intended to hold, transport, or otherwise contact potable water:
 - 1. Transfer Pumps, Sample Pumps.
 - 2. Clearwells.
 - 3. Pipelines: Disinfect new pipelines that connect to existing pipelines up to point of connection.
 - 4. Disinfect surfaces of materials that will contact finished water, both during and following construction, using one of the methods described in AWWA C652 and AWWA C653. Disinfect prior to contact with finished water. Take care to avoid recontamination following disinfection.
- D. Prior to application of disinfectants, clean pump, clearwell, and piping of loose and suspended material.
- E. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so chlorine-water solution is at specified strength. Do not place concentrated liquid commercial disinfectant in pipeline or other facilities to be disinfected before it is filled with water.

3.02 TURBIDITY

- A. Cleaning of equipment and facilities shall include removal of materials that result in a turbidity exceeding limits stated in Article Testing.

3.03 PIPING

- A. Cleaning:
 - 1. Before disinfecting, clean foreign matter from pipe in accordance with AWWA C651.
 - 2. Flush pipe through flushing branches and remove branches after flushing is completed.

- B. Disinfecting Procedure: In accordance with AWWA C651, unless herein modified.

3.04 PUMPS

- A. Disinfecting Solutions: Minimum free chlorine concentration of 100 ppm.
- B. Application:
 - 1. Inject disinfecting solution into pump and associated piping and circulate for a minimum 3-hour period of time. At end of 3-hour period, solution shall have a strength of at least 50 ppm free chlorine.
 - 2. Operate valves and pump appurtenances during disinfection to ensure disinfecting solution is dispersed into all parts of pump and lines.
 - 3. If disinfecting solution contained in pump has a residual free chlorine concentration less than 50 ppm after the 3-hour retention period, reclean pump, reapply disinfecting solution, and retest until a satisfactory test result is obtained.
 - 4. After chlorination, flush water from pump until water through unit is chemically and bacteriologically equal to permanent source of supply.

3.05 CLEARWELLS

- A. Cleaning:
 - 1. Clean interior surfaces using water under pressure before sterilizing.
 - 2. Isolate clearwell from system to prevent contaminating materials from entering distribution system.
 - 3. Cleaning shall:
 - a. Remove deposits of foreign nature.
 - b. Remove biological growths.
 - c. Clean slopes, walls, top, and bottom.
 - d. Avoid damage to structure.
 - e. Avoid pollution or oil deposits by workers and equipment.
 - 4. Dispose of water used in cleaning in accordance with applicable regulations before adding disinfecting solution to clearwell.
- B. Disinfecting Procedure: In accordance with AWWA C652, unless herein modified. Parts of structures, such as ceilings or overflows that cannot be immersed, shall be spray or brush disinfected.

3.06 DISPOSAL OF CHLORINATED WATER

- A. Do not allow flow into a waterway without neutralizing disinfectant residual.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. See appendix of AWWA C651 C652 or C653 for acceptable neutralization methods.

3.07 TESTING

A. Collection of Samples:

1. Coordinate activities to allow Samples to be taken in accordance with this Specification.
2. Provide valves at sampling points.
3. Provide access to sampling points.

B. Test Equipment:

1. Clean containers and equipment used in sampling and make sure they are free of contamination.
2. Obtain sampling bottles with instructions for handling from Independent Testing laboratory.

C. Chlorine Concentration Sampling and Analysis:

1. Collect and analyze Samples in accordance with applicable AWWA Standard.
2. Sampling Locations: Approved locations per disinfection and sampling plan.
3. Analysis to be performed by Independent Testing laboratory. Samples will be analyzed using amperometric titration method for free chlorine as described in latest edition of Standard Methods for Examination of Water and Wastewater.

D. After clearwells, pumps and pipes have been cleaned, disinfected, and refilled with potable water, an independent laboratory will take water Samples and have them analyzed for conformance to bacterial limitations for public drinking water supplies.

1. Collect Samples in accordance with applicable AWWA Standard.
2. Analyze Samples for coliform concentrations in accordance with latest edition of Standard Methods for the Examination of Water and Wastewater.
3. Sampling Locations: Approved locations per disinfection and sampling plan.
4. Sampling points shall be representative and accepted by Engineer.

- E. Turbidity Sampling and Analysis:
1. After clearwells, pumps and pipes have been cleaned, disinfected, and refilled with potable water, an independent laboratory will take water Samples and have them analyzed for conformance to turbidity limitations for public drinking water supplies. Turbidity shall not exceed 0.3 NTU.
 2. If turbidity is in excess of the limit, dispose of the water in accordance with this Specification and applicable regulations, take action to remove source of turbidity, refill system, and retest.
- F. If minimum Samples required above are bacterially positive, disinfecting procedures and bacteriological testing shall be repeated until bacterial limits are met.

END OF SECTION

SECTION 40 05 15
PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
 2. American Society of Mechanical Engineers (ASME): B31.1, Power Piping.
 3. ASTM International (ASTM):
 - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 4. International Code Council (ICC):
 5. International Building Code (IBC).
 6. International Mechanical Code (IMC).
 7. Manufacturers' Standardization Society (MSS):
 - a. SP 58, Pipe Hangers and Supports—Materials, Design and Manufacture.
 - b. SP 127, Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, and Application.

1.02 SUBMITTALS

- A. Action Submittals:
1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for all piping. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
 2. Calculations for each type of pipe support, attachment and anchor.
 3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.
 4. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Maintenance information on piping support system.

1.03 QUALIFICATIONS

- A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer in the state where the Work is to be installed.

1.04 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not. Supports are shown only where specific types and locations are required; additional pipe supports may be required.
2. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this section.

B. Pipe Support Systems:

1. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
 - a. Ductile-iron Pipe 8 Inches and Under: Maximum span limited to that for standard weight steel pipe for water service.
 - b. Ductile-iron Pipe 10 Inches and Larger: Maximum span limited to 20 feet.
2. Electrical Conduit Support: Include in design of framing support system.

- C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

- D. Vertical Sway Bracing: 10-foot maximum centers or as shown.

- E. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show they are adequate for additional load, or if they are strengthened to support additional load.

PART 2 PRODUCTS

2.01 GENERAL

- A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.
- B. Special support and hanger details may be required for cases where standard catalog supports are not applicable.
- C. Materials: 304 Stainless Steel or higher Grade; unless otherwise indicated.

2.02 WALL BRACKETS, SUPPORTS, AND GUIDES

- A. Welded Steel Wall Bracket: MSS SP 58, Type 33 (heavy-duty):
 - 1. Anvil; Figure 199, 3,000 pound rating.
 - 2. B Line; Figure B3067, 3,000 pound rating.
- B. Offset Pipe Clamp:
 - 1. Anvil; Figure 103, sizes 3/4 inch through 8 inches.
 - 2. B-Line; Figure B3148, sizes 3/4 inch through 8 inches.
 - 3. Refer to Standard detail 4005-505 for additional requirements.
- C. Channel Type:
 - 1. Unistrut; P2558 Series; Single Piece 1/2" to 6" Pipe Strap.
 - 2. Anvil; Power-Strut; B2400 Series; Single Piece 1/2" to 6" Pipe Strap.
 - 3. Refer to Standard detail 4005-521 for additional requirements.

2.03 PIPE SADDLES

- A. Saddle Supports, Pedestal Type:
 - 1. Minimum standard weight pipe stanchion, saddle, and anchoring flange.
 - 2. Refer to Standard Detail 4005-500 for additional requirements.
 - 3. Nonadjustable Saddle: MSS SP , Type 37 with U-bolt.
 - a. Anvil; Figure 259, sizes 4 inches through 36 inches with Figure 63C base.
 - b. B-Line; Figure B3095, sizes 1 inch through 36 inches with B3088S base.
 - 4. Adjustable Saddle: MSS SP 58, Type 38 without clamp.
 - a. Anvil; Figure 264, sizes 2-1/2 inches through 36 inches with Figure 62C base.

- b. B-Line; Figure B3092, sizes 3/4 inch through 36 inches with Figure B3088S base.

2.04 ACCESSORIES

A. Anchor Bolts:

- 1. Size and Material: Sized by Contractor for required loads, 1/2-inch minimum diameter, and as specified in Section 05 50 00, Metal Fabrications.
- 2. Bolt Length (Extension Above Top of Nut):
 - a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
 - b. Maximum Length: No more than a full nut depth above top of nut.

B. Dielectric Barriers:

- 1. Plastic coated hangers, isolation cushion, or tape.
- 2. Manufacturer and Products:
 - a. B-Line; B1999 Vibra Cushion.
 - b. B-Line; Iso Pipe, Isolation Tape.

C. Insulation Shields:

- 1. Type: Galvanized steel or stainless steel, MSS SP 58, Type 40.
- 2. Manufacturers and Products:
 - a. Anvil; Figure 167, sizes 1/2 inch through 24 inches.
 - b. B-Line; Figure B3151, sizes 1/2 inch through 24 inches.

D. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles:

- 1. In accordance with MSS SP 58.
- 2. Use only if wall or floor mounted support is not feasible. Requires approval by Engineer.
- 3. Attachments:
 - a. Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
 - b. Concrete Attachment Plates:
 - 1) Anvil; Figure 47, Figure 49, or Figure 52.
 - 2) B-Line; Figure B3084, Figure B3085, or Figure B3086.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install support systems in accordance with MSS SP 58, unless shown otherwise.
2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.
6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
7. Do not use adhesive anchors for attachment of supports to ceiling or walls.
8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
10. Install lateral supports for seismic loads at changes in direction.
11. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
12. Repair mounting surfaces to original condition after attachments are completed.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
 - a. Single Pipes: Clevis hangers or adjustable swivel split-ring; only with approval by Engineer.
 - b. Grouped Pipes: Not allowed.
2. Horizontal Piping Supported from Walls:
 - a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
 - b. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
3. Horizontal Piping Supported from Floors:
 - a. Saddle Supports:
 - 1) Pedestal Type, elbow and flange.
 - 2) Provide minimum 1-1/2-inch grout beneath baseplate.

4. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration.

C. Standard Attachments:

1. Existing Concrete Ceilings: Channel type support with minimum of two anchor points, concrete attachment plates or concrete anchors as limited below:
 - a. Single point attachment to ceiling is not allowed.
2. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.
3. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.

D. Intermediate and Pipe Alignment Guides:

1. Provide pipe alignment guides, or pipe supports that provide same function, at expansion joints and loops.
2. Guide pipe on each side of expansion joint or loop at 4 pipe and 14 pipe diameters from each joint or loop.
3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

E. Accessories:

1. Insulation Shield: Install on insulated piping with oversize rollers and supports.
2. Dielectric Barrier:
 - a. Provide between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.
 - b. Install rubber wrap between submerged metal pipe and oversized clamps.

3.02 FIELD FINISHING

- A. Paint atmospheric exposed steel components as specified in Section 09 90 00, Painting and Coating.

END OF SECTION

SECTION 40 27 00
PROCESS PIPING—GENERAL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
1. American Society of Mechanical Engineers (ASME):
 - a. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
 - b. B1.20.1, Pipe Threads, General Purpose (Inch).
 - c. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
 - d. B16.9, Factory-Made Wrought Butt welding Fittings.
 - e. B16.11, Forged Fittings, Socket-Welding and Threaded.
 - f. B16.15, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
 - g. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
 - h. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - i. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
 - j. B31.3, Process Piping.
 - k. B31.9, Building Services Piping.
 2. American Water Works Association (AWWA):
 - a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - b. C606, Grooved and Shouldered Joints.
 3. ASTM International (ASTM):
 - a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
 - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
 - d. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- f. A135/A135M, Standard Specification for Electric-Resistance-Welder Steel Pipe.
- g. A139/A139M, Standard Specification for Electro-Fusion (Arc)-Welded Steel Pipe (NPS 4 Inches and Over).
- h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- i. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
- j. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
- k. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
- l. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
- m. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
- n. A197/A197M, Standard Specification for Cupola Malleable Iron.
- o. A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
- p. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- q. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- r. A276, Standard Specification for Stainless Steel Bars and Shapes.
- s. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- t. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- u. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- v. A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
- w. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
- x. A395/A395M, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- y. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- z. A409/A409M, Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service.
- aa. A536, Standard Specification for Ductile Iron Castings.
- bb. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- cc. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
- dd. A743/A743M, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
- ee. A744/A744M, Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
- ff. A774/A774M, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
- gg. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
- hh. B32, Standard Specification for Solder Metal.
- ii. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
- jj. B61, Standard Specification for Steam or Valve Bronze Castings.
- kk. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- ll. B75/B75M, Standard Specification for Seamless Copper Tube.
- mm. B88, Standard Specification for Seamless Copper Water Tube.
- nn. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
- oo. B462, Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
- pp. B464, Standard Specification for Welded UNS N08020 Alloy Pipe.
- qq. B474, Standard Specification for Electric Fusion Welded Nickel and Nickel Alloy Pipe.
- rr. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
- ss. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- tt. D1330, Standard Specification for Rubber Sheet Gaskets.

- uu. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - vv. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - ww. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - xx. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - yy. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - zz. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
 - aaa. F436, Standard Specification for Hardened Steel Washers.
 - bbb. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - ccc. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- 4. FM Global (FM).
 - 5. NSF International (NSF):
 - a. ANSI 61: Drinking Water System Components - Health Effects.
 - b. ANSI 372: Drinking Water System Components - Lead Content.

1.02 DESIGN REQUIREMENTS

- A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
 - 1. Process Piping: ASME B31.3, normal fluid service unless otherwise specified.
 - 2. Building Service Piping: ASME B31.9, as applicable.
 - a. Sanitary Building Drainage and Vent Systems.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
 - 2. Flanged Pipe and Fitting: Dimensioned layout drawings for all flanged piping greater than 4 inches in diameter, including locations of pipe supports and special fittings, and connections to existing piping.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3. Pipe label templates.
4. Pipe colors by type/size. Submit painting systems as part of Section 09 90 00, Painting and Coatings submittals.

B. Informational Submittals:

1. Manufacturer's Certification of Compliance, in accordance with Section 01 61 00, Common Product Requirements:
 - a. Pipe and fittings.
 - b. Factory applied resins and coatings.
2. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Flanged Pipe and Fittings: Manufacturer's product data sheets for gaskets including torqueing requirements and bolt tightening procedures.

1.04 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements, and:

1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
3. Linings and Coatings: Prevent excessive drying.
4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPING

- A. As specified on Piping Data Sheet(s) and Piping Schedule located at the end of this section as Supplement.
- B. Diameters Shown:
 - 1. Standardized Products: Nominal size.
 - 2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.
 - 3. Cement-Lined Ductile Iron Pipe: Lining inside diameter.

2.03 JOINTS

- A. Grooved End System:
 - 1. Rigid type.
 - 2. Use of flexible grooved joints allowed where shown on Drawings or with prior approval by Engineer.
 - 3. Flanges: When required, furnish with grooved type flange adapters of same manufacturer as grooved end couplings.
- B. Flanged Joints:
 - 1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
 - 2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.
- C. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.

2.04 PIPE CORROSION PROTECTION

- A. Coatings: See Section 09 90 00, Painting and Coating, for details of coating requirements.

2.05 FINISHES

- A. Factory prepare, prime, field touch up, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.
- B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

3.02 PREPARATION

- A. See Piping Schedule and Section 09 90 00, Painting and Coating, for additional requirements.
- B. Notify Engineer at least 2 weeks prior to demolition of pipe or fittings.
- C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.03 INSTALLATION—GENERAL

- A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
- B. Remove foreign objects prior to assembly and installation.
- C. Do not move cement lined ductile iron pipe with pallet forks. Move only with straps and other similar devices.
- D. Flanged Joints:
 - 1. Install perpendicular to pipe centerline.
 - 2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
 - 3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
 - 4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
 - 5. Grooved Joint Flange Adapters: Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.

6. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
 7. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
 8. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
 9. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
 10. Manufacturer: Same as pipe manufacturer or grooved joint flange adapter manufacturer.
- E. Threaded and Coupled Joints:
1. Conform to ASME B1.20.1.
 2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
 3. Countersink pipe ends, ream and clean chips and burrs after threading.
 4. Make connections with not more than three threads exposed.
 5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.
- F. Grooved-End Joints:
1. Piping shall be grooved in accordance with manufacturer's latest published instructions and shall be accurately cut with tools conforming to coupling manufacturer's standards and to AWWA C606.
 2. Install grooved joint couplings and gaskets in accordance with manufacturer's latest published installation instructions.
- G. Soldered Joints:
1. Use only solder specified for particular service.
 2. Cut pipe ends square and remove fins and burrs.
 3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
 4. Wipe excess solder from exterior of joint before hardened.
 5. Before soldering, remove stems and washers from solder joint valves.
- H. PVC and CPVC Piping:
1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
 2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

I. Ductile Iron Piping:

1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive blade cutter. Do not flame cut.
2. Dressing Cut Ends:
 - a. General: As required for the type of joint to be made.
 - b. Rubber Gasketed Joints: Remove sharp edges or projections.
 - c. Push-On Joints: Bevel, as recommended by pipe manufacturer.
 - d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End Pipe Couplings: As recommended by the coupling or adapter manufacturer.

3.04 INSTALLATION—EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 40 05 15, Piping Support Systems.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

F. Piping clearance, unless otherwise shown:

1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

3. From Adjacent Work: Minimum 1 inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.05 PIPE CORROSION PROTECTION

A. Ductile Iron Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating, and as shown in Piping Schedule.

B. Carbon Steel Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating.

C. Copper Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating.

D. PVC and CPVC Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating.

E. Piping Accessories:

1. Exposed:
 - a. Field paint black and galvanized steel, brass, copper, and bronze piping components as specified in Section 09 90 00, Painting and Coating, as applicable to base metal material.
 - b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.06 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

- A. Application and Installation: As specified in Section 40 27 01, Process Piping Specialties.

3.07 INSULATION

- A. See Section 40 42 13, Process Piping Insulation.

3.08 DISINFECTION

- A. See Section 33 13 00, Disinfecting of Water Utility Distribution.

3.09 FIELD FINISHING

- A. Notify Engineer at least 3 days prior to start of surface preparation or coating application work.
- B. As specified in Section 09 90 00, Painting and Coating.

3.10 PIPE IDENTIFICATION

- A. As specified in Pipe Legend with labels per Section 10 14 00, Signage.

3.11 FIELD QUALITY CONTROL

- A. Pressure Leakage Testing: As specified in Section 40 80 01, Process Piping Leakage Testing.

3.12 SUPPLEMENTS

- A. The supplements listed below, following “End of Section,” are a part of this Specification:
1. Piping Schedule Legend.
 2. Piping Schedule.
 3. Data Sheets.

Number	Title
40 27 00.01	Cement-Mortar-Lined Ductile Iron Pipe and Fittings
40 27 00.08	Stainless Steel Pipe and Fittings—General Service
40 27 00.10	Polyvinyl Chloride (PVC) Pipe and Fittings
40 27 00.13	Copper and Copper Alloy Pipe, Tubing, and Fittings

END OF SECTION

PIPING SCHEDULE LEGEND

SERVICE

FD	Floor Drain
DR	Drain (Process)
SA	Sample
V	Vent (Process)
SPD	Sump Pump Discharge
FE	Filter Effluent
FW	Finished Water
FIL	Filtrate

EXPOSURE

ALL	All
EXP	Exposed

MATERIAL

CLDI	Cement-Lined Ductile Iron
COP	Copper
PVC	Polyvinyl Chloride
SST	Stainless Steel
STL	Steel

JOINT TYPE

FL	Flanged
GR	Grooved
HU	Hub and spigot
PRJ	Proprietary Restrained

RM	Restrained Mechanical
S	Screwed
W	Welded (including solvent and fusion)

PRESSURE TEST

G	Gravity Service: Test pressure is not shown on gravity services. Test to highest liquid level that pipe can be subject to.
H	Hydrostatic
I	In Service
P	Pneumatic
PC	Test per Uniform Plumbing Code
NA	Not Applicable

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

Piping Schedule										
Service	Legend	Size(s) (In.) ¹	Exposure	Piping Material	Specification Section	Joint Type	Lining/ Coating ²	Test Pressure and Type (psig-x), x = Type indicated in Legend	Pipe Color and Label ³	Remarks
UV Influent/ UV Effluent	UVI/ UVE	>= 12"	EXP	CLDI	40 27 01.01	FL	Note 2	100, H	"Filter Effluent", "Finished Water"	Notes 4 and 5.
UV Effluent Drain	UVE - Drain	6"	EXP	CLDI	40 27 01.01	FL	Note 2	G	"Filter Effluent", "Finished Water"	Notes 4 and 5.
Backwash Supply	BWS	12"	EXP	CLDI	40 27 01.01	FL	Note 2	100, H	"Backwash Supply"	Notes 4 and 5.
Filtrate	FIL	6"	EXP	CLDI	40 27 01.01	GR or FL	Note 2	150, H	"Filtrate"	Match existing pipe size/type.
Sample	SA	<2"	EXP	COP or SST	40 27 01.13 or 40 27 00.08	W	Note 2	150, H	None, "Sample"	Note 4
Drain (Process)	DR	<4"	EXP	PVC	40 27 01.10	W	Note 2	G	"Drain"	Note 4
Floor Drain (Sanitary)	FD	3"	EXP	COP	40 27 01.13	W	Note 2	G	None, "Drain"	Note 4
Vent (Process)	V	<=2"	EXP	PVC	40 27 01.10	W	Note 2	G	None, "Vent"	

Piping Schedule										
Service	Legend	Size(s) (In.)¹	Exposure	Piping Material	Specification Section	Joint Type	Lining/ Coating²	Test Pressure and Type (psig-x), x = Type indicated in Legend	Pipe Color and Label³	Remarks
<p>1. “>” Greater Than; “<” Less Than; “<=” Less Than or Equal To; “>=” Greater Than or Equal To; “All” All Sizes</p> <p>2. Coating system number as specified in Section 09 90 00, Painting and Coating, and as specified in Article Pipe Corrosion Protection.</p> <p>3. Pipe color to match existing or refer to Section 09 90 00 for Pipe Color requirements.</p> <p>4. Clean and disinfect per 33 13 00, Disinfection of Water Utility Distribution Facilities.</p> <p>5. Insulate per 40 42 13, Process Piping Insulation.</p> <p>6. Flexible polyethylene tubing or reinforced PVC hose allowed for < 1/2” SA lines for instrument or analyzer connections; NSF 61 certified.</p>										

SECTION 40 27 00.01 CEMENT-MORTAR LINED DUCTILE IRON PIPE AND FITTINGS	
Item	Description
General	<p>Materials in contact with potable water shall conform to NSF 61 acceptance.</p> <p>Pipe manufacturer shall submit certification that source manufacturing facility has been producing ductile iron pipe of specified diameters, dimensions, and standards for a period of not less than 10 years. Testing of pipe required by AWWA C151/A21.51 shall be conducted in testing and laboratory facilities located in the USA and operating under USA laws and regulations. Pipe shall be handled during manufacture and shipped without nesting (without insertion of one pipe inside another).</p>
Pipe	Exposed Pipe Using Grooved End and Flange Joints: AWWA C115/A21.15, thickness Class 53 minimum, 250 psi minimum working pressure.
Lining	Cement-mortar: AWWA C104/A21.4.
Fittings	<p>Lined and coated same as pipe.</p> <p>Grooved End: AWWA C606 and AWWA C110/A21.10, ductile iron, 250 psi minimum working pressure; Victaulic.</p> <p>Flange: AWWA C110/A21.10 ductile iron, faced and drilled, Class 125 flat face Gray cast iron will not be allowed.</p>
Joints	<p>Grooved End: Rigid type radius cut conforming to AWWA C606, 250 psi minimum working pressure; Victaulic.</p> <p>Flange: Dimensions per AWWA C110/A21.10 flat face, ductile iron, threaded conforming to AWWA C115/A21.15. Gray cast iron will not be allowed.</p>
Couplings	<p>Grooved End: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic.</p> <p>Grooved End Adapter Flanges: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic.</p> <p>Flanged: Refer to Section 40 27 01, Process Piping Specialties.</p>

SECTION 40 27 00.01 CEMENT-MORTAR LINED DUCTILE IRON PIPE AND FITTINGS	
Item	Description
Bolting	<p>Mechanical, Proprietary Restrained, and Grooved End Joints: Manufacturer's standard.</p> <p>Flanged: ASTM A307, Grade B carbon steel heavy hex head or stud bolts, ASTM A563, Grade A carbon steel heavy hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Stud bolts are not allowed when bolting to tapped flanges. Torque bolts per gasket manufacturer recommendations.</p> <p>SST Flanged Pipe or Equipment Connections: Type 304 stainless steel, ASTM A320/A320M Grade B8M hex head bolts, ASTM A194/A194M Grade 8M hex head nuts and ASTM F436 Type 3 alloy washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress. Include dielectric insulating gaskets for dissimilar metal corrosion protection.</p>
Gaskets	<p>General: Gaskets in contact with potable water shall be NSF ANSI 61 certified.</p> <p>Grooved End Joints: Halogenated butyl conforming to ASTM D2000 and AWWA C606.</p> <p>Flanged: 1/8-inch-thick, homogeneous black rubber (EPDM), hardness 60-80 (Shore A), rated to 275 degrees F, conforming to ASME B16.21 and ASTM D2000. Manufacturer: US Pipe, Tyton Flange Tyte bulb-style gaskets only.</p> <p>Full face for flat-faced flanges, flat-ring type for raised-face flanges. Blind flanges shall be epoxy-lined in accordance with the system specified above. Manufacturer: US Pipe, Tyton Flange Tyte bulb-style gaskets only.</p> <p>Gasket pressure rating for a minimum of 250 psig working pressure.</p>
Joint Lubricant	Manufacturer's standard.

END OF SECTION

SECTION 40 27 00.08 STAINLESS STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	Size	Description
Pipe	2-1/2" & smaller	Schedule 40S: ASTM A312/A312M, Type 304 seamless, pickled and passivated.
	3" thru 6"	Schedule 10S:ASTM A778, "as-welded" grade, Type 304L, pickled and passivated.
	8" & larger	Schedule 5S:ASTM A778, "as-welded" grade, Type 304L, pickled and passivated.
Tubing	All	ASTM A269, Type 316 stainless steel, seamless, fully annealed hydraulic tubing, 0.065-inch wall thickness minimum.
Joints	1-1/2" & smaller	Threaded or flanged at equipment as required or shown.
	2" & larger	Butt-welded or flanged at valves and equipment.
Tubing Joints	All	Flareless compression fitting
Fittings	1-1/2" & smaller	Threaded: Forged 1,000 CWP minimum, ASTM A182/A182M, Grade F304
	2" & 2-1/2"	Butt Welded: ASTM A403/A403M, Grade WP304L conforming to ASME B16.9 and MSS SP 43, annealed, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows, unless shown otherwise.
	3" & larger	Butt-Welded: ASTM A774/A774M conforming to MSS SP 43, "as-welded" grade, Type 304L pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows, unless shown otherwise.
Tubing Fittings	All	Flareless Compression Type Forged: ASTM A182/A182M, Grade F316, Parker-Hannifin Ferulok, Flodar BA Series.

SECTION 40 27 00.08 STAINLESS STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	Size	Description
Flanges	All	Forged Stainless Steel: ASTM A182/A182M, Grade F304LASME B16.5 Class 150, slip-on weld neck or raised face. Weld slip-on flanges inside and outside.
Unions	2" & smaller	Threaded Forged: ASTM A182/A182M, Grade F304, 2,000-pound WOG, integral ground seats, AAR design meeting the requirements of ASME B16.11, bore to match pipe.
Bolting	All	Flanged SST Pipe or Equipment: Type 304 stainless steel, ASTM A320/A320M Grade B8M hex head bolts, ASTM A194/A194M Grade 8M hex head nuts and ASTM F436 Type 3 alloy washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress.
Gaskets	All Flanges	Flanged: 1/8-inch-thick, homogeneous black rubber (EPDM), hardness 60-80 (Shore A), rated to 275 degrees F, conforming to ASME B16.21 and ASTM D2000. Manufacturer: US Pipe, Tyton Flange Tyte bulb-style gaskets only. Full face for flat-faced flanges, flat-ring type for raised-face flanges. Blind flanges shall be epoxy-lined in accordance with the system specified above. Manufacturer: US Pipe, Tyton Flange Tyte bulb-style gaskets only.
Thread Lubricant	2" & smaller	General Service: Nickel pigmented PTFE, designed for stainless steel pipe, Air Force A-A-58092, AA Thread Seal Tape, Inc.

END OF SECTION

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	Size	Description
General	All	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Tubing	<1/2"	NSF 61 certified polyethylene or reinforced PVC tubing. Pressure rating and fittings rated 1.5 x operating pressure.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One-piece, molded hub type PVC flat face flange in accordance with Fittings above, ASME B16.1, Class 125 drilling
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts, ASTM A194/A194M Grade 8M hex head nuts and ASTM F436 Type 3 alloy washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress. With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts, ASTM A563 Grade A heavy hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress.

SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	Size	Description
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch-thick ethylene propylene (EPR) rubber. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	Socket type joints shall be made employing solvent cement that meets or exceeds the requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656, chemically resistant to the fluid service, and as recommended by pipe and fitting manufacturer, except solvent weld cement for PVC pipe joints in sodium hypochlorite service shall be free of silica filler and shall be certified by the manufacturer to be suitable for that service, IPS Weld-On 724 or approved equal. Certification shall be submitted. Solvent cement and primer shall be listed by NSF 61 for contact with potable water.
Thread Lubricant	All	Teflon Tape.

END OF SECTION

SECTION 40 27 00.13 COPPER AND COPPER ALLOY PIPE, TUBING, AND FITTINGS	
Item	Description
General	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	Oxygen Service: Red brass, seamless, standard wall thickness, conforming to ASTM B43.
Tubing	Seamless, conforming to ASTM B88 as follows: Water (exposed)Type L, hard drawn Domestic hot waterType L, hard drawn Sample line serviceType L, hard drawn
Fittings	Water Services: ASTM B75/B75M commercially pure wrought copper, socket joint, dimensions conforming to ASME B16.22.
Flanges	Water Services: Class 150, ASTM B75/B75M commercially pure wrought copper, socket joint, ASME B16.24 standard.
Bolting	Water Services: ASTM A307, carbon steel, Grade A hex head bolts, ASTM A563 Grade A hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress.
Gaskets	1/16-inch-thick nonasbestos compression type, full face, Cranite, John Manville.
Solder	Water Services: Joints 2-1/2 Inch and Smaller: Wire solder (95 percent tin), conforming to ASTM B32 Alloy Grade Sn95. Do not use cored solder. Joints Larger Than 2-1/2 Inch: Wire solder, melt range approximately 440 degrees F to 660 degrees F, conforming to ASTM B32 Alloy Grade HB or HN. Do not use cored solder.

END OF SECTION

SECTION 40 27 01
PROCESS PIPING SPECIALTIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
 - b. B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 2. American Water Works Association (AWWA):
 - a. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
 - b. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
 - c. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
 - d. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
 - e. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
 - f. Manual M11, Steel Pipe—A Guide for Design and Installation.
 3. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
 4. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
 5. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.02 SUBMITTALS

- A. Action Submittals:
1. Manufacturer's data on materials, construction, end connections, ratings, overall lengths, and live lengths (as applicable).

- B. Operation and Maintenance Data as specified in Section 1 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide required piping specialty items, whether shown or not shown on Drawings, as required by applicable codes and standard industry practice.
- B. Rubber ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints are considered flexible joints; welded, screwed, and flanged pipe joints are not considered flexible.
- C. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 COUPLINGS

- A. General:
 - 1. Coupling linings for use in potable water systems shall be in conformance with NSF/ANSI 61.
 - 2. Couplings shall be rated for working pressure not less than indicated in Piping Schedule for the service and not less than 150 psi.
 - 3. Couplings shall be lined and coated with liquid epoxy in accordance with AWWA C210.
 - 4. Sleeve type couplings shall conform to AWWA C219 and shall be hydraulically expanded beyond minimum yield for accurate sizing and proofing of tensile strength.
- B. Restrained Flange Adapter:
 - 1. Pressure Rating:
 - a. Minimum Working Pressure Rating: Not less than 150 psi.
 - b. Safety Factor: Not less than two times working pressure and shall be supported by manufacturer's proof testing.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Thrust Restraint:
 - a. Provide hardened steel wedges that bear against and engage outer pipe surface, and allow articulation of pipe joint after assembly while wedges remain in their original setting position on pipe surface.
 - b. Products employing set screws that bear directly on pipe will not be acceptable.
 - c. Utilize 304 SST nuts, bolts, and washers.
 3. Manufacturer and Product: EBAA Iron Sales Co.; Mega-Flange.
- C. Restrained Dismantling Joints:
1. Pressure Rating:
 - a. Minimum working pressure rating shall not be less than rating of the connecting flange.
 - b. Proof testing shall conform to requirements of AWWA C219 for bolted couplings.
 - c. Utilize 304 SST nuts, bolts, and washers.
 2. Manufacturers and Products:
 - a. Dresser Piping Specialties; Style 131.
 - b. Smith Blair, Inc.; Model 975.

2.03 SERVICE SADDLES

- A. Double-Strap Iron:
1. Pressure Rating: Capable of withstanding 150 psi internal pressure without leakage or over stressing.
 2. Run Diameter: Compatible with outside diameter of pipe on which saddle is installed.
 3. Taps: Iron pipe threads.
 4. Materials:
 - a. Body: Malleable or ductile iron.
 - b. Straps: Stainless steel.
 - c. Hex Nuts and Washers: Steel.
 - d. Seal: Rubber.
 5. Manufacturers and Products:
 - a. Smith-Blair; Series 313 or 366.
 - b. Dresser; Style 91.

2.04 PIPE SLEEVES

- A. Modular Mechanical Seal:
1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.

2. Fabrication:
 - a. Assemble interconnected rubber links with ASTM A276, Type 316 stainless steel bolts and nuts.
 - b. Pressure plates shall be reinforced nylon polymer.
3. Size: According to manufacturer's instructions for size of pipes shown to provide a watertight seal between pipe and wall sleeve opening, and to withstand a hydrostatic head of 40 feet of water.
4. Installation: Install per manufacturer's instructions. Prepare wall opening surface per Contract Drawings and coat per 09 90 00, Painting and Coatings.
5. Manufacturer: GPT Industries., Link-Seal Division.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide accessibility to piping specialties for control and maintenance.

3.02 PIPING FLEXIBILITY PROVISIONS

- A. General:
 1. Thrust restraint shall be provided as specified in Section 40 27 00, Process Piping—General.
 2. Install flexible couplings to facilitate piping installation, in accordance with approved shop drawings.

3.03 PIPING EXPANSION

- A. Piping Installation: Allow for thermal expansion due to differences between installation and operating temperatures.
- B. Anchors: Install as specified in Section 40 05 15, Piping Support Systems, to withstand expansion joint thrust loads and to direct and control thermal expansion.

3.04 SERVICE SADDLES

- A. Ferrous Metal Piping (except stainless steel): Double-strap iron.

3.05 FLEXIBLE PIPE CONNECTIONS TO EQUIPMENT

- A. Install to prevent piping from being supported by equipment, for vibration isolation, and where shown.

END OF SECTION

SECTION 40 27 02
PROCESS VALVES AND OPERATORS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Water Works Association (AWWA):
 - a. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - b. C504, Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).
 - c. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
 - d. C542, Electric Motor Actuators for Valves and Slide Gates.
 - e. C550, Protective Interior Coatings for Valves and Hydrants.
 2. ASTM International (ASTM):
 - a. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - c. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - d. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
 - e. B61, Standard Specification for Steam or Valve Bronze Castings.
 - f. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - g. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
 - h. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
 - i. B139/B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
 - j. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
 - k. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
 - l. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
 - m. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.

- n. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- 3. Manufacturers Standardization Society (MSS):
 - a. SP-80, Bronze Gate, Globe, Angle, and Check Valves.
 - b. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- 4. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 5. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
- 6. Underwriters Laboratories (UL).

1.02 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings:
 - a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
 - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - c. Certification for compliance to NSF/ANSI 61 for valves used for drinking water service.
 - d. Power and control wiring diagrams, including terminals and numbers.
 - e. For each power actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.
 - f. Sizing calculations for open-close/throttle and modulating valves.
 - g. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
- 2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for:
 - a. Electric actuators; full compliance with AWWA C542.

- b. Butterfly valves; full compliance with AWWA C504.
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
4. Tests and inspection data.
5. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
6. Manufacturer's Certificate of Proper Installation, in accordance with Section 1 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.01 GENERAL

- A. Valves to include gear operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, chain, wrench, and accessories to allow a complete operation from the intended operating level.
- B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.
- C. Valve same size as adjoining pipe, unless otherwise called out on Drawings or in Supplements. Valve shall be flanged unless shown otherwise on Drawings.
- D. Valve ends to suit adjacent piping.
- E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.
- F. Size operators and actuators to operate valve for full range of pressures and velocities.
- G. Valve to open by turning counterclockwise, unless otherwise specified.
- H. Factory mount and test operator, actuator, and accessories.
- I. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

J. Handwheels shall be 24-inch diameter.

2.02 SCHEDULE

- A. Additional requirements relative to this section are shown on Electric Actuated Valve Schedule located at the end of this section.

2.03 MATERIALS

- A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.

1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139/B139M (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
2. Stainless steel Alloy 18-8 may be substituted for bronze.

- B. Valve materials in contact with or intended for drinking water service to meet the following requirements:

1. Materials to comply with requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements.
2. Coatings materials to be formulated from materials deemed acceptable to NSF/ANSI 61.
3. Supply certification product is certified as suitable for contact with drinking water by an accredited certification organization in accordance with NSF/ANSI 61. Provide certification for each valve type used for drinking water service.

2.04 FACTORY FINISHING

- A. General:

1. Interior coatings for valves and hydrants shall be in accordance with AWWA C550, unless otherwise specified.
2. Exterior coating for valves and hydrants shall be in accordance with Section 09 90 00, Painting and Coating.
3. Material in contact with potable water shall conform to NSF/ANSI 61.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

B. Where epoxy lining and coating are specified, factory finishing shall be as follows:

1. In accordance with AWWA C550.
2. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.
3. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

2.05 VALVES

A. Gate Valves:

1. Type V100 Gate Valve 3 Inches and Smaller:
 - a. All-bronze, screwed bonnet, packed gland, single solid wedge gate, nonrising stem, Class 125 rated 200 psi CWP, complies with MSS SP-80 Type 1.
 - b. Manufacturers and Products:
 - 1) Crane; Figure 438, NPT threaded ends.
 - 2) Stockham; Figure B103, NPT threaded ends.
 - 3) Crane; Figure 1324, soldered ends.
 - 4) Stockham; Figure B104, soldered ends.
 - c. All-bronze, screwed bonnet, packed gland, single solid wedge gate, rising stem, Class 125 rated 200 psi CWP, complies with MSS SP-80 Type 2.
 - d. Manufacturers and Products:
 - 1) Crane; Figure 428, NPT threaded ends.
 - 2) Stockham; Figure B-100, NPT threaded ends.
 - 3) Crane; Figure 1334, soldered ends.
 - 4) Stockham; Figure B-108, soldered ends.

B. Globe Valves:

1. Type V200 Globe Valve 3 Inches and Smaller:
 - a. All-bronze, union bonnet, packed gland, inside screw, rising stem, TFE disc, Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 2.
 - b. Manufacturers and Products:
 - 1) Stockham; Figure B-22T, NPT threaded end.
 - 2) Crane Co.; Figure 7TF, NPT threaded end.
 - 3) Milwaukee; Model 1590T, soldered ends.
 - 4) NIBCO; Figure S-235-Y, soldered ends.
2. Type V208 Needle Disc Type Globe Valve 1/8 Inch to 3/4 Inch:

- a. All-bronze, threaded bonnet, packed gland, rising stem, bronze body and stem, Class 200 rated 200 psi SWP/400 psi CWP, complies with MSS SP-80.
- b. Manufacturers and Products:
 - 1) Crane Cat.; No. 88.
 - 2) Stockham; B-64.

C. Ball Valves:

- 1. Type V300 Ball Valve 3 Inches and Smaller for General Water and Air Service:
 - a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.
 - b. Manufacturers and Products:
 - 1) Threaded:
 - a) Conbraco Apollo; 70-100.
 - b) Nibco; T-580-70.
 - 2) Soldered:
 - a) Conbraco Apollo; 70-200.
 - b) Nibco; S-580-70.
- 2. Type V306 Stainless Steel Ball Valve 2 Inches and Smaller:
 - a. Two-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, NPT threaded ends, ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 psig CWP, complies with MSS SP-110.
 - b. Manufacturers and Products:
 - 1) Conbraco Apollo; 76F-100 Series.
 - 2) Nibco; T-585-S6-R-66-LL.
- 3. Type V330 PVC Ball Valve 2 Inches and Smaller:
 - a. Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon O-ring stem seals, to block flow in both directions. Provide pressure relief hole drilled on low pressure side of ball.
 - b. Manufacturers and Products:
 - 1) Nibco; Chemtrol Tru-Bloc.
 - 2) ASAHI/America; Type 21.
 - 3) Spears; True Union.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

D. Butterfly Valves:

1. General:
 - a. In full compliance with AWWA C504 and following requirements:
 - 1) Suitable for throttling operations and infrequent operation after periods of inactivity.
 - 2) Elastomer seats which are bonded or vulcanized to the body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM D429, Method B. Elastomers shall be compatible with chloramines (combined chlorine) residual; EPDM recommended.
 - 3) Bubble-tight with rated pressure applied from either side. Test valves with pressure applied in both directions.
 - 4) No travel stops for disc on interior of body.
 - 5) Self-adjusting V-type or O-ring shaft seals.
 - 6) Isolate metal-to-metal thrust bearing surfaces from flowstream.
 - 7) Provide worm gear actuator with handwheel. Valve actuators to meet the requirements of AWWA C504.
 - 8) Provide linings and coatings per AWWA, unless otherwise indicated on Drawings or specified herein.
 - 9) Valves to be in full compliance with NSF/ANSI 61. Provide NSF/ANSI 61 certificate for each valve.
 2. Type V500 Butterfly Valve Water Works Service 3 Inches to 72 Inches:
 - a. AWWA C504, Class 150B.
 - b. Short body type, flanged ends.
 - c. Cast-iron body, cast or ductile iron disc, Type 304 stainless steel shafts, EPDM rubber seat bonded or molded in body only, and stainless steel seating surface.
 - d. Provide epoxy lining and coating in compliance with AWWA C550.
 - e. Manufacturers and Products:
 - 1) Pratt; Model 2FII or Triton XR-70.
 - 2) DeZurik; AWWA Valve.

E. Check and Flap Valves:

1. Type V600 Check Valve 2 Inches and Smaller:
 - a. All bronze, threaded cap, threaded or soldered ends, swing type replaceable bronze disc, rated 125-pound SWP, 200-pound WOG.
 - b. Manufacturers and Products:
 - 1) Stockham; Figure B-319, threaded ends.
 - 2) Milwaukee; Figure 509, threaded ends.
 - 3) Stockham; Figure B-309, soldered ends.
 - 4) Milwaukee; Figure 1509, soldered ends.

F. Self-Regulated Automatic Valves:

1. Type V710 Pressure-Reducing Valve 2-1/2 Inches and Smaller:
 - a. Direct diaphragm operated, spring controlled, bronze body, NPT threaded ends, 200-psig rated minimum.
 - b. Size/Rating: As shown in Valve Schedule or Drawings.
 - c. Manufacturers and Products:
 - 1) Fisher; Type 75A.
 - 2) Watts; Series 223.
2. Type V744 Air Release Valve 1/2 Inch to 2 Inches:
 - a. Suitable for water service, automatically exhaust small amounts of entrained air that accumulates in a system. In CLOSED position, seat against resilient seat to prevent water leakage.
 - b. Rated 150 psi working pressure, cast-iron or ductile iron body and cover, stainless steel float and trim, NPT threaded inlet and outlet, built and tested to AWWA C512. All wetted materials shall be stainless steel. Operating pressure is >5 psi.
 - c. Manufacturers and Products:
 - 1) APCO Valve and Primer Corp.; Series 50, 200, and 200A.
 - 2) Val-Matic Valve; Series 15A to 45.6.
3. Type V746 Combination Air Release Valve 1 Inch to 16 Inches:
 - a. Suitable for water service, combines operating features of air and vacuum valve and air release valve. Air and vacuum portion to automatically exhaust air during filling of system and allow air to re-enter during draining or when vacuum occurs. Air release portion to automatically exhaust entrained air that accumulates in system.
 - b. Valve single body or dual body, air release valve mounted on air and vacuum valve, isolation valve mounted between the dual valves. 1-inch through 3-inch valves with NPT threaded inlet and outlet, 4-inch and larger valves with ASME B16.1 Class 125 flanged inlet and cover outlet.

- c. Rated 150 psi working pressure, cast-iron or ductile iron body and cover, stainless steel float and trim, built and tested to AWWA C512. All wetted materials shall be stainless steel.
- d. Manufacturers and Products:
 - 1) APCO Valve and Primer Corp.; Series 143C to 147C or 1804 to 1816.
 - 2) Val-Matic Valve; Series 201C to 203C or 104/22 to 116/38.

2.06 OPERATORS AND ACTUATORS

A. Manual Operators:

- 1. General:
 - a. For AWWA valves, operator force not to exceed requirements of applicable valve standard. Provide gear reduction operator when force exceeds requirements.
 - b. Operator self-locking type or equipped with self-locking device.
 - c. Position indicator on quarter-turn valves.
 - d. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator's threaded steel reach rod with internally threaded bronze or ductile iron nut.
- 2. Exposed Operator:
 - a. Galvanized and painted handwheel, provide oversized 16-inch handwheel for valves less than or equal to 12-inch diameter; 24-inch handwheel for valves greater than 12-inch diameter, unless indicated otherwise.
 - b. Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.
 - c. Valve handles to take a padlock, and wheels a chain and padlock.

B. Electric Motor Actuators, 480 Volts:

- 1. General:
 - a. Comply with latest version of AWWA C542.
 - b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of valve.
 - c. Controls integral with actuator and fully equipped as specified in AWWA C542.
 - d. Stem protection for rising stem valves.
- 2. Actuator Operation—General:
 - a. Suitable for full 90-degree rotation of quarter-turn valves or for use on multiturn valves, as applicable.

- b. Manual override handwheel.
 - c. Valve position indication.
 - d. Operate from FULL CLOSED to FULL OPEN positions or the reverse in the number of seconds given in Electric Actuated Valve Schedule.
 - e. Nonintrusive Electronic Control: Local controls, diagnostics, and calibration, including limit and torque settings, shall be accomplished non-intrusively. Electronic valve position display with capability to show continuous torque output. If applicable, provide two hand-held configuration units for every 10 actuators provided, two minimum.
3. Open-Close(O/C)/Throttling(T) Service:
- a. Size motors for one complete OPEN-CLOSE-OPEN cycle no less than once every 10 minutes.
 - b. Actuator suitable for throttling operation of valve at intermediate positions.
 - c. LOCAL-OFF-REMOTE Selector Switch, padlockable in each position:
 - 1) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.
 - 2) Remote OPEN-STOP-CLOSE momentary control dry contact inputs in REMOTE position. Integral seal-in circuits for remote OPEN and CLOSE commands; valve travel stops when remote STOP contact opens.
 - 3) Auxiliary contact that closes in REMOTE position.
 - d. OPEN and CLOSED indicating lights.
 - e. Integral reversing motor starter with built-in overload protection.
4. Modulating (M) Service:
- a. Size actuators for continuous modulating duty.
 - b. Feedback potentiometer, or equivalent, and integral electronic positioner/comparator circuit to maintain valve position.
 - c. HAND-OFF-AUTO (Local-Off-Remote) Selector Switch, padlockable in each position:
 - 1) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in HAND (Local) position.
 - 2) 4 mA to 20 mA dc input signal to control valve in AUTO (Remote) position.
 - 3) Auxiliary contact that closes in AUTO (Remote) position.
 - d. OPEN and CLOSED indicating lights.
 - e. Ac motor with solid state reversing starter or dc motor with solid state reversing controller, and built-in overload protection. Controller capable of 1,200 starts per hour.
 - f. Duty cycle limit timer and adjustable band width, or equivalent, to prevent actuator hunting.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- g. Valve position output converter that generates isolated 4 mA to 20 mA dc signal in proportion to valve position, and is capable of driving into loads of up to 500 ohms at 24 volts dc.
- 5. Limit Switch:
 - a. Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amps at 120 volts ac.
 - b. Each valve actuator to have a minimum of two auxiliary transfer contacts at end position, one for valve FULL OPEN and one for valve FULL CLOSED.
 - c. Housed in actuator control enclosure.
- 6. Control Features: Electric motor actuators with features as noted above, and as modified/supplemented in Electric Actuated Valve Schedule.
- 7. Manufacturers and Products:
 - a. Rotork Controls; IQ3 Series.
 - b. Flowserve Limatorque; QX Series.

2.07 ACCESSORIES

- A. Tagging: 1-1/2-inch diameter heavy brass or stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve operator bearing valve tag number shown on Drawings.
- B. Limit Switch: Factory installed NEMA 4X limit switch by actuator manufacturer.
- C. T-Handled Operating Wrench: One galvanized operating wrench, length to meet project requirements.
- D. Extension Bonnet for Valve Operator: Complete with enclosed stem, neck and stem extension, support brackets, and accessories for valve and operator. Lengths to meet project requirements.
- E. Chain Wheel and Guide:
 - 1. Handwheel direct-mount type.
 - 2. Complete with chain.
 - 3. Galvanized or cadmium-plated.
 - 4. Manufacturers and Products:
 - a. Clow Corp.; Figure F-5680.
 - b. Walworth Co.; Figure 804.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flange Ends:

1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. PVC Valves: Install using solvents approved for valve service conditions.

D. Valve Installation and Orientation:

1. General:

- a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
- b. Install valves in location for easy access for routine operation and maintenance.
- c. Install valves per manufacturer's recommendations.

2. Gate, Globe, and Ball Valves:

- a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
- b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.

3. Butterfly Valves:

- a. Unless otherwise restricted or shown on Drawings, install valve a minimum of 8 diameters downstream of a horizontal elbow or branch tee with shaft in horizontal position.
- b. For vertical elbow or branch tee immediately upstream of valve, install valve with shaft in vertical position.
- c. For horizontal elbow or branch tee immediately upstream of valve, install valve with shaft in horizontal position.
- d. When installed immediately downstream of swing check, install valve with shaft perpendicular to swing check shaft.
- e. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

4. Check Valves:
 - a. Install valve in accordance with manufacturer's instructions and provide required distance from immediate upstream fitting.
 - b. Install valve in vertical flow (up) piping only for gas services.
 - c. Install swing check valve with shaft in horizontal position.
 - d. Install double disc swing check valve to be perpendicular to flow pattern when discs are open.
 5. Solenoid Valves: Install in accordance with manufacturer's instructions.
- E. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.
- F. Extension Stem for Operator: Where depth of valve operating nut is 3 feet or greater below finish grade, furnish operating extension stem with 2 inch operating nut to bring operating nut to a point within 6 inches of finish grade.
- G. Torque Tube: Where operator for quarter-turn valve is located on floor stand, furnish extension stem torque tube of a type properly sized for maximum torque capacity of valve.
- H. Chain Wheel and Guide: Install chain wheel and guide assemblies or chain lever assemblies on manually operated valves over 6 feet 9 inches above finish floor. Install chain to within 3 feet of finish floor. Where chains hang in normally traveled areas, use appropriate "L" type tie-back anchors. Install chains to within operator horizontal reach of 2 feet 6 inches maximum, measured from normal operator standing location or station.

3.02 TESTS AND INSPECTION

- A. Valve may be either tested while testing pipelines, or as a separate step.
- B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.
- C. Set, verify, and record set pressures for relief and regulating valves.
- D. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Engineer.
- E. Test hydrostatic relief valve seating; record leakage. Adjust and retest to maximum leakage of 0.1 gpm per foot of seat periphery.

3.03 MANUFACTURER'S SERVICES

- A. Valve(s) as listed below require manufacturer's field services: V500.
- B. Manufacturer's Representative: Present at Site for minimum person-days listed below, travel time excluded:
 - 1. 1 person-days for installation assistance and inspection.
 - 2. 1 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
- C. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.04 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are part of this Specification.
 - 1. Electric Actuated Valve Schedule.

END OF SECTION

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

Electric Actuated Valve Schedule									
Tag Number	Valve Type	Actuator Power Supply	Valve Size (inches)	Process Fluid	Maximum Operating Flow (gpm)	Maximum ΔP (psi)	Service	Travel Time (Seconds)	Control Feature Modifications/Supplements
FV-100 UV Inlet 1	Butterfly	480-volt, 3-phase	24"	UVI	17,350	100	O/C	30	C,G,L, Z
FV-200 UV Inlet 2	Butterfly	480-volt, 3-phase	24"	UVI	17,350	100	O/C	30	C,G,L, Z
FCV-125 UV Effluent 1	Butterfly	480-volt, 3-phase	24"	UVE	17,350	100	M	30	C,G, J, L
FCV-225 UV Effluent 2	Butterfly	480-volt, 3-phase	24"	UVE	17,350	100	M	30	C,G, J, L
FV-300 Clearwell Interconnect 1	Butterfly	480-volt, 3-phase	36"	FW	17,350	100	O/C	30	C,G,L
FV-325 Clearwell Interconnect 2	Butterfly	Manual Handwheel	36"	FW	17,350	100	O/C		

Service: O/C = Open-Close, T = Throttling, M = Modulating
Control Feature Modifications/Supplements:
C = Actuator shall remain in last position upon loss of signal.
G = Motor and control enclosure(s) NEMA 250, Type 4 with 120-volt space heaters.
H = Motor and control enclosure(s) NEMA 250, Type 6 (IP 68) with 120-volt space heaters.
I = Motor and control enclosure(s) NEMA 250, Type 7 with 120-volt space heaters.
J = Valve position output converter that generates isolated 4 mA to 20 mA dc signal in proportion to valve position, and is capable of driving into loads of up to 500 ohms at 24 volts dc.
K = 120-volt secondary control power transformer.
L = Externally operable power disconnect switch.
Z. Provide extension neck and stem to mount actuator 3 ft above grating level of 972.50.

SECTION 40 42 13
PROCESS PIPING INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 2. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C165, Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
 - c. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - d. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - e. C534/C534M, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - f. C547, Standard Specification for Mineral Fiber Pipe Insulation.
 - g. C552, Standard Specification for Cellular Glass Thermal Insulation.
 - h. C585, Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
 - i. C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 - j. C1729, Standard Specification for Aluminum Jacketing for Insulation.
 - k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - l. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
 3. International Code Council (ICC): International Energy Conservation Code (IECC).
 4. Underwriters Laboratories Inc. (UL).

1.02 SUBMITTALS

- A. Action Submittals: Manufacturer's descriptive literature.
- B. Informational Submittals: Maintenance information.

PART 2 PRODUCTS

2.01 PIPE AND FITTING INSULATION

- A. Type 1—Elastomeric:
 - 1. Material: Flexible elastomeric pipe insulation, closed-cell structure in accordance with ASTM C534/C534M.
 - 2. Temperature Rating: Minus 297 degrees F to 220 degrees F.
 - 3. Nominal Density: 3 pcf to 6 pcf.
 - 4. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.25 Btu-in./hr-square foot degrees F at 75 degrees F per ASTM C177 or ASTM C518.
 - 5. Maximum water vapor transmission of 0.06 perm-inch per ASTM E96/E96M, Procedure A.
 - 6. Joints: Manufacturer's adhesive.
 - 7. Flame Spread Rating: Less than 25 per ASTM E84.
 - 8. Smoke Developed Index: Less than 50 per ASTM E84.
 - 9. Manufacturers and Products:
 - a. Nomaco; K-Flex.
 - b. Armacell; AP Armaflex.

2.02 INSULATION AT PIPE HANGERS AND SUPPORTS

- A. Refer to Section 40 05 15, Piping Support Systems.
- B. Copper, Ductile Iron, and Nonmetallic Pipe: High-density insert, thickness equal to adjoining insulation of Type 3 or other rigid insulation or manufactured pre-insulated pipe hanger and insulation shield. Extend insert beyond shield.

2.03 INSULATION FINISH SYSTEMS

- A. Type F1—PVC:
 - 1. Polyvinyl chloride (PVC) jacketing, minimum 20 mils indoors and 30 mils outdoors, for straight run piping and fitting locations, temperatures to 140 degrees F.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Color: PVC jacketing shall be color coded to match colors listed in pipe schedule where suitable matching colors are available. If no suitable colors are available jacketing shall be white.
3. Flame Spread Rating: 25 per ASTM E84.
4. Smoke Developed Index: 50 per ASTM E84.
5. Manufacturers and Products:
 - a. Knauf Insulation; Proto 1000.
 - b. Johns Manville; Zeston 2000 or 300.
 - c. Speedline; 25/50 Smoke-Safe.

PART 3 EXECUTION

3.01 APPLICATION

A. General:

1. Insulate valve bodies, flanges, and pipe couplings.
2. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
3. Do not insulate flexible pipe couplings and expansion joints.
4. Service and Insulation Thickness: Refer to Supplement Service and Insulation Thickness table following “End of Section” and to Piping Schedule in Section 40 27 00, Process Piping—General.

3.02 INSTALLATION

A. General:

1. Install in accordance with manufacturer’s instructions and as specified herein.
2. Install after piping system has been pressure tested and leaks corrected.
3. Install over clean dry surfaces.
4. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
5. Do not allow insulation to cover nameplates or code inspection stamps.
6. Run insulation or insulation inserts continuously through pipe hangers and supports, wall openings, ceiling openings, and pipe sleeves, unless otherwise shown.
7. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
8. Personnel Protection: Install on pipes from floor to 8 feet high. Install on pipes within 4 feet of platforms and to 8 feet high above platforms.

- B. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.
- C. Placement:
 - 1. Insulate valves and fittings with sleeved or cut pieces of same material.
 - 2. Seal and tape joints.
- D. Vapor Barrier:
 - 1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
 - 2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
 - 3. Do not use staples and screws to secure vapor sealed system components.

3.03 FIELD FINISHING

- A. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.
- B. Where pipe labels or banding are specified, apply to finished insulation, not to pipe.

3.04 SUPPLEMENTS

- A. The supplement listed below, following “End of Section,” is a part of this specification:
 - 1. Service and Insulation Thickness Table.

END OF SECTION

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

Service and Insulation Thickness							
Service Type	Pipe Legend	Thickness	Fluid Temperature (degrees F) ¹	Insulation	Finish Systems ²		
					Concealed from View	Indoors Exposed	Outdoors
UV Influent/UV Effluent	UVI/UVE	1-inch	35 – 80F	Type 1		Type F1	
Backwash Supply	BWS	1-inch	35 – 80F	Type 1		Type F1	

1. Use these fluid temperatures unless otherwise noted in the Piping Schedule.

2. Refer to Section 09 90 00, Paintings and Coatings, for pipe color schedule. Exposed piping insulation finishing system shall match pipe color.

SECTION 40 80 01
PROCESS PIPING LEAKAGE TESTING

PART 1 GENERAL

1.01 SUBMITTALS

A. Action Submittals:

1. Testing Plan:
 - a. Submit prior to testing and include at least the information that follows.
 - 1) Testing dates.
 - 2) Piping systems and section(s) to be tested.
 - 3) Test type.
 - 4) Method of isolation.
 - 5) Calculation of maximum allowable leakage for piping section(s) to be tested.
2. Certifications of Calibration: Testing equipment.
3. Certified Test Report.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

- A. Notify Engineer in writing 5 days in advance of testing. Perform testing in presence of Engineer.
- B. Pressure Piping:
 1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
 2. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
 3. New Piping Connected to Existing Piping:
 - a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.
 4. Test Pressure: As indicated on Piping Schedule.
- C. Test section may be filled with water and allowed to stand under low pressure prior to testing.

3.02 HYDROSTATIC TEST FOR PRESSURE PIPING

- A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.
- B. Exposed Piping:
 - 1. Perform testing on installed piping prior to application of insulation.
 - 2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
 - 3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
 - 4. Maintain hydrostatic test pressure continuously for 60 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
 - 5. Examine joints and connections for leakage.
 - 6. Correct visible leakage and retest as specified.
 - 7. Leave pipe full of water after repair of leaks. Empty pipe of water prior to final cleaning or disinfection.
 - 8. Correct leakage greater than allowable, and retest as specified.

3.03 FIELD QUALITY CONTROL

- A. Test Report Documentation:
 - 1. Test date.
 - 2. Description and identification of piping tested.
 - 3. Test fluid.
 - 4. Test pressure.
 - 5. Remarks, including:
 - a. Leaks (type, location).
 - b. Repair/replacement performed to remedy excessive leakage.
 - 6. Signed by Contractor and Engineer to represent that test has been satisfactorily completed.

END OF SECTION

**SECTION 40 90 00
INSTRUMENTATION AND CONTROL
FOR PROCESS SYSTEMS**

PART 1 GENERAL

1.01 SUMMARY

- A. This section gives general requirements for Process Instrumentation and Control (PIC). The following PIC subsections expand on requirements of this section:
1. Section 40 91 00, Instrumentation and Control Components.
- B. Major Work Items: Includes but is not limited to engineering, furnishing, programming, installing, calibrating, adjusting, testing, documenting, starting up, and training for complete PIC.
1. Process instrumentation including primary elements, transmitters, control devices, and control panels.
 2. Programmable controllers.
 3. Computers and networks for Human Machine Interface (HMI).
 4. Applications Software: Provided by Contractor for PLCs and HMI.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section and other PIC subsections:
1. American National Standards Institute (ANSI).
 2. ASTM International (ASTM):
 - a. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - c. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - d. B32, Standard Specification for Solder Metal.
 - e. B88, Standard Specification for Seamless Copper Water Tube.
 3. Deutsche Industrie-Norm (DIN): VDE 0611, Specification for modular terminal blocks for connection of copper conductors up to 1,000V ac and up to 1,200V dc.

4. Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
5. International Society of Automation (ISA):
 - a. RP12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety.
 - b. S5.1, Instrumentation Symbols and Identification.
 - c. S5.4, Instrument Loop Diagrams.
 - d. S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
 - e. TR20.00.01, Specification Forms for Process Measurement and Control Instruments, Part 1: General.
6. International Conference on Energy Conversion and Application (ICECA).
7. National Electrical Code (NEC).
8. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. ICS 1, Industrial Control and Systems General Requirements.
9. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
10. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
11. Underwriters Laboratory, Inc. (UL): 508A, Standard for Safety, Industrial Control Panels.

1.03 DEFINITIONS

A. Abbreviations:

1. DCU: Distributed Control Unit.
2. FDT: Factory Demonstration Test.
3. HMI: Human-Machine Interface.
4. HVAC: Heating, Ventilating, and Air Conditioning.
5. I&C: Instrumentation and Control.
6. I/O: Input and Output.
7. O&M: Operation and Maintenance.
8. P&ID: Process and Instrument Diagram.
9. PC: Personal Computer.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

10. PIC: Process Instrumentation and Control.
 11. PLC: Programmable Logic Controller.
 12. RTU: Remote Terminal Unit.
 13. SCADA: Supervisory Control and Data Acquisition.
 14. SLDC: Single Loop Digital Controller.
 15. SSDT: Staging Site Demonstration Test.
- B. Enclosure: Control panel, console, cabinet, or instrument housing.
- C. Instructor Day: Eight hours of actual instruction time.
- D. Standard Software: Software packages that are independent of Project on which they are used. Standard software includes system software, supervisory control, and data acquisition (SCADA) software.
1. System Software: Application independent (non-project specific) software developed by digital equipment manufacturers and software companies. Includes, but is not limited to, operating systems; network support, programming languages (C, C++, Visual C++, BASIC, Visual Basic, etc); Office Suites (word processor, spreadsheet, database, etc.); e-mail; security (firewall, antivirus; spam, spyware, etc.) debugging aids; and diagnostics.
 2. SCADA Software: Software packages independent of specific process control project on which they are used. Includes, but is not limited to, providing configuring and run-time capability for, data acquisition (I/O driver, OPC servers, etc.), monitoring, alarming, human-machine interface, supervisory control, data collection, data retrieval, trending, report generation, control, and diagnostics.
 3. Controller Programming Software: Software packages for the configuring of PLCs, RTUs, DCUs, SLDC, and fieldbus devices.
- E. Application Software: Software to provide functions unique to this Project and that are not provided by standard software alone, including but not limited to:
1. Configuring databases, tables, displays, historians, reports, parameter lists, ladder logic, function block, and control strategies required to implement functions unique to this Project.
 2. Programming in any programming or scripting language.
- F. Rising/Falling: Define action of discrete devices about their setpoint.
1. Rising: Contacts close when an increasing process variable rises through setpoint.

2. Falling: Contacts close when a decreasing process variable falls through setpoint.

G. Signal Types:

1. Analog Signal, Current Type:
 - a. 4 to 20 mA dc signals conforming to ISA S50.1.
 - b. Unless otherwise indicated for specific PIC subsection components, use the following ISA S50.1 options.
 - 1) Transmitter Type: Number 2, two-wire.
 - 2) Transmitter Load Resistance Capacity: Class L.
 - 3) Fully isolated transmitters and receivers.
2. Analog Signal, Voltage Type: 1 to 5 volts dc within panel where common high precision dropping resistor is used.
3. Discrete signals, two-state logic signals using dc or 120V ac sources as indicated.
4. Pulse Frequency Signals:
 - a. Direct-current pulses whose repetition rate is linearly proportional to process variable.
 - b. Pulses generated by contact closures or solid state switches.
 - c. Power source less than 30V dc.
5. Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

1.04 SYSTEM DESCRIPTION

A. UV Operation:

1. As part of this project, UV disinfection is being installed on the discharge of transfer pumps 4-6 to serve as an additional disinfection process. When UV is in operation, the filtered water will flow through clearwell 1 and clearwell 2, then all the plant water is pumped by transfer pumps 4-6 to the reservoir. When UV is in operation, transfer pumps 1-3 will not be operational. Water will flow from clearwell 1 into clearwell 2 through an interconnecting pipe where both valves must be open.
2. When the UV system is not in operation, the UV disinfection system will remain deenergized/offline and flow from clearwell 2 only will be pumped by transfer pumps 4-6 and pass through the UV reactors, flowmeters and piping. The inlet and outlet automatic isolation valves (FV-100, FV-200, FCV-125, FCV-225) shall be controlled by the UV Master Control Panel (UV MCP) and shall remain OPEN to allow flow to pass to the reservoir uninterrupted. All manual valves in the

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- Transfer Pump 4-6 system will also remain OPEN unless a pump or UV reactor is taken out of service for maintenance. When UV is not in operation, transfer pumps 1–3 will be operational. Water will flow from clearwell 1 only to transfer pumps 1-3. The valves on the interconnecting pipe between clearwells 1 and 2 must be closed.
3. An operator selectable toggle button shall be provided in the UV MCP or via SCADA to select a UV DISINFECTION ACTIVE mode or UV DISINFECTION NOT ACTIVE mode. Under UV DISINFECTION ACTIVE mode, control of the duty/standby UV reactors and inlet/outlet isolation valves, management of UV system status, data and alarms, off-specification and total flow measurement and totalization shall become active for each UV reactor (UVR-1, UVR-2). Under UV DISINFECTION NOT ACTIVE mode, continuous flow measurement and totalization shall be obtained from each flowmeter (FQM 105 and FQM 205) and an offline status node shall be provided for each UV reactor; but no off-specification water volume should be reported under this mode of operation.
 4. When UV disinfection is required, one duty UV reactor shall be energized while the other serve as an active standby UV reactor. The inlet and outlet automatic isolation valves for the standby UV reactor shall be CLOSED to force all flow through the duty UV reactor. Duty UV reactor inlet and outlet valves shall remain OPEN during UV reactor STARTUP and DISINFECTION modes. Off-specification water produced during the UV reactor warm-up period (5 minutes or less) shall be calculated by the UV reactor local control panel and reported to the UV Master Control Panel and SCADA. UV system operational and alarm data shall be reported from the UV system to the UV master control panel and SCADA, as specified herein. Transfer pumps 1–3 shall be turned OFF and FV-300 set to OPEN. Water will flow from clearwell 1 into clearwell 2 through the 30 inches FW interconnecting pipe. All the plant water flow will be pumped to the finished water reservoir through transfer pumps 4–6 and UV reactors (UVR-1 or UVR-2).
 5. Selection of the Duty UV reactor shall be selectable via OIU on the UV MCP. Lead-lag UV reactor shall be swapped at least every 7 days automatically as well as provided with a manual toggle button. If the duty UV reactor enters a major or critical alarm condition (as defined by the UV system supplier), the lag UV reactor shall be turned ON and inlet/outlet valves Opened while the duty UV reactor shall be turned OFF and inlet/outlet valves Closed. A lag timer shall be included to ensure flow through the UV piping is maintained at Transfer Pump 4-6 setpoints. Off-specification water produced during the UV reactor warm-up period (5 minutes or less) or UV shutdown and valve closure shall be calculated by the UV reactor local control panel and reported to the UV Master Control Panel and SCADA.

6. If neither the UV reactor is available in UV DISINFECTION ACTIVE mode, an alarm condition shall be generated in the UV MCP OIU and at SCADA. The lead UV reactor inlet/outlet valves shall remain OPEN. Off-specification water produced shall be calculated by the duty UV reactor local control panel and reported to the UV Master Control Panel and SCADA.
7. Additional alarm conditions to be reported at the UV MCP and SCADA include:
 - a. UV DISINFECTION ACTIVE mode; FCV-300 CLOSED or set to LOCAL mode.
 - b. UV DISINFECTION ACTIVE mode; UV system inlet/outlet valves (FV-100, FV-200, FCV-125, FCV-225) set to LOCAL mode, or Fail to Open or Close when commanded.
 - c. UV DISINFECTION ACTIVE mode; any of the Transfer Pumps 1-3 ON.
 - d. UV DISINFECTION ACTIVE mode; all Transfer Pumps 4-6 OFF.
 - e. UV DISINFECTION ACTIVE mode; zero flow through both FIT 105 or FIT 205.
 - f. UV DISINFECTION ACTIVE mode; loss of communication with UV LCP 1 or UV LCP 2.
 - g. UV DISINFECTION ACTIVE mode; loss of UVT signal AE 340 or AE 350.
 - h. Wet floor detection.

B. Chloramine Disinfection:

1. Filtered water is disinfected with chlorine and ammonia to form chloramines. The chlorine and ammonia are added before clearwells 1 and 2 through separate chemical lines to each clearwell influent. This will not change whether UV is on or off. Currently, total chlorine, free chlorine, and free ammonia are measured at the effluent of clearwell 1 on the transfer pumps 1–3 discharge pipe and at the effluent of clearwell 2 on the transfer pumps 4–6 discharge pipe.
2. A new sample location and analyzer will be added on the new pipe connecting clearwells 1 and 2. This location will be used to measure chloramination parameters in clearwell 1 during UV disinfection. When UV disinfection is in operation, the new sample pump on the interconnect pipe downstream of Clearwell 1 shall be turned ON and manual isolation valves selected to send this water to the new or existing water quality analyzers measuring chloramination parameters in water from clearwell 1. When UV is not in operation, the existing sample location on the discharge of transfer pumps 1-3 will be used and

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- the new sample pump on the interconnect pipe downstream of Clearwell 1 will be turned OFF. Operators can manually select to send this water to the new analyzers or existing analyzers.
3. The sample location on the discharge of transfer pumps 4–6 will also be equipped with a new analyzer. When UV is in operation, this location will indicate chloramination conditions on the blend of water from clearwells 1 and 2 and can be used to adjust chloramination parameters in clearwell 2. When UV is not in operation, this sample location will still be used and operators can adjust manual valves to send this water to the new or existing water quality analyzers measuring chloramination parameters in water from clearwell 2.
- C. Detailed Wiring Design: Panel wiring diagrams, interconnecting wiring diagrams, and loop wiring diagrams are included in Contract Drawings and designed to completely show control panel wiring, terminations, wire numbers, interfaces with other systems, hardwired functions, interlocks, and wiring of components to be provided.
- D. Design Requirements:
1. Complete detailed design of PIC components and PIC drawings.
 2. Provide consistent hardware and software functions for PIC. For example, provide functions in control logic, sequence controls, and display layouts in same or similar manner.
 3. PIC design as shown and specified includes:
 - a. Functional requirements, performance requirements, and component specifications.
 - b. P&IDs, block diagrams, and network diagrams.
 4. Typical drawings for installation details, control panel layouts, control panel schedules, PLC I/O module wiring, panel power, and control diagrams.
- E. Use a qualified PIC System Integrator for at least the following work:
1. For PIC Equipment and Ancillaries:
 - a. Completing detail design.
 - b. Submittals.
 - c. Equipment, enclosures, and ancillaries.
 - d. Instructions, details, and recommendations to, and coordination with Contractor for Certificate of Proper Installation.
 - e. Verify readiness for operation.
 - f. Verify correctness of final power and signal connections (lugging and connecting).
 - g. Adjusting and calibrating.

- h. Starting up.
 - i. Testing and coordination of testing.
 - j. Training.
 - k. Assist Engineer with Functional Test Part 2 as defined in Article Field Quality Control.
2. Verify following Work not by PIC System Integrator is provided:
- a. Correct type, size, and number of signal wires with their raceways.
 - b. Correct electrical power circuits and raceways.
 - c. Correct size, type, and number of PIC-related pipes, valves, fittings, and tubes.
 - d. Correct size, type, materials, and connections of process mechanical piping for in-line primary elements.
3. NonPIC Equipment Directly Connected to PIC Equipment:
- a. Obtain from Contractor, manufacturers' information on installation, interface, function, and adjustment.
 - b. Coordinate with Contractor to allow required interface and operation with PIC.
 - c. For operation and control, verify installations, interfacing signal terminations, and adjustments have been completed in accordance with manufacturer's recommendations.
 - d. Test to demonstrate required interface and operation with PIC.
 - e. Examples of items in this category, but not limited to the following:
 - 1) Valve operators, position switches, and controls.
 - 2) Chemical feed pump and feeder speed/stroke controls.
 - 3) Automatic samplers.
 - 4) Motor control centers.
 - 5) Adjustable speed and adjustable frequency drive systems.
 - f. Examples of items not in this category:
 - 1) Internal portions of equipment provided under Division 26, Electrical, that are not directly connected to PIC equipment.
 - 2) Internal portions of package system instrumentation and controls that are not directly connected to PIC equipment.
- F. PIC System Integrator shall be:
- 1. Commerce Controls, Inc.
 - 2. UIS, Utility Instrumentation Services.
 - 3. No equal.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

1.05 SUBMITTALS

A. General:

1. Submit proposed Submittal breakdown consisting of sequencing and packaging of information in accordance with Project Schedule.
2. Partial Submittals not in accordance with Project Schedule will not be accepted.
3. Submittal Format:
 - a. Hard Copy: Required for all submittals.
 - b. Electronic Copies: Required, unless otherwise noted for specific items.
 - 1) Manufacturers' Standard Documents: Adobe Acrobat PDF.
 - 2) Documents created specifically for Project:
 - a) Text and Graphics: Microsoft Word.
 - b) Lists: Microsoft Excel, unless otherwise noted for specific items.
 - c) Drawings: AutoCAD.
4. Identify proposed items, options, installed spares, and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).
5. Legends and Abbreviation Lists:
 - a. Definition of symbols and abbreviations used; for example, engineering units, flowstreams, instruments, structures, and other process items used in nameplates, legends, data sheets, point descriptions, HMI displays, alarm/status logs, and reports.
 - b. Use identical abbreviations in PIC subsections.
 - c. Submit updated versions as they occur.
6. Activity Completion:
 - a. Action Submittals: Completed when reviewed and approved.
 - b. Informational Submittals: Completed when reviewed and found to meet conditions of the Contract.

B. Action Submittals:

1. Bill of Materials: List of required equipment.
 - a. Group equipment items by enclosure and field, and within an enclosure, as follows:
 - 1) PIC Components: By component identification code.
 - 2) Other Equipment: By equipment type.
 - b. Data Included:
 - 1) Equipment tag number.
 - 2) Description.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- 3) Manufacturer, complete model number and all options not defined by model number.
 - 4) Quantity supplied.
 - 5) Component identification code where applicable.
 - 6) For panels, include panel reference number and name plate inscription.
- c. Formats: Hard copy and Microsoft Excel.
2. Catalog Cuts: I&C components, electrical devices, and mechanical devices:
- a. Catalog information, marked to identify proposed items and options.
 - b. Descriptive literature.
 - c. External power and signal connections.
 - d. Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.
3. Instrument List:
- a. Engineer will provide an initial Instrument List in Microsoft Excel. Data from this may be used as starting point for creating final Instrument List and Component Data Sheets.
 - b. Applicable fields to be completed include, but are not limited to:

Instrument List Characteristics	
Item	Initially Completed By
Tag Number	Engineer
Loop Number	Engineer
Description	Engineer
Manufacturer and complete model number	Contractor
Size and scale range	Engineer
Setpoints	Engineer
Reference P&IDs, Electrical, Mechanical, Interconnection Drawings and Installation Details Drawings	Engineer
Instrument detail number	Engineer

- c. Submit updated version of Instrument List.
- d. Electronic Copies: Microsoft Excel.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

4. Component Data Sheets: Data sheets for I&C components.
 - a. Format:
 - 1) Similar to ISA TR20.00.01.
 - 2) Microsoft Excel, one component per data sheet.
 - 3) Submit proposed format for Component Data Sheets before completing data sheets for individual components.
 - b. Content: Specific features and configuration data for each component, including but not limited to:
 - 1) Tag Number.
 - 2) Component type identification code and description.
 - 3) Location or service.
 - 4) Service conditions.
 - 5) Manufacturer and complete model number.
 - 6) Size and scale range.
 - 7) Setpoints.
 - 8) Materials of construction.
 - 9) Options included.
 - 10) Power requirements.
 - 11) Signal interfaces.
 - 12) Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.
 - c. Electronic Copies: Microsoft Excel.
5. Sizing and Selection Calculations:
 - a. Primary Elements:
 - 1) Complete calculations plus process data used. Example for Flow Elements:
 - a) Minimum and maximum values, permanent head loss, and assumptions made.
 - b. Controller, Computing, and Function Generating Modules: Actual scaling factors with units and how they were computed.
 - c. Electronic Copies: Microsoft Excel, one file for each group of components with identical sizing calculations.
6. Preliminary Panel Elevation Drawings: Provide prior to submitting Panel Construction Drawings:
 - a. Scale Drawings: Show dimensions and location of front of panel devices.
 - b. Panel Legend (Bill of Material): List front of panel devices by tag number. Include nameplate inscriptions, service legends, and annunciator inscriptions.
 - c. Submit electronic copies of Drawings.
7. Panel Construction Drawings:
 - a. Scale Drawings: Show dimensions and locations of panel-mounted devices, doors, louvers, subpanels, internal and external.

- b. Panel Legend (Bill of Material): List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
 - c. Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
 - d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
 - e. Construction Notes: Finishes, wire color schemes, wire ratings, wire, terminal block numbering, and labeling scheme.
 - f. Submit electronic copies of Drawings.
8. Detailed Wiring Diagrams:
- a. Refer to Drawings for Detailed Wiring Diagrams including:
 - 1) Panel Wiring Diagrams for discrete control and power circuits.
 - 2) Loop Wiring Diagrams showing individual wiring diagram for each analog or pulse frequency loop.
 - 3) Interconnecting Wiring Diagrams showing electrical connections between equipment, consoles, panels, terminal junction boxes, and field-mounted components.
 - b. Prepare as-built redline markup of detailed wiring diagrams. Show terminal numbers on switch blocks, relays, and internal components.
 - c. Submit electronic copies of Drawings.
9. Panel Wiring Diagrams:
- a. Cover wiring within a panel including, but not limited to, instrumentation, control, power, and communications, and digital networks.
 - b. Objectives: For use in wiring panels, making panel connections, and future panel trouble shooting.
 - c. Diagram Type:
 - 1) Ladder diagrams where applicable in a format similar to those shown on Drawings. Include devices that are mounted in or on the panel that require electrical connections. Show unique rung numbers on left side of each rung.
 - 2) Schematic drawings for wiring of circuits that cannot be well represented by ladder diagrams.
 - d. Item Identification: Identify each item with attributes listed.
 - 1) Wires: Wire number and color. Cable number if part of multiconductor cable.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- 2) Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.
 - 3) Components:
 - a) Tag number, terminal numbers, and location (“FIELD”, enclosure number, or MCC number).
 - b) Switching action (open or close on rising or falling process variable), setpoint value and units, and process variable description (for example, Sump Level High).
 - 4) I/O Points: PLC unit number, I/O tag number, I/O address, terminal numbers, and terminal strip numbers.
 - 5) Relay Coils:
 - a) Tag number and its function.
 - b) On right side of run where coil is located, list contact location by ladder number and sheet number.
Underline normally closed contacts.
 - 6) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
 - 7) Communications and Networks: Network type, address or node identification, port or channel number, and type of connector.
- e. Show each circuit individually. No “typical” diagrams or “typical” wire lists will be allowed.
 - f. Ground wires, surge protectors, and connections.
 - g. Wire and Cable Names: Show names and wire color for circuits entering and leaving a panel. Refer to Division 26, Electrical.
10. Loop Wiring Diagrams: Individual, end-to-end wiring diagram for each analog and discrete or equipment loop.
- a. Conform to the minimum requirements of ISA S5.4.
 - b. Under Paragraph 5.3 of ISA S5.4, include the information listed under Subparagraphs 2 and 6.
 - c. Show loop components within a panel and identify each component, component terminals, and panel terminals.
 - d. If a loop connects to panels or devices not provided under this section and its subsections, such as control valves, motor control centers, package system panels, variable speed drives, include the following information:
 - 1) Show the first component connected to within the panel or device that is not provided under this section and its subsections.
 - 2) Identify the component by tag and description.
 - 3) Identify panel and component terminal numbers.

- e. Drawing Size: Individual 11-inch by 17-inch sheet for each loop.
 - f. Divide each loop diagram into areas for panel face, back-of-panel, field and PLC.
 - g. One Drawing Per Loop: Show each loop individually. No “typical” loop diagrams will be allowed.
 - h. Show:
 - 1) Terminal numbers, location of dc power supply, and location of common dropping resistors.
 - 2) Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.
 - 3) Tabular summary on each analog loop diagram:
 - a) Transmitting Instruments: Output capability.
 - b) Receiving Instruments: Input impedance.
 - c) Loop Wiring Impedance: Estimate based on wire sizes and lengths shown.
 - d) Total loop impedance.
 - e) Reserve output capacity.
 - 4) Circuit and raceway schedule names.
 - i. Loop drawings shall not be required if only one device and/or all connections can be clearly shown on I/O module drawings.
11. Communications and Digital Networks Diagrams:
- a. Scope: Includes connections to telephone system, Ethernet network, remote I/O, and fieldbus (for example, Modbus, Profibus, Foundation Fieldbus, Device Net, etc.).
 - b. Format: Network schematic diagrams for each different type of network.
 - c. Show:
 - 1) Interconnected devices, both passive and active.
 - 2) Device names and numbers.
 - 3) Terminal numbers.
 - 4) Communication Media: Type of cable.
 - 5) Connection Type: Type of connector.
 - 6) Node and device address numbers.
 - 7) Wire and cable numbers and colors.
12. Panel Power Requirements and Heat Dissipation: For control panels tabulate and summarize:
- a. Required voltages, currents, and phases(s).
 - b. Maximum heat dissipations Btu per hour.
 - c. Calculations.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- d. Steady State Temperature Calculations: For nonventilated panels, provide heat load calculations showing the panel estimated internal steady state temperature for ambient air temperatures of 90 degrees F.
13. Panel Plumbing Diagrams: For each panel containing piping and tubing. Show type and size for:
 - a. Pipes and Tubes: Thickness, pressure rating, and materials.
 - b. Components: Valves, regulators, and filters.
 - c. Connections to panel-mounted devices.
 - d. Panel interface connections.
 - e. Submit electronic copies of Drawings.
14. Installation Details: Include modifications or further details required and define installation of I&C components.
15. Spares, expendables, and test equipment.
16. Electronic Copies: Microsoft Excel.
17. PLC I/O List:
 - a. Managed by Engineer:
 - 1) During construction Engineer will maintain PLC I/O List and give electronic Microsoft Excel copies to PIC System Integrator.
 - 2) Engineer will assign PLC I/O points to specific chassis, slot, and point addresses.
 - b. PLC I/O List Changes: Changes to PLC I/O List reflecting actual equipment and instrumentation provided.
 - 1) Mark up electronic file of latest PLC I/O List from Engineer. Highlight changed cells with yellow, new rows with red, and rows to be deleted with green.
 - 2) Submit marked up copies changes at 30-day intervals.
18. PLC I/O List: Submit I/O assignment and Rack/Slot/Point.
19. Shop Drawings for Changes Impacting PLC and SLDC Programming:
 - a. Submit details of changes required to PLC and SLDC monitoring and control resulting from installation of alternative or upgraded process equipment and instrumentation, and other causes.
 - b. Submit changes at 30-day intervals.
20. Color schedule for control panels.
21. Applications Software Documentation: For equipment for which Engineer does not provide applications software provide:
 - a. Complete configuration documentation for microprocessor based programmable devices.
 - b. For each device, include program listings and function block diagrams, as appropriate, showing:
 - 1) Functional blocks or modules used.
 - 2) Configuration, calibration, and tuning parameters.
 - 3) Descriptive annotations.
 - c. Refer to PIC subsections for additional requirements.

C. Informational Submittals:

1. Statements of Qualification:
 - a. PIC System Integrator.
 - b. PIC System Integrator's site representative.
 - c. Resume for each PIC System Integrator's onsite startup and testing team member (engineers, technicians, and software/configuring personnel).
2. Operation and Maintenance Data: In accordance with Section 01 78 23, Operation and Maintenance Data, and in addition the following:
 - a. General:
 - 1) Provide sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for PIC components.
 - 2) Submittal Format: Both hard copy and electronic copies for all submittals. Refer to Article Submittals, heading Submittal Format.
 - b. Final versions of Legend and Abbreviation Lists.
 - c. Process and Instrumentation Diagrams: Marked up copy of revised P&ID to reflect as-built PIC design.
 - d. Provide the following items as defined under heading Action Submittals:
 - 1) Bill of materials.
 - 2) Catalog cuts.
 - 3) Instrument list.
 - 4) Component data sheets.
 - 5) Detailed Wiring Diagrams: As-built drawings.
 - a) Panel wiring diagrams.
 - b) Loop diagrams.
 - c) Interconnecting wiring diagrams.
 - 6) Panel plumbing diagrams.
 - 7) Applications software documentation.
 - e. Manufacturer's O&M manuals for components, electrical devices, and mechanical devices:
 - 1) Content for Each O&M Manual:
 - a) Table of Contents.
 - b) Operations procedures.
 - c) Installation requirements and procedures.
 - d) Maintenance requirements and procedures.
 - e) Troubleshooting procedures.
 - f) Calibration procedures.
 - g) Internal schematic and wiring diagrams.
 - h) Component and I/O Module Calibration Sheets from field quality control calibrations.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- 2) Provide PDF file with linked index to all manuals.
 - f. List of spares, expendables, test equipment and tools provided.
 - g. List of additional recommended spares, expendables, test equipment, and tools. Include quantities, unit prices, and total costs.
 3. Provide Manufacturer's Certificate of Proper Installation where specified.
 4. Testing Related Submittals:
 - a. Factory Demonstration Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures:
 - a) Proposed test procedures, forms, and checklists.
 - b) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
 - 3) Test Documentation: Copy of signed off test results.
 - b. Staging Site Demonstration Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
 - 3) Test Documentation: Copy of signed-off test results when tests are completed.
 - c. Functional Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
 - 3) Test Documentation:
 - a) Copy of signed-off test results.
 - b) Completed component calibration sheets.
 - d. Performance Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
 - 3) Test Documentation: Copy of signed-off test results.
 5. Owner Training Plan: In accordance with Section 01 43 33, Manufacturers' Field Services.

6. Maintenance Service Agreement: Prior to Substantial Completion, submit service agreements signed by Owner and maintenance provider for work required under Article Maintenance Service.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. PIC System Integrator: Minimum of 10 years' experience providing, integrating, installing, and starting up similar systems as required for this Project.
2. PIC System Integrator's Site Representative: Minimum of 5 years' experience installing systems similar to PIC required for this Project.

B. PIC Coordination Meetings:

1. General: Refer to Section 01 31 19, Project Meetings, for PIC coordination meetings.
2. PIC Schedule Coordination Meeting:
 - a. Timing: Following Engineer review of PIC Schedule.
 - b. Purpose: Discuss Engineer's comments and resolve scheduling issues.
3. Training Coordination Meeting:
 - a. Timing: Following Engineer review of preliminary training plan.
 - b. Purpose:
 - 1) Resolve required changes to proposed training plan.
 - 2) Identify specific Owner personnel to attend training.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 61 00, Common Product Requirements.
- B. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers, and related equipment as recommended by capsule manufacturer.
- C. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.
- D. Cover panels and other elements that are exposed to dusty construction environments.

1.08 SEQUENCING AND SCHEDULING

- A. Refer to Section 01 31 13, Project Coordination, for Contractor's scheduling requirements for applications software testing.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. Prerequisite Activities and Lead Times: Do not start following key Project activities until prerequisite activities and lead times listed below have been completed and satisfied:
1. Shop Drawing Reviews by Engineer:
 - a. Prerequisite: Engineer acceptance of Schedule of Values and Progress Schedule.
 - b. Schedule: In accordance with completed schedule of Shop Drawing and Sample submittals specified in Section 01 33 00, Submittal Procedures.
 2. Test Prerequisite: Associated test procedures Submittals completed.
 3. Training Prerequisite: Associated training plan Submittal completed.
 4. PLC and HMI Configuration Training Session 1 Prerequisite: PLC and HMI hardware and software Shop Drawings approved.
 5. Equipment Delivered to Staging Site: Refer to PIC subsections for a definition of this equipment.
 - a. Prerequisites:
 - 1) PLC and HMI applications software configuration completed.
 - 2) FDT completed.
 6. Staging Site Demonstration Test Prerequisite: PLC and HMI staging equipment delivered to staging site.
 7. PLC and HMI Shipment to Site:
 - a. General Prerequisites:
 - 1) Approval of PIC Shop Drawings and preliminary operation and maintenance data.
 - 2) FDT and SSDT completed.
 8. PLC and HMI Installation Prerequisite: Equipment received at Site.
 9. Functional Test Part 1 Prerequisite: PLC and HMI installation complete.
 10. Functional Test Part 2 Prerequisite: Functional Test Part 1 completed.
 11. Performance Test Prerequisite: Functional Test Part 2 completed and facility started up.

1.09 MAINTENANCE

- A. Maintenance Service Agreement:
1. Duration of 1 year, unless otherwise noted in PIC subsections.
 2. Start on date of Substantial Completion.
 3. Performed by factory-trained service engineers with experience on PIC systems to be maintained.
 4. PIC Systems Covered: PIC components.
 5. Materials and labor for demand maintenance with coverage 8:00 a.m. to 5:00 p.m. 7 days a week.

- 6. Response Time: Service engineer shall be onsite within 24 hours of request by Owner.
- 7. Spare Parts: If not stocked onsite, delivered to Site within 24 hours from time of request.
- 8. Repair or replace components or software found to be faulty.
- 9. Replace and restock within 1 month onsite spare parts and expendables used for maintenance. Provide list of items used and replaced.
- 10. Submit records of inspection, maintenance, calibration, repair, and replacement within 2 weeks after each Site visit.

- B. Telephone Support: As specified in PIC subsections.
- C. Software Subscription: As specified in PIC subsections.

1.10 EXTRA MATERIALS

- A. As specified in PIC subsections.
- B. In computing spare parts quantities based on specified percentages, round up to nearest whole number.
- C. Spare Parts:

Description	Percent of Each Type and Size Used	No Less Than
Annunciator light bulbs	20	2
dc power supplies	20	2
Fuses	20	5
Indicating light bulb	20	5
Relays	20	3
Terminal Blocks	10	10
Hand Switches and Lights	10	1
Surge Suppressors	10	2

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide PIC functions shown on Drawings and required in PIC subsections for each system and loop. Furnish equipment items required in PIC subsections. Furnish materials, equipment, and software, whether indicated or not, necessary to effect required system and loop performance.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. First Named Manufacturer: PIC design is based on first named manufacturers of equipment, materials, and software.
 - 1. If an item is proposed from other than first named manufacturer, obtain approval from Engineer for such changes in accordance with the General Conditions, Article 6.05 Substitutes and “Or-Equals”.
 - 2. If proposed item requires, but not limited to, different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories, provide such equipment and work.
- C. Like Equipment Items:
 - 1. Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer’s services.
 - 2. Implement same or similar functions in same or similar manner. For example control logic, sequence controls, and display layouts.
- D. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 I&C COMPONENTS

- A. Specifications: Refer to Section 40 91 00, Instrumentation and Control Components, for specifications for I&C components.
- B. Components for Each Loop: Major components for each loop are listed in Instrument List referenced in Article Supplements. Furnish equipment that is necessary to achieve required loop performance.

2.03 PROGRAMMABLE LOGIC CONTROLLERS

- A. Reference PLC Equipment List in Article, Supplements, and PLC components in Section 40 91 00, Instrumentation and Control Components.

2.04 FIELD BUS, NETWORK, AND HMI COMPONENTS

- A. Reference PIC subsections.

2.05 SERVICE CONDITIONS

- A. Standard Service Conditions: The following defines certain types of environments. PIC subsections refer to these definitions by name to specify the service conditions for individual equipment units. Design equipment for continuous operation in these environments:
1. Computer Room, Air Conditioned:
 - a. Temperature: 60 degrees F to 80 degrees F.
 - b. Relative Humidity: 40 percent to 60 percent.
 - c. NEC Classification: Nonhazardous.
 2. Inside, Air Conditioned:
 - a. Temperature:
 - 1) Normal: 60 degrees F to 80 degrees F.
 - 2) With Up to 4-Hour HVAC System Interruptions: 40 degrees F to 105 degrees F.
 - b. Relative Humidity:
 - 1) Normal: 10 percent (winter) to 70 percent (summer).
 - 2) With Up to 4-Hour HVAC System Interruption: 10 percent to 100 percent.
 - c. NEC Classification: Nonhazardous.
 3. Inside:
 - a. Temperature: 20 degrees F to 104 degrees F.
 - b. Relative Humidity: 10 percent to 95 percent noncondensing.
 - c. NEC Classification: Nonhazardous.
- B. Standard Service Conditions for Panels and Consoles: Unless otherwise noted, in Control Panel Schedule located in Article Supplements at End of Section, design equipment for continuous operation in these environments:
1. Freestanding Panel and Consoles:
 - a. Inside, Air Conditioned: NEMA 1.
 - b. Inside: NEMA 4X, 316 Stainless Steel.
 2. Field Elements: Outside.
- C. Special Environmental Requirements: Design following panels for continuous operation in environments listed.

2.06 NAMEPLATES AND TAGS

- A. Panel Nameplates: Enclosure identification located on enclosure face.
1. Location and Inscription: As shown on Drawings.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Materials: Laminated plastic attached to panel with stainless steel screws.
 3. Letters: 1/2-inch-high, black on white background, unless otherwise noted.
- B. Component Nameplates, Panel Face: Component identification located on panel face under or near component.
1. Location and Inscription: As shown on panel drawing.
 2. Materials: Adhesive-backed, laminated plastic.
 3. Letters: 3/16-inch-high, black on white background, unless otherwise noted.
- C. Component Nameplates, Back of Panel: Component identification located on or near component inside of enclosure.
1. Inscription: Component tag number.
 2. Materials: Adhesive-backed, laminated plastic.
 3. Letters: 3/16-inch-high, black on white background, unless otherwise noted.
- D. Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches.
1. Inscription:
 - a. Refer to table under Paragraph Standard Pushbutton Colors and Inscriptions.
 - b. Refer to table under Paragraph Standard Light Colors and Inscriptions.
 - c. Refer to P&IDs on Drawings.
 2. Materials: Laminated plastic, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.
 3. Letters: Black on gray or white background.
- E. Service Legends: Component identification nameplate located on face of component.
1. Inscription: As shown on panel drawing.
 2. Materials: Adhesive-backed, laminated plastic.
 3. Letters: 3/16-inch-high, black on white background, unless otherwise noted.
- F. Nametags: Component identification for field devices.
1. Inscription: Component tag number.

2. Materials: 16-gauge, Type 304 stainless steel.
3. Letters: 3/16-inch-high, imposed.
4. Mounting: Affix to component with 16-gauge or 18-gauge stainless steel wire or stainless steel screws.

2.07 MECHANICAL SYSTEM COMPONENTS

- A. Reference Section 40 91 00, Instrumentation and Control Components.

2.08 FUNCTIONAL REQUIREMENTS FOR CONTROL LOOPS

- A. Shown on Drawings, in panel control diagrams, and Process and Instrumentation Diagrams (P&ID). P&ID format and symbols are in accordance with ISA S5.1, except as specified or shown on Drawings.
- B. Supplemented by Loop Specifications that describe requirements not obvious on P&IDs or panel control diagrams.
- C. Supplemented by standard functional requirements in PIC subsections.

2.09 LOOP SPECIFICATIONS

- A. See Article Supplements located at End of Section.
- B. Organization: By unit process and loop number.
- C. Loop Subheadings:
 1. Hardwired Special Functions: Clarifies functional performance of loop, including abstract of interlocks for hard wired logic, for example in MCCs and control panels.
 2. PLC Special Functions: Specifies nonstandard PLC functions. When required for clarification, additional definition is shown by logic diagrams or sequence diagrams on Drawings.
 3. HMI Special Functions: Specifies nonstandard HMI functions.

2.10 ELECTRICAL REQUIREMENTS

- A. Electrical Raceways: As specified in Section 26 05 01, Electrical.
- B. Wiring External to PIC Equipment:
 1. Special Control and Communications Cable: Provided by PIC System Integrator as noted in Component Specifications and PIC subsections.
 2. Other Wiring and Cable: As specified in Section 26 05 01, Electrical.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- C. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.
- D. Wires within Enclosures:
 - 1. ac Circuits:
 - a. Type: 600-volt, Type MTW stranded copper.
 - b. Size: For current to be carried, but not less than No. 18 AWG.
 - 2. Analog Signal Circuits:
 - a. Type: 600-volt stranded copper, twisted shielded pairs or triad with a 100 percent, aluminum-polyester shield, rated 60 degrees C.
 - b. Panels with Circuits Less Than 600 volts: Rated at 600 volts. Belden No. 18 AWG Type 9341, Triad Beldon No. 1121A.
 - c. Size: No. 18 AWG, minimum.
 - 3. Other dc Circuits.
 - a. Type: 600-volt, Type MTW stranded copper.
 - b. Size: For current carried, but not less than No. 18 AWG.
 - 4. Special Signal Circuits: Use manufacturer's standard cables.
 - 5. Wire Identification: Numbered and tagged at each termination.
 - a. Wire Tags: Machine printed, heat shrink.
 - b. Manufacturers:
 - 1) Brady Perma Sleev.
 - 2) Tyco Electronics.
- E. Terminate and identify wires entering or leaving enclosures as follows:
 - 1. Analog and discrete signal, terminate at numbered terminal blocks.
 - 2. Special signals terminated using manufacturer's standard connectors.
 - 3. Identify wiring in accordance with requirements in Section 26 05 01, Electrical.
- F. Terminal Blocks for Enclosures:
 - 1. Quantity:
 - a. Accommodate present and spare indicated needs.
 - b. Wire spare PLC I/O points to terminal blocks.
 - c. One wire per terminal for field wires entering enclosures.
 - d. Maximum of two wires per terminal for No. 18 AWG wire for internal enclosure wiring.
 - e. Spare Terminals: 20 percent of connected terminals, but not less than 5 per terminal block, unless otherwise shown on Drawings.
 - 2. Terminal Block Types: Reference Section 40 91 00, Instrumentation and Control Components, Part 2, Article Electrical Components.

- G. Grounding of Enclosures:
1. Furnish isolated copper grounding bus for signal and shield ground connections.
 2. Ground this ground bus at a common signal ground point in accordance with National Electrical Code requirements.
 3. Single Point Ground for Each Analog Loop:
 - a. Locate signal ground at dc power supply for loop.
 - b. Use to ground wire shields for loop.
 4. Ground terminal block rails to ground bus.
- H. Analog Signal Isolators:
1. Furnish signal isolation for analog signals that are sent from one enclosure to another.
 2. Do not wire in series instruments on different panels, cabinets, or enclosures.
- I. Wiring Interface: Terminate and identify wiring entering or leaving enclosures.
1. Analog and Discrete Signal Wires: Terminate at numbered terminal blocks as shown on the wiring diagrams.
 2. Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer's standard connectors for the device to which the signals terminate.
- J. Electrical Transient Protection:
1. General:
 - a. Function: Protect elements of PIC against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.
 - b. Surge suppressors are not shown for external analog transmitters. Determine quantity and location, and show in Shop Drawings. Refer to example wiring in installation details in Drawings.
 - c. Provide, install, coordinate, and inspect grounding of surge suppressors at:
 - 1) Connection of ac power to PIC equipment including panels, consoles assemblies, and field-mounted analog transmitters and receivers.
 - 2) At the field and panel, console, or assembly connection of signal circuits that have portions of the circuit extending outside of a protective building.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Surge Suppressor Types: Reference Section 40 91 00, Instrumentation and Control Components, Part 2, Surge Suppressors.
3. Installation and Grounding of Suppressors:
 - a. As shown. See Surge Suppressor Installation Details.
 - b. Grounding equipment, installation of grounding equipment, and terminations for field mounted devices are provided under Division 26, Electrical.

2.11 PANEL FABRICATION

A. General:

1. Nominal Panel Dimensions: As shown on Drawings.
2. Instrument Arrangements: As shown on Drawings.
3. Panel Component Schedule: Refer to Control Panel Schedule in Article Supplements which provides a list by local control panel of major panel-mounted components for each panel. In case of a conflict between this list and Instrument List, Instrument List takes precedence. In case of a conflict between Panel Component Schedule and P&IDs, P&IDs take precedence.
4. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.
5. Fabricate panels, install instruments and wire, and plumb at PIC System Integrator's facility. No fabrication other than correction of minor defects or minor transit damage permitted onsite.
6. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL 508A.
7. Electrical Work: In accordance with the applicable requirements of Section 26 05 01, Electrical.

B. Temperature Control:

1. Freestanding Panels:
 - a. Nonventilated Panels: Size to adequately dissipate heat from equipment mounted inside panel and on panel.
 - b. Ventilated Panels:
 - 1) Furnish with louvers and forced ventilation as required to prevent temperature buildup from equipment mounted inside panel and on panel.
 - 2) For panels with backs against wall, furnish louvers on top and bottom of panel sides.
 - 3) For panels without backs against wall, furnish louvers on top and bottom of panel back.
 - 4) Louver Construction: Stamped sheet metal.

- 5) Ventilation Fans:
 - a) Furnish where required to provide adequate cooling.
 - b) Create positive internal pressure within panel.
 - c) Fan Motor Power: 120V ac, 60-Hz, thermostatically controlled.
 - 6) Air Filters: Washable aluminum, Hoffman Series A-FLT.
 - c. Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation.
 2. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel and on panel face.
 3. Space Heaters:
 - a. Thermostatically controlled to maintain internal panel temperatures above dewpoint.
 - b. Refer to Control Panel Schedule in Article Supplements.
- C. Freestanding Panel Construction:
1. Materials:
 - a. Sheet steel, unless otherwise shown on Drawings.
 - b. Minimum Thickness: 10-gauge, unless otherwise noted.
 2. Panel Front:
 - a. Fabricated from a single piece of sheet steel, unless otherwise shown on Drawings.
 - b. No seams or bolt heads visible when viewed from front.
 - c. Panel Cutouts: Smoothly finished with rounded edges.
 - d. Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.
 3. Internal Framework:
 - a. Structural steel for instrument support and panel bracing.
 - b. Permit panel lifting without racking or distortion.
 4. Lifting rings to allow simple, safe rigging and lifting of panel during installation.
 5. Adjacent Panels: Securely bolted together so front faces are parallel.
 6. Door:
 - a. Full height, fully gasketed access door where shown on Drawings.
 - b. Latch: Three-point, Southco Type 44.
 - c. Handle: "D" ring, foldable type.
 - d. Hinges: Full-length, continuous, piano-type, steel hinges with stainless steel pins.
 - e. Rear Access: Extend no further than 24 inches beyond panel when opened to 90-degree position.
 - f. Front and Side Access Doors: As shown on Drawings.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

D. Nonfreestanding Panel Construction:

1. Based on environmental design requirements and referenced in Article Environmental Requirements, provide the following unless otherwise noted in Control Panel Schedule in Article Supplements:
 - a. Panels listed as inside, air conditioned:
 - 1) Enclosure Type: NEMA 4X.
 - 2) Materials: Type 316 stainless steel.
 - b. Other Panels:
 - 1) Enclosure Type: NEMA 4X.
 - 2) Materials: Type 316 stainless steel.
2. Metal Thickness: 14-gauge, minimum.
3. Doors:
 - a. Rubber-gasketed with continuous hinge.
 - b. Stainless steel lockable quick-release clamps.
4. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. H. F. Cox.
 - c. Or approved equal.

E. Breather and Drains: Furnish with NEMA 250, Type 4 and 4X panels:

1. Manufacturer and Product: Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1-N4D, Breather Model ECD1-N4B.

F. Control Panel Electrical:

1. Power Distribution within Panels:
 - a. Feeder Circuits:
 - 1) One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.
 - 2) Make provisions for feeder circuit conduit entry.
 - 3) Furnish terminal block for termination of wires.
 - b. Power Panel: Furnish main circuit breaker and circuit breaker on each individual branch circuit distributed from power panel.
 - 1) Locate to provide clear view of and access to breakers when door is open.
 - 2) Breaker Sizes: Coordinate such that fault in branch circuit will blow only branch breaker, but not trip main breaker.
 - a) Branch Circuit Breakers: 15 amps at 250V ac.
 - 3) Breaker Manufacturers and Products: Refer to Section 26 05 01, Electrical.

- c. Circuit Wiring: P&IDs and Control Diagrams on Drawings show detailed wiring diagrams that use the following rules for circuit wiring:
 - 1) Devices on Single Circuit: 20, maximum.
 - 2) Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.
 - 3) Branch Circuit Loading: 12 amperes continuous, maximum.
 - 4) Panel Lighting and Service Outlets: Put on separate 15 amp, 120V ac branch circuit.
 - 5) Provide 120V ac plugmold for panel components with line cords.
- 2. Signal Distribution:
 - a. Signal Wiring: Separate analog signal cables from power and control within a panel and cross at right angles where necessary.
 - b. Within Panels: 4 to 20 mA dc signals may be distributed as 1V dc to 5V dc.
 - c. Outside Panels: Isolated 4 to 20 mA dc only.
 - d. Signal Wiring: Twisted shielded pairs.
 - e. RTD and Thermocouple Extension Cable:
 - 1) Continuous field to panel with no intermediate junction boxes or terminations.
 - 2) RTDs in motor windings are considered a 600-volt circuit.
 - 3) Terminate thermocouple extension wire directly to loop instrument.
- 3. Signal Switching:
 - a. Use dry circuit type relays or switches.
 - b. No interruption of 4 to 20 mA loops during switching.
 - c. Switching Transients in Associated Signal Circuit:
 - 1) 4 to 20 mA dc Signals: 0.2 mA, maximum.
 - 2) 1V dc to 5V dc Signals: 0.05V, maximum.
- 4. Relay Types: Reference Section 40 91 00, Instrumentation and Control Components, Part 2, Article Electrical Components.
- 5. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.
- 6. Internal Panel Lights for Freestanding Panels:
 - a. Type: Switched 100-watt incandescent back-of-panel lights.
 - b. Quantity: One light for every 4 feet of panel width.
 - c. Mounting: Inside and in the top of back-of-panel area.
 - d. Protective metal shield for lights.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

7. Service Outlets for Freestanding Panels:
 - a. Type: Three-wire, 120-volt, 15-ampere, GFCI GFCI duplex receptacles.
 - b. Quantity:
 - 1) Panels 4 Feet Wide and Smaller: One.
 - 2) Panels Larger than 4 Feet Wide: One for every 4 feet of panel width, two minimum per panel.
 - c. Mounting: Evenly spaced along back-of-panel area.
8. Internal Panel Lights and Service Outlets for Smaller Panels:
 - a. Internal Panel Light: Switched 100-watt incandescent light.
 - b. Service Outlet: Breaker protected 120-volt, 15-amp, GFCI GFCI duplex receptacle:
 - c. Required for panels. Refer to Control Panel Schedule in Article Supplements.
9. Standard Pushbutton Colors and Inscriptions:
 - a. Use following unless otherwise noted in individual Loop Specifications:

Tag Function	Inscription(s)	Color
OO	ON OFF	Black Black
OC	OPEN CLOSE	Black Black
OCA	OPEN CLOSE AUTO	Black Black Black
OOA	ON OFF AUTO	Black Black Black
MA	MANUAL AUTO	Black Black
SS	START STOP	Black Black
RESET	RESET	Black
EMERGENCY STOP	EMERGENCY STOP	Red

- b. Lettering Color:
 - 1) Black on white and yellow buttons.
 - 2) White on black, red, and green buttons.

10. Standard Light Colors and Inscriptions:
- a. Use following color code and inscriptions for service legends and lens colors for indicating lights, unless otherwise noted in individual Loop Specifications:

Tag Function	Inscription(s)	Color
ON	ON	Red
OFF	OFF	Green
OPEN	OPEN	Red
CLOSED	CLOSED	Green
LOW	LOW	Amber
FAIL	FAIL	Amber
HIGH	HIGH	Amber
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow

- b. Lettering Color:
- 1) Black on white and amber lenses.
 - 2) White on red and green lenses.

G. PIC Enclosure Internal Wiring:

1. Restrain by plastic ties or ducts or metal raceways.
2. Hinge Wiring: Secure at each end so bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
3. Arrange wiring neatly, cut to proper length, and remove surplus wire.
4. Provide abrasion protection for wire bundles that pass through holes or across edges of sheet metal.
5. Connections to Screw Type Terminals:
 - a. Locking-fork-tongue or ring-tongue lugs.
 - b. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations.
 - c. Wires terminated in a crimp lug, maximum of one.
 - d. Lugs installed on a screw terminal, maximum of two.
6. Connections to Compression Clamp Type Terminals:
 - a. Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- b. Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two.
7. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
8. Terminate 24V dc and analog signal circuits on separate terminal block from ac circuit terminal blocks.
9. Separate analog and dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.
10. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.
11. Plastic Wire Duct Fill: Do not exceed manufacturer's recommendations.
12. Conductors Carrying Foreign Voltages within a Panel:
 - a. Route foreign voltage conductors into panel and land on a circuit blade disconnect type terminal block.
 - b. Use wire with orange insulation to identify foreign voltage circuits within panel from terminal block on. Do not use wires with orange insulation for any other purpose.
13. Harness Wiring:
 - a. 120V ac: No. 14 AWG, MTW.
 - b. 24V dc: No. 16 AWG, MTW where individual conductors are used and Type TC shielded tray cable where shielded wire is used.
14. Panelwork:
 - a. No exposed connections.
 - b. Allow adjustments to equipment to be made without exposing these terminals.
 - c. For power and control wiring operating above 80V ac or dc use covered channels or EMT raceways separate from low voltage signal circuits.
15. Plastic Wire Ducts Color:
 - a. 120V ac: White.
 - b. 24V dc: Gray.
 - c. Communications Cables and Fiber Optic Jumpers: Orange.
16. Provide a communications plastic wire duct for communications cables and fiber optic cables between the communications devices in control panel and communications raceways. Design plastic wire duct design to take into account the minimum bending radius of the communications cable.
17. Make plastic wire ducts the same depth.
18. Provide a minimum of 1-1/2 inches between plastic wire ducts and terminal blocks.

- H. Control Relay Arrangement: Install control relays associated with specific loops in same panel section as corresponding terminal blocks or side panels. Provide 20 percent space for future relays. Locate spare space in same sections as spare terminal blocks.
- I. Factory Finishing:
 - 1. Furnish materials and equipment with manufacturer's standard finish system in accordance with Section 09 90 00, Painting and Coating.
 - 2. Use specific color if indicated. Otherwise use manufacturer's standard finish color, or light gray if manufacturer has no standard color.
 - 3. Stainless Steel and Aluminum: Not painted.
 - 4. Nonmetallic Panels: Not painted.
 - 5. Steel Panels:
 - a. Sand panel and remove mill scale, rust, grease, and oil.
 - b. Fill imperfections and sand smooth.
 - c. Paint panel interior and exterior with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.
 - d. Sand surfaces lightly between coats.
 - e. Dry Film Thickness: 3 mils, minimum.
 - f. Color: Interior – gloss white, Exterior – ANSI 61 gray.

2.12 CORROSION PROTECTION

- A. Corrosion-Inhibiting Vapor Capsules:
 - 1. Areas Where Required: Refer to Part 3, Article Protection.
 - 2. Manufacturers and Products:
 - a. Northern Instruments; Model Zerust VC.
 - b. Hoffmann Engineering; Model A-HCI.

2.13 SOURCE QUALITY CONTROL

- A. General:
 - 1. Engineer may actively participate in many of the tests.
 - 2. Engineer reserves right to test or retest specified functions.
 - 3. Engineer's decision will be final regarding acceptability and completeness of testing.
 - 4. Procedures, Forms, and Checklists:
 - a. Except for Unwitnessed Factory Test, conduct tests in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- b. Describe each test item to be performed.
 - c. Have space after each test item description for sign off by appropriate party after satisfactory completion.
 - 5. Required Test Documentation: Test procedures, forms, and checklists signed by Engineer and Contractor.
 - 6. Conducting Tests:
 - a. Provide special testing materials and equipment.
 - b. Wherever possible, perform tests using actual process variables, equipment, and data.
 - c. If not practical to test with real process variables, equipment, and data provide suitable means of simulation.
 - d. Define simulation techniques in test procedures.
 - e. Test Format: Cause and effect.
 - 1) Person conducting test initiates an input (cause).
 - 2) Specific test requirement is satisfied if correct result (effect), occurs.
 - f. For PIC systems for which Engineer provides applications software, provide sufficient temporary software configuring to allow FDT and SSdT testing of these subsystems.
- B. Unwitnessed Factory Test:
- 1. Scope: Inspect and test PIC to ensure it is operational, ready for FDT.
 - 2. Location: PIC System Integrator's facility.
 - 3. Integrated Test:
 - a. Interconnect and test PIC, except for primary elements and smaller panels.
 - b. Exercise and test functions.
 - c. Provide stand-alone testing of smaller panels.
 - d. Simulate inputs and outputs for primary elements, final control elements, and panels excluded from test.
- C. Staging Site Demonstration Test (SSdT):
- 1. Scope: Demonstrate that the specified PIC equipment and standard software has been properly installed at staging site and is ready for applications software development by Engineer.
 - 2. Refer to PIC subsections for additional details.

PART 3 EXECUTION

3.01 EXAMINATION

- A. For equipment not provided by PIC System Integrator, but that directly interfaces with PIC, verify the following conditions:
 - 1. Proper installation.
 - 2. Calibration and adjustment of positioners and I/P transducers.
 - 3. Correct control action.
 - 4. Switch settings and dead bands.
 - 5. Opening and closing speeds and travel stops.
 - 6. Input and output signals.

3.02 INSTALLATION

- A. Material and Equipment Installation: Follow manufacturers' installation instructions, unless otherwise indicated or directed by Engineer.
- B. Wiring connected to PIC components and assemblies, including power wiring in accordance with requirements in Section 26 05 01, Electrical.
- C. Electrical Raceways: As specified in Section 26 05 01, Electrical.
- D. Mechanical Systems:
 - 1. Copper and Stainless Steel Tubing Support: Continuously supported by aluminum tubing raceway system.
 - 2. Plastic Tubing Support: Except as shown on Drawings, provide continuous support in conduit or by aluminum tubing raceway system.
 - 3. Install conduit for plastic tubing and tubing raceways parallel with, or at right angles to, structural members of buildings. Make vertical runs straight and plumb.
 - 4. Tubing and Conduit Bends:
 - a. Tool-formed without flattening, and of same radius.
 - b. Bend Radius: Equal to or larger than conduit and tubing manufacturer's recommended minimum bend radius.
 - c. Slope instrument connection tubing in accordance with installation details.
 - d. Do not run liquid filled instrument tubing immediately over or within a 3-foot plan view clearance of electrical panels, motor starters, or mechanical mounting panel without additional protection. Where tubing must be located in these zones, shield electrical device to prevent water access to electrical equipment.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- e. Straighten coiled tubing by unrolling on flat surface. Do not pull to straighten.
 - f. Cut tubing square with sharp tubing cutter. Deburr cuts and remove chips. Do not gouge or scratch surface of tubing.
 - g. Blow debris from inside of tubing.
 - h. Make up and install fittings in accordance with manufacturer's recommendations. Verify make up of tube fittings with manufacturer's inspection gauge.
 - i. Use lubricating compound or TFE tape on stainless steel threads to prevent seizing or galling.
 - j. Run tubing to allow but not limited to, clear access to doors, controls and control panels; and to allow for easy removal of equipment.
 - k. Provide separate support for components in tubing runs.
 - l. Supply expansion loops and use adapters at pipe, valve, or component connections for proper orientation of fitting.
 - m. Keep tubing and conduit runs at least 12 inches from hot pipes.
 - n. Locate and install tubing raceways in accordance with manufacturer's recommendations. Locate tubing to prevent spillage, overflow, or dirt from above.
 - o. Securely attach tubing raceways to building structural members.
5. Enclosure Lifting Rings: Remove rings following installation and plug holes.

E. Field Finishing: Refer to Section 09 90 00, Painting and Coating.

3.03 FIELD QUALITY CONTROL

A. General:

- 1. Coordinate PIC testing with Owner and affected Subcontractors.
- 2. Notify Engineer of Performance Test schedule 4 weeks prior to start of test.
- 3. Engineer may actively participate in tests.
- 4. Engineer reserves right to test or retest specified functions.
- 5. Engineer's decision will be final regarding acceptability and completeness of testing.

B. Onsite Supervision:

- 1. Require PIC System Integrator to observe PIC equipment installation to extent required in order to provide Certificates of Proper Installation.
- 2. Require PIC site representative to supervise and coordinate onsite PIC activities.

3. Require PIC site representative to be onsite while onsite work covered by this section and PIC subsystems is in progress.

C. Testing Sequence:

1. Provide Functional Tests and Performance Tests for facilities as required to support staged construction and startup of plant.
2. Refer to article Sequence of Work under Section 01 31 13, Project Coordination, for a definition of project milestones.
3. Refer to Section 01 91 14, Equipment Testing and Facility Startup, for overall testing requirements.
4. Completion: When tests (except Functional Test) have been completed and required test documentation has been accepted.

D. Testing:

1. Prior to Facility Startup and Performance Evaluation period for each facility, inspect, test, and document that associated PIC equipment is ready for operation.
 - a. Loop/Component Inspections and Tests:
 - 1) These inspections and tests will be spot checked by Engineer.
 - 2) Check PIC for proper installation, calibration, and adjustment on loop-by-loop and component-by-component basis.
 - 3) Provide space on forms for signoff by PIC System Integrator.
 - 4) Use loop status report to organize and track inspection, adjustment, and calibration of each loop and include the following:
 - a) Project name.
 - b) Loop number.
 - c) Tag number for each component.
 - d) Checkoffs/Signoffs for Each Component:
 - (1) Tag/identification.
 - (2) Installation.
 - (3) Termination wiring.
 - (4) Termination tubing.
 - (5) Calibration/adjustment.
 - e) Checkoffs/Signoffs for the Loop:
 - (1) Panel interface terminations.
 - (2) I/O interface terminations with PLCs.
 - f) I/O Signals for PLCs, are Operational: Received/sent, processed, adjusted.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- g) Total loop operational.
- h) Space for comments.
- 5) Component calibration sheet for each active I&C component (except simple hand switches, lights, gauges, and similar items) and each PLCs, I/O module and include the following:
 - a) Project name.
 - b) Loop number.
 - c) Component tag number or I/O module number.
 - d) Component code number for I&C elements.
 - e) Manufacturer for I&C elements.
 - f) Model number/serial number for I&C elements.
 - g) Summary of Functional Requirements; For Example:
 - (1) Indicators and recorders, scale and chart ranges.
 - (2) Transmitters/converters, input and output ranges.
 - (3) Computing elements' function.
 - (4) Controllers, action (direct/reverse) and control modes (P, I, D).
 - (5) Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).
 - (6) I/O Modules: Input or output.
 - h) Calibrations, for example, but not limited to:
 - (1) Analog Devices: Actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
 - (2) Discrete Devices: Actual trip points and reset points.
 - (3) Controllers: Mode settings (P&ID).
 - (4) I/O Modules: Actual inputs or outputs of 0, 10, 50, and 100 percent of span, rising and falling.
 - (5) Space for comments.
- b. Maintain loop status reports, valve adjustment sheets, and component calibration sheets at Site, and make them available to Engineer at all times.
- c. Engineer reviews loop status sheets and component calibration sheets and spot-check their entries periodically, and upon completion of Preparation for Testing. Correct deficiencies found.
- d. FDT-Repeat:
 - 1) Repeat FDT onsite with installed PIC equipment and software.
 - 2) As listed in PIC subsections, certain portions of FDT may not require retesting.

- 3) Use FDT test procedures as basis for this test.
 - 4) In general, this test shall not require witnessing. However, portions of this test, as identified by Engineer during original FDT shall be witnessed.
 - e. Forms: See Loop Status Report, Instrument Calibration Sheet, and I&C Valve Adjustment Sheet referenced in Article Supplements.
 2. Functional Test Part 2: Combined effort between Contractor, PIC System Integrator, and Engineer to confirm PIC, including applications software, is ready for operation.
 - a. Prerequisite: Completion of Functional Test Part 1.
 - b. Joint test with Engineer. Repeat of Engineer's SSDT application software tests, except using real field sensors and equipment. Plant interlocking and communications with PLCs, HMI tested on loop-by-loop basis.
 - c. Test procedures provided by Engineer based on Functional Test Part 1 and on SSDT application software tests.
 - d. Completed when Functional Test has been conducted and Engineer has spot-checked associated test forms and checklists in field.
 3. Functional Test:
 - a. Scope: Confirm PIC, including applications software, is ready for operation.
 - b. Refer to PIC subsections for additional requirements.
 - c. Completed when Functional Test has been conducted and Engineer has spot-checked associated test forms and checklists in field.
 4. Required Test Documentation: Test procedures, forms, and checklists. Signed by Engineer and Contractor except for Functional Test items signed only by Contractor.
- E. Performance Tests Prior to Facility Startup: 1.
- F. Performance Test During and After Facility Startup:
 1. Once a facility's Functional Test has been completed and that facility has been started up, perform a witnessed. Performance Test on associated PIC equipment to demonstrate that it is operating as required by Contract Documents. Demonstrate each required function on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.
 2. Loop-specific and nonloop-specific tests same as required for FDT except that entire installed PIC tested using actual process variables and functions demonstrated.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3. Perform local and manual tests for each loop before proceeding to remote and automatic modes.
4. Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.
5. Make updated versions of documentation required for Performance Test available to Engineer at Site, both before and during tests.
6. Make O&M data available to Engineer at Site both before and during testing.
7. Follow daily schedule required for FDT.
8. Determination of Ready for Operation: When Functional Test has been completed.
9. Refer to examples of Performance Test procedures and forms in Article Supplements.

3.04 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative: As required by each PIC subsection.

3.05 TRAINING

- A. General:

1. Provide an integrated training program for Owner's personnel.
2. Perform training to meet specific needs of Owner's personnel.
3. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.
4. Provide instruction on one working shift(s) as needed to accommodate the Owner's personnel schedule.
5. Owner reserves the right to reuse recordings of training sessions.

- B. Management Seminar:

1. Length: 2 days.
2. Location: Owner's facility.
3. Objective: Provide overview for nonoperations and maintenance personnel for understanding the PIC.
4. Attended by management, engineering, and other nonoperations and nonmaintenance personnel.

5. Primary Topics:
 - a. PIC Overview: How hardware and software are used for operation and control of facilities.
 - b. Block Diagram Presentation of PIC: How and what information flows within system and what is done by each functional unit.
 - c. Process/Operator Interface: Explanation and demonstration of how to use HMI PC to access displays, reports, and controls.
 - d. Management-oriented explanation of data management displays and printouts.
 - e. Walk-through of installed systems.

- C. Operations and Maintenance Training:
 1. General:
 - a. Refer to specific requirements specified in PIC Subsections.
 - b. Include review of O&M data and survey of spares, expendables, and test equipment.
 - c. Use equipment similar to that provided.
 - d. Unless otherwise specified in PIC subsections, provide training suitable for instrument technicians with at least a 2-year associate engineering or technical degree, or equivalent education and experience in electronics, instrumentation, or digital systems.
 2. Operations Training: For Owner's operations personnel on operation of I&C components.
 - a. Training Session Duration: 5 instructor days.
 - b. Number of Training Sessions: Two.
 - c. Location: Project Site.
 - d. Course Objective: Develop skills needed to use I&C components and functions to monitor and control the plant on a day-to-day basis.
 - e. Content: Conduct training on loop-by-loop basis.
 - 1) Loop Functions: Understanding of loop functions, including interlocks for each loop.
 - 2) Loop Operation: For example, adjusting process variable setpoints, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
 - 3) Interfaces with PIC subsystems.
 3. Maintenance Training:
 - a. Training Session Duration: 5 instructor days.
 - b. Number of Training Sessions: One.
 - c. Location: Project Site.
 - d. Course Objective: Develop skills needed for routine maintenance of PIC.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- e. Content: Provide training for each type of component and function provided.
 - 1) Loop Functions: Understanding details of each loop and how they function.
 - 2) Component calibration.
 - 3) Adjustments: For example, controller tuning constants, current switch trip points, and similar items.
 - 4) Troubleshooting and diagnosis for equipment and software.
 - 5) Replacing lamps, chart paper, and fuses.
 - 6) I&C components removal and replacement.
 - 7) Periodic preventive maintenance.

3.06 CLEANING

- A. Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

3.07 PROTECTION

- A. Use corrosion-inhibiting vapor capsules in enclosures to protect electrical, instrumentation, and control devices, including spare parts, from corrosion.
- B. Periodically replace capsules based on capsule manufacturer's recommendations.

3.08 SUPPLEMENTS

- A. Supplements listed below, follows "End of Section," are part of this Specification.
 - 1. Loop Specifications.
 - 2. PLC Input/Output List.
 - 3. Preparation for Testing and Functional Test Forms:
 - a. Loop Status Report: Each sheet shows status of instruments on a loop. Also, gives functional description for loop.
 - b. Instrument Calibration Sheet: Shows details on each instrument (except simple hand switches, lights, and similar items).
 - c. I&C Valve Adjustment Sheet: Shows details for installation, adjustment, and calibration of a given valve.
 - 4. Performance Test Sheet: Describe Performance Test for a given loop.
 - a. List requirements of the loop.
 - b. Briefly describe test.
 - c. Cite expected results.
 - d. Provide space for checkoff by witness.

END OF SECTION

EXAMPLE LOOP SPECIFICATION

4.01 LOOP 14-5: AERATION BLOWERS FLOW CONTROLS

- A. Hardwired Functions: Monitor and control existing blower and provide the following:
1. Compute square root of each flow signal at FP-14-5.
 2. Compute sum of square root signals at FP-14-5.
 3. Indicate total flow at FP-14-5.
 4. Send inlet vane position to FP-14(3).
 5. Send blower airflow analog signals to PLC-14.
 6. Receive blower airflow setpoint signals from PLC-14.
 7. Provide P&ID flow control of blowers based on local setpoint at FP-14-5 or remote setpoint from PLC-14.
- B. PLC Special Functions: Manual/Auto control modes for blowers M-14-5(3). Allow these control modes to be selected for blowers at the same time.
1. Manual: Manual adjustment of blower airflow setpoint.
 - a. Setpoint Range: 0 to 200 kcfm.
 - b. Initial Setting: 10 kcfm.
 2. Auto: DO Control.
 - a. Ratio control for plant influent flow FIT-02-3.
 - 1) Adjustable Ratio Range: 0 to 2 kcfm/mgd.
 - 2) Initial Setting: 0.5 kcfm/mgd.
 - b. P&ID control for aeration tank DO.
 - 1) DO Setpoint Range: 0 to 12 mg/L.
 - 2) Initial Setting: 2 mg/L.
 - c. DO selectable from any of one of the six tanks, AIT-04(6) or average from six tanks, one per tank.
 - d. Compute Aeration Tank airflow demand as product of ration control output and PIC control output when P&ID control is enabled.
 3. Log alarms for following conditions:
 - a. ZT-14-2(3) is more than 98 percent for more than 5 seconds.
 - b. Too Few Blowers On: Two blowers are on and inlet guide vane position ZT-14-2(3) is less than 22 percent for more than 5 seconds.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

EXAMPLE PLC I/O LIST

PLC	Point No	Description	P&ID	Function	Type	I/O
22PLC-1		Panel No. 22LCP-1				
22PLC-1	22LIT02-1	Primary Effluent Pmp Sta Wet Well Level	08-I-02	Level		AI
22PLC-1	22FIT-04-1	Primary Effluent Flow	08-I-02	Flow		AI
22PLC-1	22FIT-05-1	CBOD Flow/Valve	08-I-02	Flow		AI
22PLC-1	22FV01-1	Filter Recycle Valve	08-I-02	Position		AI
22PLC-1	20M01-1-ON	Primary Clarifier Drive No.1	08-I-14	ON	Status	DI
22PLC-1	20M01-1-OVRLD	Primary Clarifier Drive No.1	08-I-14	Overload	Alarm	DI
22PLC-1	20M01-2	Primary Clarifier Drive No.2	08-I-14	ON	Status	DI
22PLC-1	20M01-2-OVRLD	Primary Clarifier Drive No.2	08-I-14	Overload	Alarm	DI
22PLC-1	22P03-1-FAIL	Primary Effluent Pump No.1	08-I-02	Fail	Alarm	DI
22PLC-1	22P03-1-ON	Primary Effluent Pump No.1	08-I-02	On	Status	DI
22PLC-1	22P03-1-REM	Primary Effluent Pump No.1	08-I-02	Remote	Status	DI
22PLC-1-R1		Panel No. 10LCP-1; Remote I/O Unit RIO-1				
22PLC-1-R1	10AIT-01H2S	Screenings Room H2S Gas Level	08-I-01	H2S		AI
22PLC-1-R1	10FIT-12-1	Influent Flow	08-I-01	Flow		AI
22PLC-1-R1	12FIT-02-1	Grit Pump Flow	08-I-14	Flow		AI
22PLC-1-R1	10FIT-12-1	Influent Flow	08-I-01	Flow	Control	AO
22PLC-1-R1	12FIT-02-1	Grit Pump Flow	08-I-14	Flow	Control	AO
22PLC-1-R1	14FV02-1CLSD	Flow Equal Basin Flow / Rtn Valve	08-I-02	Closed	Status	DI
22PLC-1-R1	14FV02-1OPND	Flow Equal Basin Flow / Rtn Valve	08-I-02	Opened	Status	DI

CITY OF ANN ARBOR, MI
INTERIM UV DISINFECTION SYSTEM

PLC	Point No	Description	P&ID	Function	Type	I/O
22PLC-1-R1	14FV02-1REM	Flow Equal Basin Flow / Rtn Valve	08-I-02	Remote	Status	DI
22PLC-1-R1	10YS91-1	Critical Alarm/Ack -Influent PS	08-I-01	Critical	Hold	DO
22PLC-1-R1	14FV02-1CLOSE	Flow Equal Basin Flow / Rtn Valve	08-I-02	Close	Momentary	DO
22PLC-1-R1	14FV02-1OPEN	Flow Equal Basin Flow / Rtn Valve	08-I-02	Open	Momentary	DO
22PLC-1-R1	14FV02-1STOP	Flow Equal Basin Flow / Rtn Valve	08-I-02	Stop	Momentary	DO

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

JACOBS

LOOP STATUS REPORT—EXAMPLE FORMAT

Rev.06.05.92

Project Name: <i>Newport News WTP</i>						Project No. <i>WDC23456.C1</i>	
FUNCTIONAL REQUIREMENTS:							
<i>1. Measure, locally indicate, and transmit RAS flow to LP-10.</i>							
<i>2. At LP-10 indicate flow and provide flow control by modulation of FCV-10-2.</i>							
<i>3. Provide high RAS flow alarm on LP-10.</i>							
COMPONENT STATUS (Check and initial each item when complete)							
Tag Number	Delivered	Tag ID Checked	Installation	Termination Wiring	Termination Tubing	Calibration	
<i>FE/FIT-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Feb-7-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>N.A.</i>	<i>May-6-90 VDA</i>	
<i>FIC-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>Apr-4-90 DWM</i>		<i>May-4-90 VDA</i>	
<i>FSH-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>Apr-4-90 DWM</i>		<i>May-7-90 VDA</i>	
<i>FAH-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>Apr-4-90 DWM</i>		<i>May-7-90 VDA</i>	
<i>FCV-10-2</i>	<i>Mar-2-90 DWM</i>	<i>Mar-2-90 DWM</i>	<i>Apr-20-90 DWM</i>	<i>Apr-30-90 DWM</i>		<i>May-16-90 VDA</i>	
REMARKS: None.							
Loop Ready for Operation		By: <i>D.W. Munzer</i>		Date: <i>May-18-90</i>		Loop No.: <i>10-2</i>	

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

JACOBS INSTRUMENT CALIBRATION SHEET—EXAMPLE—ANALYZER/TRANSMITTER Rev.06.05.92

COMPONENT			MANUFACTURER				PROJECT					
Code: <i>A7</i>			Name: <i>Leeds & Northrup</i>				Number: <i>WDC30715.B2</i>					
Name: <i>pH Element & Analyzer/Transmitter</i>			Model: <i>12429-3-2-1-7</i>		Serial #: <i>11553322</i>		Name: <i>UOSA AWT PHASE 3</i>					
FUNCTIONS												
Indicate? Y Record? N	RANGE	VALUE	UNITS	COMPUTING FUNCTIONS? N			CONTROL? N					
	Chart:			Describe:			Action? direct / reverse Modes? P / I / D					
Transmit/ Convert? Y	Scale:	<i>1-14</i>	<i>pH units</i>				SWITCH? N					
	Input:	<i>1-14</i>	<i>pH units</i>				Unit Range: Differential: fixed/adjustable					
	Output:	<i>4-20</i>	<i>mA dc</i>				Reset? automatic / manual					
ANALOG CALIBRATIONS						DISCRETE CALIBRATIONS					Note No.	
REQUIRED			AS CALIBRATED				REQUIRED			AS CALIBRATED		
Input	Indicated	Output	Increasing Input		Decreasing Input		Number	Trip Point	Reset Pt.	Trip Point	Reset Pt.	
			Indicated	Output	Indicated	Output						(note rising or falling)
<i>1.0</i>	<i>1.0</i>	<i>4.0</i>	<i>1.0</i>	<i>4.0</i>	<i>1.0</i>	<i>3.9</i>	<i>1.</i>	<i>N.A.</i>		<i>N.A.</i>		
<i>2.3</i>	<i>2.3</i>	<i>5.6</i>	<i>2.2</i>	<i>5.5</i>	<i>2.3</i>	<i>5.6</i>	<i>2.</i>					<i>1.</i>
<i>7.5</i>	<i>7.5</i>	<i>12.0</i>	<i>7.5</i>	<i>11.9</i>	<i>7.5</i>	<i>12.0</i>	<i>3.</i>					
<i>12.7</i>	<i>12.7</i>	<i>18.4</i>	<i>12.7</i>	<i>18.3</i>	<i>12.6</i>	<i>18.3</i>	<i>4.</i>					
<i>14.0</i>	<i>14.0</i>	<i>20.0</i>	<i>14.0</i>	<i>20.0</i>	<i>14.0</i>	<i>20.0</i>	<i>5.</i>					
CONTROL MODE SETTINGS:			P: <i>N.A.</i>	I:	D:		<i>6.</i>					
#	NOTES:								Component Calibrated and Ready for Start-up			
	<i>1. Need to recheck low pH calibration solutions.</i>								By: <i>J.D. Sewell</i>			
									Date: <i>Jun-6-92</i>			
									Tag No.: <i>AIT-12-6[pH]</i>			

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

JACOBS

I&C VALVE ADJUSTMENT SHEET—EXAMPLE

Rev.06.05.92

PARTS	Project Name: <i>SFO SEWPCP</i>		Project Number: <i>SFO10145.G2</i>		
Body	Type: <i>Vee-Ball</i>		Mfr: <i>Fisher Controls</i>		
	Size: <i>4-inch</i>		Model: <i>1049763-2</i>		
	Line Connection: <i>159 # ANSI Flanges</i>		Serial #: <i>1003220</i>		
Operator	Type: <i>Pneumatic Diaphragm</i>		Mfr: <i>Fisher Controls</i>		
	Action: <i>Linear – Modulated</i>		Model: <i>4060D</i>		
	Travel: <i>3-inch</i>		Serial #: <i>2007330</i>		
Positioner	Input Signal: <i>3-15 psi</i>		Mfr: <i>Fisher Controls</i>		
	Action: <i>Direct - air to open</i>		Model: <i>20472T</i>		
	Cam: <i>Equal percentage</i>		Serial #: <i>102010</i>		
Pilot Solenoid	Action:		Mfr:		
	Rating: <i>None</i>		Model:	Serial #:	
I/P Converter	Input: <i>4-20 mA dc</i>		Mfr: <i>Taylor</i>		
	Output: <i>3-15 psi</i>		Model: <i>10-T-576-3</i>		
	Action: <i>Direct</i>		Serial #: <i>1057-330</i>		
Position Switch	Settings: <i>Closed / Open 5 deg, rising</i>		Mfr: <i>National Switch</i>		
	Contacts: <i>Close / Close</i>		Model: <i>1049-67-3</i>		
			Serial #: <i>156 & 157</i>		
Power Supply	Type: <i>Pneumatic</i>		Air Set Mfr: <i>Air Products</i>		
	Potential: <i>40 psi</i>		Model: <i>3210D</i>		
			Serial #: <i>1107063</i>		
ADJUSTMENTS	Initial	Date	VERIFICATION	Initial	Date
Air Set	<i>JDS</i>	<i>Jun-06-92</i>	Valve Action	<i>JDS</i>	<i>Jun-03-92</i>
Positioner	<i>JDS</i>	<i>Jun-06-92</i>	Installation	<i>JDS</i>	<i>Jun-03-92</i>
Position Switches	<i>JDS</i>	<i>Jun-06-92</i>	Wire Connection	<i>JDS</i>	<i>Jun-04-92</i>
I/P Converter	<i>JDS</i>	<i>Jun-07-92</i>	Tube Connection	<i>JDS</i>	<i>Jun-04-92</i>
Actual Speed	<i>JDS</i>	<i>Jun-07-92</i>			
REMARKS: <i>Valve was initially installed backwards.</i>				Valve Ready for Start-up	
<i>Observed to be correctly installed May-25-92</i>				By: <i>J.D. Sewell</i>	
				Date: <i>Jun-07-92</i>	
				Tag No.: <i>FCV-10-2-1</i>	

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

JACOBS PERFORMANCE TEST SHEET - EXAMPLE

Rev.06.05.92

Project Name: <i>SFO SEWPCP Plant Expansion</i>			Project No.: <i>SFO12345.C1</i>
Demonstration test(s): For each functional Requirement of the loop: (a) List and number the requirement. (b) Briefly describe the demonstration test. (c) Cite the results that will verify the required performance. (d) Provide space for signoff.			
<i>1. MEASURE EFFLUENT FLOW</i>			
<i>1.a With no flow, water level over weir should be zero and</i>			
<i>FIT indicator should read zero.</i>			<i>Jun-20-92 BDG</i>
<i>2. FLOW INDICATION AND TRANSMISSION TO LP & CCS</i>			
<i>With flow, water level and FIT indicator should be related by expression</i>			
<i>$Q(\text{MGD}) = 429 * H^{2/3}$ (H = height in inches of water over weir).</i>			
<i>Vary H and observe that following.</i>			
<i>2.a Reading of FIT indicator.</i>			<i>Jun-6-92 BDG</i>
<i>2.b Reading is transmitted to FI on LP-521-1</i>			<i>Jun-6-92 BDG</i>
<i>2.c Reading is transmitted and displayed to CCS.</i>			<i>Jun-6-92 BDG</i>
<i>H(measured) 0 5 10 15</i>			
<i>Q(computed) 0 47.96 135.7 251.7</i>			
<i>Q(FIT indicator) 0 48.1 137 253</i>			
<i>Q(LI on LP-521-1) 0 48.2 138 254</i>			
<i>Q(display by CCS) 0 48.1 136.2 252.4</i>			
Forms/Sheets Verified	By	Date	Loop Accepted By Owner
Loop Status Report	<i>J.D. Sewell</i>	<i>May-18-92</i>	By: <i>J.D. Smith</i>
Instrument Calibration Sheet	<i>J.D. Sewell</i>	<i>May-18-92</i>	Date: <i>Jun-6-92</i>
I&C Valve Calibration Sheet	<i>N.A.</i>		
Performance Test	By	Date	
Performed	<i>J. Blow MPSDC Co.</i>	<i>Jun-6-92</i>	
Witnessed	<i>B. DeGlanville</i>	<i>Jun-6-92</i>	Loop No.: <i>30-12</i>

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

JACOBS SYSTEM PROBLEM REPORT			
Project Name:		Project No.:	
Test Name:		SPR Number:	
Test Number:		Problem Status:	
Problem Type: Hardware Software Documentation Unknown Other			
SYMPTOMS:	Time:	Date:	By:
Description:			
Can problem be reproduced at will? Y / N			
DIAGNOSIS:	Time:	Date:	By:
Description:			
CORRECTION:	Time:	Date:	By:
Description:			
FINAL SIGN OFF	Time:	Date:	By:

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

JACOBS LOOP STATUS REPORT							
Project Name:					Project No.		
FUNCTIONAL REQUIREMENTS:							
COMPONENT STATUS (Check and initial each item when complete)							
Tag Number	Delivered	Tag ID Checked	Installation	Termination Wiring	Termination Tubing	Calibration	
REMARKS:							
Loop Ready for Operation			By:		Date:		Loop No.:

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

JACOBS INSTRUMENT CALIBRATION SHEET											
COMPONENT			MANUFACTURER				PROJECT				
Code:			Name:				Number:				
Name:			Model:				Name:				
			Serial #:								
FUNCTIONS											
	RANGE	VALUE	UNITS	COMPUTING FUNCTIONS? Y / N			CONTROL? Y / N Action? direct / reverse Modes? P / I / D				
Indicate? Y / N	Chart:			Describe:			SWITCH? Y / N Unit Range: Differential: fixed/adjustable Reset? automatic / manual				
Record? Y / N	Scale:										
Transmit/ Convert? Y / N	Input:										
	Output:										
ANALOG CALIBRATIONS						DISCRETE CALIBRATIONS				Note. No	
REQUIRED			AS CALIBRATED				REQUIRED				AS CALIBRATED
Input	Indicated	Output	Increasing Input		Decreasing Input		Number	Trip Point (note rising or falling)	Reset Pt.	Trip Point (note rising or falling)	Reset Pt.
			Indicated	Output	Indicated	Output					
							1.				
							2.				
							3.				
							4.				
							5.				
CONTROL MODE SETTINGS:			P:	I:	D:		6.				
#	NOTES:										Component Calibrated and Ready for Start-up By: Date: Tag No.:

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

JACOBS I&C VALVE ADJUSTMENT SHEET					
PARTS	Project Name:			Project Number:	
Body	Type:			Mfr:	
	Size:			Model:	
	Line Connection:			Serial #:	
Operator	Type:			Mfr:	
	Action:			Model:	
	Travel:			Serial #:	
Positioner	Input Signal:			Mfr:	
	Action:			Model:	
	Cam:			Serial #:	
Pilot Solenoid	Action:			Mfr:	
	Rating:			Model:	
				Serial #:	
I/P Converter	Input:			Mfr:	
	Output:			Model:	
	Action:			Serial #:	
Position Switch	Settings:			Mfr:	
	Contacts:			Model:	
				Serial #:	
Power Supply	Type:			Air Set Mfr:	
	Potential:			Model:	
				Serial #:	
ADJUSTMENTS	Initial	Date	VERIFICATION	Initial	Date
Air Set			Valve Action		
Positioner			Installation		
Position Switches			Wire Connection		
I/P Converter			Tube Connection		
Actual Speed					
REMARKS:				Valve Ready for Start-up	
				By:	
				Date:	
				Tag No.:	

SECTION 40 91 00
INSTRUMENTATION AND CONTROL COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

- A. This section gives general requirements for instrumentation and control components.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

PART 2 PRODUCTS

2.01 GENERAL

- A. Article Mechanical Systems Components covers requirements of mechanical PIC components that are not specifically referenced by Section 40 90 00, Instrumentation and Control for Process Systems, Instrument Lists or Data Sheets.
- B. Article Electrical Components covers requirements for electrical PIC components that are not specifically referenced by Section 40 90 00, Instrumentation and Control for Process Systems, Instrument Lists or Data Sheets.
- C. All other Part 2 articles cover components that are referenced by Instrument Lists or Data Sheets in Section 40 90 00, Instrumentation and Control for Process Systems, or by specific component numbers in other PIC subsections.
- D. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the

maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MECHANICAL SYSTEMS COMPONENTS

A. Flow Element, Rotameter, Purge:

1. For air or water service, unless otherwise noted.
2. Materials: Glass tube, fiberglass body, stainless steel float, nylon ball check valve.
3. Direct-Reading Scale Length: 2-1/2 inches, minimum.
4. Scale Ranges: 0 scfh to 2.5 scfh for air service or 0 gph to 10 gph for water service.
5. Integral inlet needle valves.
6. Integral differential pressure regulators:
 - a. For water service.
 - b. For air service for level ranges greater than 10 feet of water.
7. Rotameters for water service.
8. Manufacturers and Products:
 - a. ABB, Series 10A6100.
 - b. Brooks; Series DS-1350.

B. Manifold, Three-Valve Equalizing:

1. Type: For isolation and equalization of differential pressure transducers.
2. Materials: Stainless steel.
3. Manufacturers and Products:
 - a. Anderson, Greenwood and Co.; Type M1.
 - b. Evans.

C. Pressure Gauge: For other than process variable measurement.

1. Dial Size: Nominal 4.5-inch dial size.
2. Accuracy: 0.5 percent of span.
3. Scale Range: Such that normal operating pressure lies between 50 percent and 80 percent of scale range.
4. Connection: 1/4-inch NPT through bottom, unless otherwise noted.
5. Materials: SST body, glycerine filled case.
6. Range: 0-30 psig, unless otherwise indicated.
7. Manufacturers and Products:
 - a. Ashcroft Utility; Gauge Series 1209.
 - b. Or equal.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

D. Valve, Needle:

1. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
2. Size: 0.020-inch orifice.
3. Manufacturers and Products:
 - a. Whitey; Model 21RF2.
 - b. Hoke; 3700 Series.

E. ON/OFF Valves:

1. Type: Ball valve.
2. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
3. Manufacturers and Products:
 - a. Whitey; Series 41 through Series 43.
 - b. Hoke; Flomite 7100 Series.

F. Regulating Valves:

1. Type: Needle valves, with regulating stems and screwed bonnets.
2. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
3. Manufacturers and Products:
 - a. Whitey; Catalog No. RF or No. RS.
 - b. Hoke; 3100 through 3300 Series.

G. Valve, Three-Way:

1. Type: Ball valve.
2. Materials: Brass or stainless steel with nylon handle as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
3. Manufacturers and Products:
 - a. Whitey; Series 41 through Series 43.
 - b. Hoke; Selecto-Mite Series.

H. Valve, Four-Way:

1. Type: Four-way, two-position ball valve.

2. Materials:
 - a. Body and Stem: Type 316 stainless steel.
 - b. Handle: Black nylon.
 - c. Packing Gland: Teflon.
 3. Ball and stem bed, one-piece assembly.
 4. Machined handle stops and directional nameplates.
 5. Manufacturers and Products:
 - a. Whitey; Series 457.
 - b. Hoke; Multi-Mite Series.
- I. Spool Valve:
1. Type: Five-port arrangement as shown, two-position, push-to-operate knob attached to the spool stem, and spring return.
 2. Materials: Aluminum construction with Teflon impregnated aluminum spool, stainless steel spring, and Buna-N O-rings.
 3. Port Connection: 1/4-inch outside diameter tube fittings.
 4. Manufacturer and Product: Norgren; T71DAOO-TSO-TKO.
- J. Solenoid Valve, Two-Way:
1. Type: Globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation.
 2. Materials:
 - a. Body: Brass or stainless steel globe valves as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
 - b. Valve Seat: Buna-N.
 3. Size: Normally closed or opened, as noted.
 4. Coil: 115V ac, unless noted otherwise.
 5. Solenoid Enclosure: NEMA 4.
 6. Manufacturer and Product: ASCO; Red Hat Series 8260.
- K. Pressure Regulator, Air:
1. Provide air at reduced pressures, as shown, constant to within plus or minus 10 percent for flows from 0 scfh to 300 scfh with 100 psi supply pressure.
 2. Setscrew for outlet pressure adjustment.
 3. Integral filter and relief valve.
 4. Manufacturers and Products:
 - a. Masoneilan; Series 77-4.
 - b. Fisher; Series 67FR.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

L. Pressure Regulator, Water:

1. Materials:
 - a. Body: Bronze.
 - b. Spring Case: Cast iron.
 - c. Seat Rings: Brass.
 - d. Valve Disk and Holder: Buna-N and bronze.
 - e. Diaphragm: Buna-N diaphragm.
2. Sizing: For maximum of 7 psi offset pressure.
3. Manufacturers and Products:
 - a. Fisher; Controls Type 95H or 95L.
 - b. Masoneilan; Series 17.

M. Test Tap:

1. Manufacturers and Products:
 - a. Imperial-Eastman; quick-disconnect couplings No. 292-P and caps No. 259-P.
 - b. Crawford Fitting Co.; Swagelok quick-connects Series QC4 and caps QC4-DC.
 - c. Parker; CPI Series precision quick couplings.

N. Copper Tubing and Fittings:

1. Type K hard copper, ASTM B88, with commercially pure wrought copper solder joint fittings. Make joints with 95-5 wire solder, ASTM B32, Grade 95 TA. Do not use cored solder.
2. Alternatively, Type K, soft temper copper tubing, ASTM B88, with brass compression type fittings may be used where shown on Drawings.
3. Manufacturers:
 - a. Parker-Hannifin.
 - b. Swagelok tube fittings.

O. Plastic Tubing and Fittings:

1. Tubing:
 - a. Polyethylene capable of withstanding 190 psig at 175 degrees F.
 - b. Manufacturers and Products:
 - 1) Dekoron; Type P.
 - 2) Imperial Eastman; Poly-Flo black instrument tubing.
2. Fittings:
 - a. Type: Brass compression.
 - b. Manufacturers and Products:
 - 1) Imperial Eastman; Poly-Flo tube fittings.
 - 2) Dekoron; E-Z fittings.

- P. Stainless Steel Tubing: ASTM A312/A312M, Type 316, 0.065-inch wall, seamless, soft annealed, as shown on Drawings.
- Q. Stainless Steel Fittings:
1. Compression Type:
 - a. Materials: Type 316 stainless steel, ASTM A182/A182M forged bodies or ASTM A276 barstock bodies, flareless.
 - b. Manufacturers and Products:
 - 1) Parker Flodar; BA Series.
 - 2) Swagelok tube fittings.
 - 3) Parker CPI tube fittings; Parker A-LOK dual ferrule tube fittings.
 2. Socket Weld Type:
 - a. Materials: Type 316 stainless steel, ASTM A182/A182M forged bodies or ASTM A276 barstock bodies, 3,000 psi maximum working pressure, safety factor 4:1.
 - b. Manufacturers:
 - 1) Cajon.
 - 2) Swagelok.
 - 3) Parker WELDLOK.
- R. Air Set: Consists of a shutoff valve, pressure regulator, discharge pressure gauge, and interconnecting tubing.
- S. Purge Set:
1. Parts: Purge rotameter flow element, pressure regulator, pressure gauge, test tap, shutoff valve, spool valve, and interconnecting tubing as shown on Drawings and as required in this section.
 2. Pressure Gauge Scale Range: 150 percent of the process variable.
 3. Mounting:
 - a. Within consoles, panels, or a separate enclosure as shown.
 - b. For separate enclosure mounted purge sets, refer to paragraphs Nonfreestanding Panel Construction and Factory Finishing for enclosure requirements.
- T. Tubing Raceways:
1. Cable tray systems complete with tees, elbows, reducers, and covers.
 2. Size in accordance with manufacturer's recommendations for intended service.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3. Materials: Galvanized steel or aluminum brass as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
 4. Manufacturers:
 - a. Globetray.
 - b. Cope.
- U. Air Supply Sets:
1. Parts: Integrally Mounted:
 - a. Pressure Controls: Automatic START/STOP, factory set at 30 psig to 50 psig.
 - b. Valves: Manual drain, manual shutoff, pressure relief, and check valve.
 - c. Pressure gauge.
 - d. Inlet filter muffler.
 - e. Power: 120V ac.
 - f. Compressor: Oilless, single cylinder, rated for at least 1 scfm at 50 psig.
 - g. Manufacturers and Products:
 - 1) ITT Pneumotive; GH Series.
 - 2) Gast.
 2. Simplex Air Supply Sets:
 - a. Air Receiver: 2 gallons.
 - b. Compressors: One.
 3. Duplex Air Supply Sets:
 - a. Air Receiver: 20 gallons.
 - b. Compressors: Two.
 - c. Automatic Failover Control: Factory set at 20 psig.

2.03 ELECTRICAL COMPONENTS

- A. Terminal Blocks for Enclosures:
1. General:
 - a. Connection Type: Screw compression clamp.
 - b. Compression Clamp:
 - 1) Complies with DIN-VDE 0611.
 - 2) Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.
 - 3) Guides strands of wire into terminal.
 - c. Screws: Hardened steel, captive, and self-locking.
 - d. Current Bar: Copper or treated brass.

- e. Insulation:
 - 1) Thermoplastic rated for minus 55 degrees C to plus 110 degrees C.
 - 2) Two funneled shaped inputs to facilitate wire entry.
- f. Mounting:
 - 1) Standard DIN rail.
 - 2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
 - 3) End Stops: Minimum of one at each end of rail.
- g. Wire Preparation: Stripping only permitted.
- h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
- i. Marking System:
 - 1) Terminal number shown on both sides of terminal block.
 - 2) Allow use of preprinted and field marked tags.
 - 3) Terminal strip numbers shown on end stops.
 - 4) Mark terminal block and terminal strip numbers as shown on panel control diagrams and loop diagrams.
 - 5) Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.
- j. Test Plugs: Soldered connections for 18 AWG wire.
 - 1) Pin Diameter: 0.079 inch.
 - 2) Quantity: (10, 20, 40 (need two plugs per test meter)).
 - 3) Manufacturer and Product: Entrelec; Type FC2.
- 2. Terminal Block, General Purpose:
 - a. Rated Voltage: 600V ac.
 - b. Rated Current: 30 amp.
 - c. Wire Size: 24 AWG to 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Gray body.
 - f. Spacing: 0.25 inch, maximum.
 - g. Test Sockets: One screw test socket 0.079-inch diameter.
 - h. Manufacturer and Product: Entrelec; Type M4/6.T.
- 3. Terminal Block, Ground:
 - a. Wire Size: 24 AWG to 10 AWG.
 - b. Rated Wire Size: 10 AWG.
 - c. Color: Green and yellow body.
 - d. Spacing: 0.25 inch, maximum.
 - e. Grounding: Electrically grounded to mounting rail.
 - f. Manufacturer and Product: Entrelec; Type M4/6.P.
- 4. Terminal Block, Blade Disconnect Switch:
 - a. Rated Voltage: 600V ac.
 - b. Rated Current: 10 amp.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- c. Wire Size: 22 AWG to 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Gray body, orange switch.
 - f. Spacing: 0.25 inch, maximum.
 - g. Manufacturer and Product: Entrelec; Type M4/6.SNT.
5. Terminal Block Diode:
- a. Rated Voltage: 24V dc.
 - b. Rated Current: 30 ma.
 - c. Wire Size: 16 AWG.
 - d. Manufacturer and Product: Phoenix Contact ST-IN.

B. Relays:

- 1. General:
 - a. Relay Mounting: Plug-in type socket.
 - b. Relay Enclosure: Furnish dust cover.
 - c. Socket Type: Screw terminal interface with wiring.
 - d. Socket Mounting: Rail.
 - e. Provide holddown clips.
- 2. Signal Switching Relay:
 - a. Type: Dry circuit.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 5 amps at 28V dc or 120V ac.
 - d. Contact Material: Gold or silver.
 - e. Coil Voltage: As noted or shown.
 - f. Coil Power: 0.9 watt (dc), 1.2VA (ac).
 - g. Expected Mechanical Life: 10,000,000 operations.
 - h. Expected Electrical Life at Rated Load: 100,000 operations.
 - i. Indication Type: Neon or LED indicator lamp.
 - j. Seal Type: Hermetically sealed case.
 - k. Manufacturer and Product: Potter and Brumfield; Series KH/KHA.
- 3. Control Circuit Switching Relay, Nonlatching:
 - a. Type: Compact general purpose plug-in.
 - b. Contact Arrangement: 3 Form C contacts.
 - c. Contact Rating: 10A at 28V dc or 120V ac, and 6.6A at 240V ac.
 - d. Contact Material: Silver cadmium oxide alloy.
 - e. Coil Voltage: As noted or shown.
 - f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
 - g. Expected Mechanical Life: 10,000,000 operations.
 - h. Expected Electrical Life at Rated Load: 100,000 operations.
 - i. Indication Type: Neon or LED indicator lamp.
 - j. Push-to-test button.
 - k. Manufacturer and Product: Potter and Brumfield; Series KUP.

4. Control Circuit Switching Relay, Latching:
 - a. Type: Dual coil mechanical latching relay.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 10A at 28V dc or 120V ac.
 - d. Contact Material: Silver cadmium oxide alloy.
 - e. Coil Voltage: As noted or shown.
 - f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
 - g. Expected Mechanical Life: 500,000 operations.
 - h. Expected Electrical Life at Rated Load: 50,000 operations.
 - i. Manufacturer and Product: Potter and Brumfield; Series KB/KBP.
5. Control Circuit Switching Relay, Time Delay:
 - a. Type: Adjustable time delay relay.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 10A at 30V dc or 277V ac.
 - d. Contact Material: Silver cadmium oxide alloy.
 - e. Coil Voltage: As noted or shown.
 - f. Operating Temperature: Minus 10 degrees C to 55 degrees C.
 - g. Repeatability: Plus or minus 2 percent.
 - h. Delay Time Range: Select range such that time delay setpoint fall between 20 percent to 80 percent of range.
 - i. Time Delay Setpoint: As noted or shown.
 - j. Mode of Operation: As noted or shown.
 - k. Adjustment Type: Integral potentiometer with knob external to dust cover.
 - l. Manufacturer and Products: Potter and Brumfield; Series CB for 0.1-second to 100-minute delay time ranges, Series CK for 0.1-second to 120-second delay time ranges.

C. Surge Suppressors:

1. General:
 - a. Construction: First-stage, high-energy metal oxide varistor and second-stage, bipolar silicon avalanche device separated by series impedance; includes grounding wire, stud, or terminal.
 - b. Response: 5 nanoseconds maximum.
 - c. Recovery: Automatic.
 - d. Temperature Range: Minus 20 degrees C to plus 85 degrees C.
 - e. Enclosure Mounted: Encapsulated inflame retardant epoxy.
2. Suppressors on 120V ac Power Supply Connections:
 - a. Occurrences: Tested and rated for a minimum of 50 occurrences of IEEE C62.41 Category B test waveform.
 - b. First-Stage Clamping Voltage: 350 volts or less.
 - c. Second-Stage Clamping Voltage: 210 volts or less.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- d. Power Supplies for Continuous Operation:
 - 1) Four-Wire Transmitter or Receiver: Minimum 5 amps at 130V ac.
 - 2) All Other Applications: Minimum 30 amps at 130V ac.
 - 3. Suppressors on Analog Signal Lines:
 - a. Test Waveform: Linear 8-microsecond rise in current from 0 amps to a peak current value followed by an exponential decay of current reaching one-half the peak value in 20 microseconds.
 - b. Surge Rating: Tested and rated for 50 occurrences of 2,000-amp peak test waveform.
 - 1) dc Clamping Voltage: 20 percent to 40 percent above operating voltage for circuit.
 - 2) dc Clamping Voltage Tolerance: Plus or minus 10 percent.
 - 3) Maximum Loop Resistance: 18 ohms per conductor.
 - 4. Manufacturers and Products:
 - a. Analog Signals Lines: Emerson Edco PC-642 or SRA-64 series.
 - b. 120V ac Lines: Emerson Edco HSP-121.
 - c. Field Mounted at Two-Wire Instruments:
 - 1) Encapsulated in stainless steel pipe nipples.
 - 2) Emerson Edco SS64 series.
 - d. Field Mounted at Four-Wire Instruments: With 120V ac outlet, ac circuit breaker, and 10-ohm resistors on signal lines, all in enclosure.
 - 1) Enclosure:
 - a) NEMA 4X Type 316 stainless steel with door.
 - b) Maximum Size: 12 inches by 12 inches by 8 inches deep.
 - 2) Emerson Edco; SLAC series.
- D. Power Supplies:
- 1. Furnish as required to power instruments requiring external dc power, including two-wire transmitters and dc relays.
 - 2. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
 - 3. Provide output over voltage and over current protective devices to:
 - a. Protect instruments from damage due to power supply failure.
 - b. Protect power supply from damage due to external failure.
 - 4. Enclosures: NEMA 1.
 - 5. Mount such that dissipated heat does not adversely affect other components.

6. Fuses: For each dc supply line to each individual two-wire transmitter.
 - a. Type: Indicating.
 - b. Mount so fuses can be easily seen and replaced.
 7. Manufacturers and Models:
 - a. SOLA, SDP power supply.
 - b. Or approved equal.
- E. Ethernet Switch:
1. Provide an Ethernet switch for segment connections of the area PLCs, touchscreen PCs, and Owner's SCADA system.
 2. Minimum (8) 10/100 Base-TX (RJ-45) Ports:
 - a. One port shall remain open for Owner's use.
 3. Manufacturer and Model:
 - a. Hirschmann, Spider III; Spider-SL-20-08T.
 - b. Or approved equal.
- F. Alarm Horn:
1. Sound Rating: 103 dB at 10 feet.
 2. NEMA 4X construction.
 3. Power: 120 VAC.
 4. Manufacturer and Model:
 - a. Edwards Signaling Products, Model 870P.
 - b. Or approved equal.
- G. Strobe:
1. Rate: 80 flashes per minute.
 2. Lens: Fresnel lens of Lexan.
 3. Power: 120 VAC.
 4. Color: Amber.
 5. Manufacturer and Model:
 - a. Edwards Signaling Products, 94 Series.
 - b. Or approved equal.
- H. UPS:
1. Uninterruptable Power Supply (UPS) of the online double conversion type shall be furnished to provide reliable, uninterrupted power with no break in AC output power during a complete or partial loss of incoming line power.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. UPS shall be comprised of an EMI filter, AC-DC booster, DC-DC converter, DC-AC inverter battery charger, sealed batteries, isolation and bypass relays, and shall be contained in a single enclosure.
 3. Sizing: Minimum 1,400 VA with batteries sized for 30 minute runtime.
 4. Manufacturer and Model:
 - a. Tripp Lite, SmartOnline Series.
 - b. Or approved equal.
- I. Pilot Devices:
1. Selector Switch:
 - a. Shall be round, heavy duty 30.5 mm, water tight, NEMA 4X with sealed switch contacts.
 - b. Contact blocks shall be sealed.
 - c. Shall have one normally open and one normally closed contact block minimum. Provide contact blocks as required to perform the functions as shown on the Drawings.
 - d. Manufacturer and Model:
 - 1) Allen Bradley, 800H Series.
 - 2) Or approved equal.
- J. Panel Heater:
1. Panel heater shall be thermostatically controlled, fan driven, with all components mounted in anodized minimum housing for sub-panel mounting.
 2. Manufacturer and Model:
 - a. Hoffman, Bulletin D85.
 - b. Or approved equal.
- K. Panel Light:
1. 120V LED panel light shall be provided as required.
 2. Provide a single pole toggle switch, meeting the requirements of Division 26, in a galvanized metal handy box with stainless steel cover.
 3. Manufacturer and Model: Hoffman, Panel LED.
- L. Circuit Breakers and Fuses:
1. Panel shall be provided with DIN rail mounted 120 VAC circuit breakers or fused terminal blocks, as shown on the Drawings, grouped in line and sized as required to distribute power to panel components.

2. Manufacturer and Model:
 - a. Circuit Breakers:
 - 1) Allen Bradley, 1492-SP1C Series.
 - 2) Or approved equal.
 - b. Fused Terminals:
 - 1) Bussmann, CH Series.
 - 2) Or approved equal.

2.04 I&C COMPONENTS

A. Programmable Logic Controllers (PLCs):

1. Communications:
 - a. Serial A-B DF1 full-duplex and 10/100 Mbps EtherNet/IP communications ports.
 - b. Utilize Serial communications for UV dosimeter communications.
 - c. Utilize 10/100 Mbps EtherNet/IP communications for HMIs and plant SCADA.
2. Power Supply Module: As required.
3. Digital Input Module: Provide isolated inputs.
4. Digital Output Module: Provide relay outputs.
5. Analog Input Module: Provide 4-20 mA, isolated.
6. Analog Output Module: Provide 4-20 mA isolated.
7. Spare I/O: Provide 20 percent spare I/O capacity for each PLC, minimum.
8. Manufacturer and Product: Allen-Bradley; CompactLogix 1769 L35E b/c Series, or equal.

B. Human-Machine Interface Unit (HMI):

1. Panel-mounted graphical operator interface capable of bidirectional communication with PLC-based control system.
2. Include cables and ports to interface with PLC control system, personal computers, and external compact flash drives.
3. Graphic Display Screens: Match configuration of plant control system workstations with respect to color usage conventions, general formatting, and screen navigation.
4. Manufacturer and Product: Allen-Bradley; Panel mount PC with Factorytalk View Me.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

C. A901 Chloramination Analyzer/Transmitter (AE/AIT-X-X):

1. General:
 - a. Function: Measure, indicate, and transmit Total Residual Chlorine, Mono-Chloramine, Total Ammonia, and Free Ammonia of sampled process liquid. Transmitted signals shall be proportional to measured values.
 - b. Sensor Type: High resolution, UV absorbance via 256 element array optical spectrometer. Spectral range 200 to 450 nm.
 - c. Parts: Analyzer/transmitter and accessories.
2. Performance:
 - a. Process Liquid: Water.
 - b. Range:
 - 1) 0.05 to 5 mg-Cl₂/L Total Residual Chlorine.
 - 2) 0.01 to 5 mg-Cl₂/L Monochloramine.
 - 3) 0.02 to 2 mg-N/L Total Ammonia.
 - 4) 0.02 to 1 mg-N/L Free Ammonia.
 - c. Precision: Better than 0.5 percent of range.
 - d. Accuracy: Plus or minus 0.02 mg/L or 2 percent.
 - e. Reading Interval: 10 to 9,999 minutes
 - f. Response Time: 10 minutes for the entire four parameter suite.
 - g. Sample
 - 1) Pressure Required:
 - a) Regulated to 5-10 psig.
 - b) Provide pressure regulator.
 - 2) Flow: Required range 500 to 5,000 ml per minute (0.13 to 1.32 gpm).
 - 3) Temperature: Required range 1 to 60 degrees C (34 to 140 degrees F).
 - 4) Turbidity: Required range 0 to 60 NTU.
 - 5) Suspended Solids: Required range 0 to 150 mg/l TSS.
 - 6) Filtration: None required for turbidity and suspended solids within ranges specified.
3. Features:
 - a. Automatic zeroing.
 - b. Automatic cleaning.
 - c. Analyzer pump for zeroing, cleaning, and internal sample flow.
4. Enclosure:
 - a. NEMA 4X/3R, 316 stainless-steel.
 - b. Mounting: Wall-mount or floor-mount with stand. Refer to standard detail for requirement.
 - c. Dimensions: 20 inches wide by 40 inches high by 10 inches deep, nominal.

- d. Ambient Temperature: Required range 5 to 45 degrees C (41 to 113 degrees F).
 - e. Relative Humidity: 0 to 100 percent (non-condensing).
 - 5. Signal Interface:
 - a. Analog Output: Four 4 to 20 mA dc output with 130V isolation from earth ground.
 - b. Discrete Outputs:
 - 1) Eight alarm outputs.
 - 2) Each with SPDT contacts rated at 5 amp resistive at 230V ac.
 - 6. Process Connections:
 - a. Sample Inlet: 1/4-inch FNPT fitting.
 - b. Drain Connection: 1/4-inch FNPT fitting.
 - 7. Power: 120 V ac, 50 to 60 Hz.
 - 8. Accessories:
 - a. Provide inlet fixed pressure regulator for sample line, 10 psi.
 - b. Provide inlet strainer for sample line, #20 mesh, opening of 0.69 mm (0.027 inches).
 - c. Provide control valve and flow meter for flow control
 - d. Responsible for internal valving.
 - e. 1-year maintenance kit (zeroing solution, cleaning solution, etc.).
 - f. Reagents: sufficient for 30 days' operation.
 - g. Provide all necessary stainless-steel mounting hardware and brackets for wall mount installation per Contract Drawings. Hardware shall be suitable for the service liquids listed above.
 - h. Responsible for equipment functional testing and commissioning.
 - 9. Manufacturer and Product:
 - a. ChemScan; UV-2150/S.
 - b. No substitutes.
- D. Wet Floor Detection Switch:
- 1. Type: A direct acting float that moves up and down a stationary stem or rod surrounded by a permeable shield for protection and to minimize sloshing.
 - a. The float shall rise or lower with liquid level and activate a magnetic switch within the stem or rod.
 - 2. Features:
 - a. Float body: 316 Buna N with magnet in float for actuating switch in rod. Float shall rise when immersed in water.
 - b. Mechanical switch inside of rod: Hermetically sealed reed switch
 - c. Interface relay: Solid state relay for increased load beyond 20 VA.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- d. Rod material: Type 316 stainless steel.
- e. Slesh and Protection Shield: Polycarbonate Plastic.
- 3. Manufacturer and Model:
 - a. LS-270 Series as manufactured by Gems Sensors.
 - b. Or approved equal.
- E. Flow Element and Transmitter, Electromagnetic:
 - 1. General:
 - a. Function: Measure, indicate, and transmit the flow of a conductive process liquid in a full pipe.
 - b. Type:
 - 1) Electromagnetic flowmeter, with operation based on Faraday's Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
 - 2) Full bore meter with magnetic field traversing entire flow-tube cross section.
 - 3) Unacceptable are insert magmeters or multiple single point probes inserted into a spool piece.
 - c. Parts: Flow element, transmitter, interconnecting cables, and mounting hardware. Other parts as noted.
 - 2. Service:
 - a. Stream Fluid:
 - 1) Water.
 - 2) Suitable for liquids with a minimum conductivity of 5 microS/cm and for demineralized water with a minimum conductivity of 20 microS/cm.
 - b. Flow Stream Descriptions: If and as described below.
 - 3. Operating Temperature:
 - a. Element:
 - 1) Ambient: Minus 5 to 140 degrees F, typical, unless otherwise noted.
 - 2) Process: Minus 5 to 140 degrees F, typical, unless otherwise noted.
 - b. Transmitter:
 - 1) Ambient: Minus 5 to 140 degrees F, typical, unless otherwise noted.
 - 2) Storage: 15 to 120 degrees F, typical, unless otherwise noted.
 - 4. Performance:
 - a. Flow Range: 0-20,000 GPM.
 - b. Accuracy: Plus or minus 0.5 percent of rate for all flows resulting from pipe velocities of 2 to 30 feet per second.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- c. Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.
- 5. Features:
 - a. Zero stability feature to eliminate the need to stop flow to check zero alignment.
 - b. No obstructions to flow.
 - c. Very low pressure loss.
 - d. Measures bi-directional flow.
- 6. Process Connection:
 - a. Meter Size (diameter inches): 24 inches.
 - b. Connection Type: 150-pound ANSI raised-face flanges; AWWA C207, Table 2 Class D; or wafer style depending on meter size, unless otherwise noted.
 - c. Flange Material: Carbon steel, unless otherwise noted.
- 7. Power (Transmitter): 120V ac, 60-Hz, unless otherwise noted.
- 8. Element:
 - a. Meter Tube Material: Type 304 or 316 stainless steel, unless otherwise noted.
 - b. Liner Material:
 - 1) Teflon, unless otherwise noted.
 - 2) For potable water service, must have appropriate approvals.
 - c. Liner Protectors: Covers (or grounding rings) on each end to protect liner during shipment.
 - d. Electrode Type: Flush or bullet nose as recommended by the manufacturer for the noted stream fluid.
 - e. Electrode Material: Type 316 stainless steel or Hastelloy C, unless otherwise noted.
 - f. Grounding Ring:
 - 1) Required, unless otherwise noted.
 - 2) Quantity: Two, unless otherwise noted.
 - 3) Material: Type 316 stainless steel, unless otherwise noted.
 - g. Enclosure: NEMA 4X, minimum, unless otherwise noted.
- 9. Transmitter:
 - a. Mounting: Surface (wall), unless otherwise noted.
 - b. Display: Required, unless otherwise noted.
 - 1) Digital LCD display, indicating flow rate and total.
 - 2) Bi-directional Flow Display: Required, unless otherwise noted.
 - a) Forward and reverse flow rate.
 - b) Forward, reverse and net totalization.
 - c. Parameter Adjustments: By keypad or non-intrusive means.
 - d. Enclosure: NEMA 4X, minimum, unless otherwise noted.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- e. Empty Pipe Detection:
 - 1) If noted.
 - 2) Drives display and outputs to zero when empty pipe detected.
- 10. Signal Interface (at Transmitter):
 - a. Analog Output:
 - 1) Isolated 4 mA to 20 mA dc for load impedance from 0 ohm to at least 500 ohms minimum for 24V dc supply.
 - 2) Supports Superimposed Digital HART protocol: If noted.
 - b. Discrete Outputs:
 - 1) Two discrete outputs, typical, rated for up to 30 volts, typical.
 - 2) Programmable as noted for the following typical parameters:
 - a) Totalizer pulse, high/low flow rates, percent of range, empty pipe zero, fault conditions, forward/reverse, etc.
- 11. Cables:
 - a. Types: As recommended by manufacturer.
 - b. Lengths: As required to accommodate device locations.
- 12. Built-in Diagnostic System:
 - a. Features:
 - 1) Field programmable electronics.
 - 2) Self-diagnostics with troubleshooting codes.
 - 3) Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
 - 4) Initial flow tube calibration and subsequent calibration checks.
- 13. Factory Calibration:
 - a. Calibrated in an ISO 9001 and NIST certified factory.
 - b. Factory flow calibration system must be certified by volume or weight certified calibration devices.
 - c. Factory flow calibration system shall be able to maintain calibration flow rate for at least 5 minutes for repeatability point checks.
- 14. Factory Ready for Future In situ Verifications: If noted.
 - a. Original meter parameter values available from vendor by request.
- 15. Accessories:
 - a. In situ Verification System: If noted.
 - 1) Quantity: One complete system provided for the project.
 - 2) Verifies quantitatively that the meter and signal converter's present condition is the same as originally manufactured.

- 3) Physical access to the flow-tube not required.
 - 4) Meet standards established by the National Testing Laboratory.
 - 5) Tests and stores over 50-meter parameters related to primary coils, electrodes, interconnecting cable and signal converter.
 - 6) Verification standard shall be plus or minus 1 percent of wet calibration for meters produced using the calibration verification service, or plus or minus 2 percent for standard meters.
 - 7) Windows-based software
- b. Primary Simulation System: If noted.
- 1) Quantity: One complete system provided for the project.
 - 2) Verifies proper operation of the signal converter by simulating the flow meter's output signal.
 - a) Generates pulsed dc excitation signal with a reference voltage of 70 mV.
 - b) Generated signal ranges from 0 to 99 percent (0 to 32.8 feet per second) with a resolution of 0.1 percent.
 - c) Switch selectable for forward, reverse and zero flow rate.
 - 3) Verifies various input and output signals.
16. Manufacturers:
- a. ABB Automation MagMaster (includes Transmitter):
 - 1) FEW3 (size: 3/8 to 24 inches).
 - b. No equal.

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 44 42 56.04
SUBMERSIBLE PUMPS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. American Bearing Manufacturers Association (ABMA):
 - a. 9, Load Ratings and Fatigue Life for Ball Bearings.
 - b. 11, Load Rating and Fatigue Life for Roller Bearings.
 2. American Society of Mechanical Engineers (ASME): B16.1, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 150.
 3. ASTM International (ASTM):
 - a. A48, Standard Specification for Gray Iron Castings.
 - b. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
 4. Hydraulic Institute Standards (HIS):
 - a. 11.6, Submersible Pump Test.
 - b. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
 5. National Electrical Manufacturers Association (NEMA).
 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code.
 - b. 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.
 7. Underwriters Laboratories Inc. (UL).

1.02 DEFINITIONS

- A. Terminology pertaining to pumping unit performance and construction shall conform to ratings and nomenclature of Hydraulic Institute Standards.

1.03 SUBMITTALS

- A. Action Submittals:
1. Make, model, weight, and horsepower of each equipment assembly.
 2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction, including cable seal details.

3. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity. Indicate separately head, capacity, horsepower demand, overall efficiency, and minimum submergence required at guarantee point.
4. Power and control wiring diagrams, including terminals and numbers.
5. Motor data, in accordance with the requirements of Section 26 20 00, Low-Voltage AC Induction Motors.
6. Factory-finish system.

B. Informational Submittals:

1. Special shipping, storage and protection, and handling instructions.
2. Manufacturer's printed installation instructions.
3. Factory and Field Performance Test Reports and Log.
4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that factory finish system meets requirements specified herein.
5. Suggested spare parts list to maintain equipment in service for period of 1 year. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
6. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
7. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
8. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.01 GENERAL

- A. Submersible, vertical shaft, centrifugal nonclog type.
- B. Designed for continuous operation under submerged or partially submerged conditions, and intermittent operation when totally dry without damage to pump or motor.
- C. Pumps furnished under this section to be provided by a single manufacturer.
- D. Use food-grade type oil and lubricants.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2.02 SUPPLEMENTS

- A. Specific requirements are attached to this section as supplements.

2.03 COMPONENTS

- A. Equipment consists of pump complete with motor, control system, base elbow, power cable, and pump lifting cable and control panel and level switches.
- B. Characteristics:
 - 1. Motor and rotating parts shall be removable from motor end of pump.
 - 2. Mating surfaces to be watertight and fitted with nitrile O-rings.
 - 3. Pumps fitted with dynamically balanced nonclog impellers designed to pass coarse solids and stringy materials.
- C. Lifting Arrangement:
 - 1. Stainless steel chain, 2 feet minimum, and one “grip-eye.”
 - 2. Attach chain permanently to pump and access platform with stainless steel wire rope.
 - 3. “Grip-eye” capable of being threaded over and engaging links of stainless steel chain so pump and motor may be lifted with “grip-eye” and independent hoist.
- D. Motor nameplate horsepower not to be exceeded at head-capacity point on pump curve.
- E. Pump motor and sensor cables shall be suitable for submersible pump application and cable sizing shall conform to NFPA 70 specifications for pump motors. Cables shall be of sufficient length to reach junction boxes without strain or splicing.
- F. Motor Protection Module: If required, provide pump with a motor protection module for remote mounting. Contract Drawings are based on first named submersible pump manufacturer and motor protection module. If pump and motor protection module other than first named manufacturer is provided, provide revised wiring for the motor protection module.

2.04 CONTROL PANEL

- A. NEMA 4X enclosure, for outdoor duty.
- B. Free standing, post mounted.

- C. Features:
 - 1. Main circuit breaker disconnect interlocked with panel door.
 - 2. Combination circuit breaker type, NEMA rated motor starters.
- D. Portable style pump with electrical power cord and plug matching outlet type.
- E. Single Feed: 230 volts, three-phase, 60 Hz.

2.05 ACCESSORIES

- A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in readily visible location.

2.06 FACTORY FINISHING

- A. Prepare, and prime, and finish coat in accordance with Section 09 90 00, Painting and Coating.

2.07 SOURCE QUALITY CONTROL

- A. Pump:
 - 1. Factory Performance Test:
 - a. In accordance with HIS 11.6, for submersible pump tests.
 - b. Include test data sheets. curve test results and performance test logs.
 - 2. Conduct on each pump.
 - 3. Perform under actual or approved simulated operating conditions.
- B. Submersible Motor Functional Test: In accordance with HIS 11.6.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.

3.02 FIELD FINISHING

- A. Equipment as specified in Section 09 90 00, Painting and Coating.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.03 FIELD QUALITY CONTROL

- A. Functional Test: Conduct on each pump.
 - 1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - 2. Flow Output: Measured by plant instrumentation and storage volumes.
 - 3. Test for continuous 3-hour period.
 - 4. Test Report Requirements: In accordance with Hydraulic Institute Standards for submersible pump tests HIS 14.6 and 11.6.

3.04 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:
 - 1. 1 person-days for installation assistance and inspection.
 - 2. 1 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
 - 3. 1/2 person-days for pre-startup classroom or Site training.
- B. See Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.05 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are part of this Specification.
 - 1. Data Sheets: Pump and Motor.

END OF SECTION

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

SUBMERSIBLE PUMP DATA SHEET, 44 42 56.04-01

Tag Numbers: _____

Pump Name: Spare Portable Dewatering Pump

Manufacturer and Model Number: (1) Xylem/Flygt BS 2750 HT

(2) Or Approved Equal

SERVICE CONDITIONS

Liquid Pumped (Material and Percent Solids): Water

Pumping Temperature (Fahrenheit): Normal: 60 Max: 80 Min: 35

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: 1.0

pH: 7.5-9.5

Abrasive (Y/N) N Possible Scale Buildup (Y/N): Y

Min. NPSH Available (Ft. Absolute): _____

PERFORMANCE REQUIREMENTS

Capacity (US gpm): Rated: 200

Total Dynamic Head (Ft): Rated: 40

Min. Rated Pump Hydraulic Efficiency at Rated Capacity (%): _____

Max. Pump Speed at Rated Capacity (rpm): 3,600

Constant (Y/N): Y

Adjustable (Y/N): N

DESIGN AND MATERIALS

Pump Type: Heavy-Duty Nonclog (Y/N): Y Other: _____

Volute Material: Stainless Steel

Pump Casing Material: Stainless Steel

Motor Housing Material: Stainless Steel

Wear Rings Case (Y/N): N Material: _____

Wear Ring Impeller (Y/N): N Material: _____

SUBMERSIBLE PUMP DATA SHEET, 44 42 56.04-01

Tag Numbers: _____

Pump Name: Spare Portable Dewatering Pump

Elastomers: Nitrile Rubber

Fasteners: Stainless Steel

Impeller: Type: Double-Shrouded Non-Clog (Y/N): Y Other: _____
Material: Cast Iron ASTM A48

Shaft Material: All stainless steel.

Base Elbow _____

Double Mechanical Seal (Y/N): Y Bearing Life (Hrs): _____

DRIVE MOTOR (See Section 26 20 00, Low-Voltage AC Induction Motors)

Horsepower: 15 Voltage: 230 Phase: 3 Synchronous Speed (rpm): _____

Enclosure: _____

Other Features: _____

Moisture Detection Switches (Y/N): N

Thermal Protection Embedded in Windings (Y/N): Y

REMARKS: _____

Pump shall be portable type with 3-inch hose fittings.

Provide electrical plug connection to wall outlet, provide appropriate electrical wire length

**SECTION 44 42 56.17
SAMPLING PUMPS**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers' Association (ABMA).
2. Hydraulic Institute Standards (HIS).
3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
4. Underwriters Laboratory (UL).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Make, model, weight, and horsepower of each equipment assembly.
 - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - c. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity.
 - d. Factory finish system.

B. Informational Submittals:

1. Special shipping, storage and protection, and handling instructions.
2. Manufacturer's printed installation instructions.
3. Suggested spare parts list to maintain the equipment in service for a period of 1 year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
4. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
5. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 SUPPLEMENTS

- A. Some specific requirements are attached to this section as supplements.

2.02 ACCESSORIES

- A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.
- B. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer and as specified in Section 05 50 00, Metal Fabrications.
- C. Spare Parts: Provide spare parts to maintain the equipment in service for a period of 2 years.

2.03 FACTORY FINISHING

- A. Manufacturer's standard baked enamel finish.

2.04 SOURCE QUALITY CONTROL

- A. Functional Test: Perform manufacturer's standard, test on pump.
- B. Performance Test:
 - 1. Conduct on each pump.
 - 2. Conduct in accordance with Hydraulic Institute Standards.
 - 3. Perform under simulated operating conditions.
 - 4. Test for a continuous 3-hour period without malfunction.
 - 5. Test Log:
 - a. Record the following: Capacity.
 - 6. Adjust, realign, or modify units and retest if necessary.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Connect suction and discharge piping without imposing strain to pump flanges.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3.02 FIELD QUALITY CONTROL

- A. Conduct tests on each pump.
- B. Functional Tests:
 - 1. Alignment: Test complete assemblies for proper alignment and connection, and quiet operation.

3.03 MANUFACTURER'S SERVICES

- A. See Section 01 43 33, Manufacturers' Field Services.

3.04 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this Specification.
 - 1. Pump Data Sheet, 44 42 56.17-1.

END OF SECTION

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

SAMPLING PUMP DATA SHEET 44 42 56.17- 1

Tag Numbers: N/A

Pump Name: Sample Pump 1 (Clearwell 1)

Manufacturer and Model Number: (1) Grundfos, Type JP05S
(2) Or equal
(3) _____

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Water

Pumping Temperature (Fahrenheit): Normal: 70 Max: 90 Min: 50

Specific Gravity @ 60 Degrees F: 1

pH: 9.3

Abrasive (Y/N): N Possible Scale Buildup (Y/N): Y

Inlet Pressure at Pump (psig): _____

Min. Net Positive Inlet Pressure Available (psia): _____

PERFORMANCE REQUIREMENTS

Rated Capacity: 5 US gpm at 40 psi differential pressure.

Range (US gpm): 1 to 5

DESIGN AND MATERIALS

Pump Body Material: SST

Connections:

Suction: Screwed

Discharge: Screwed

Shaft with Rotor Material: SST

DRIVE MOTOR

Horsepower: < 1 Voltage: 115-230 Phase: 1

Service Factor: 1.60

Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC X CISD-TEFC _____
TENV _____ WPI _____ WPII _____ SUBM _____

Drive Arrangement: Horizontal Offset

REMARKS: Connect pumps to electrical wiring and process piping as shown in contract drawing. Provide spare parts to maintain the equipment in service for a period of 2 years.

Provide ancillary valves (i.e. check valves, pressure relief valves, isolation valves) for a fully functional pumping system.

SECTION 44 44 73
UV SYSTEM

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of the references which may be found in this Section:

1. American Water Works Association (AWWA): F110-12 Ultraviolet Disinfection Systems for Drinking Water.
2. American National Standards Institute (ANSI).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
Water Research Foundation (WRF): Guidance for Implementing Action Spectra Correction with Medium Pressure UV Disinfection. Project Number 4376 (2015).
4. U.S. Environmental Protection Agency (USEPA): Final UV Disinfection Guidance Manual (UVDGM) - 2006 UVDGM.
5. National Fire Protection Association (NFPA): 70, National Electric Code (NEC).
6. National Science Foundation (NSF) / ANSI:
 - a. Standard 60: Drinking Water Treatment Chemicals – Health Effects.
 - b. Standard 61: Drinking Water System Components – Health Effects.
 - c. NSF/ANSI 372, Drinking Water System Components – Lead Content.
7. Underwriters Laboratory, Inc. (UL):
 - a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
 - b. 50E, Enclosures for Electrical Equipment, Environmental Considerations.
 - c. 508, Industrial Control Equipment.
 - d. 508A, Industrial Control Panels.
8. Michigan Electrical Code Rules: Part 8.
9. Michigan Administrative Code: Michigan Department of Environmental Quality (MDEQ), Drinking Water & Municipal Assistance Division, Subpart R 325.10611 Enhanced Treatment for Cryptosporidium; microbial toolbox; inactivation toolbox components.

1.02 DEFINITIONS

A. Definitions of Ultraviolet (UV) Reactor/Component Failure:

1. UV Lamps shall be deemed to have failed when:
 - a. UV Lamp fails to light when powered.
 - b. UV Lamp fails to achieve performance requirements for disinfection specified herein.
 - c. UV Intensity falls below UV Supplier's guaranteed end of life output (with UV Transmittance (UVT) \geq design value; sleeves cleaned by the UV Reactor's automatic cleaning system).
2. UV Sleeves shall be deemed to have failed when:
 - a. UV Sleeve breaks or leaks water while operating within the conditions specified herein.
 - b. UV Sleeve output falls below UV Supplier's guaranteed end of life output immediately after sleeve cleaning by the UV Reactor's automatic cleaning system.
3. UV Ballasts shall be deemed to have failed when: UV Ballasts fail to properly operate UV lamps.
4. UV Intensity Sensors shall be deemed to have failed when:
 - a. UV Intensity Sensors are not able to be calibrated at the factory.
 - b. Duty Sensors drift out of calibration more than twice per month when checked with the reference intensity sensor per USEPA guidelines. Duty sensors shall be deemed out of calibration if intensity value at 100 percent lamp power differs from reference sensor intensity value by more than 20 percent absolute value.
5. UVT Analyzer shall be deemed to have failed when:
 - a. UVT Analyzer drifts out of calibration more than once per week when checked weekly against a bench-top spectrophotometer per USEPA guidelines. UVT analyzer shall be deemed out of calibration if UVT analyzer reading differs from bench-top UVT reading by more than 2 percent absolute value.
 - b. UVT Analyzer fails to operate properly.
6. UV Reactor shall be deemed to have failed when:
 - a. Minimum required Reduction Equivalent Dose (RED) or log inactivation, as specified herein, cannot be achieved under conditions that include flow, UVT, and lamp and sleeve life within design values.
7. Substantial Completion shall be granted when:
 - a. All testing, training, and O&M submittals have been reviewed and approved by Engineer and Owner.
 - b. Warranty period for equipment guarantees shall commence upon Substantial Completion.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

1.03 SUBMITTALS

A. Shop Drawing:

1. Package 1 – Due 3 Weeks from General Contractor Notice to Proceed:
 - a. List mechanical components of UV System and provide complete catalogue information, descriptive literature, specifications, and identification of materials of construction, including spare parts.
 - b. Detailed UV reactor information including make/model, pressure rating, flange size, headloss curve, min/max flow rate, min/max UVT, min/max RED, min/max log inactivation, reactor support requirements, quantity/location of UV lamps and intensity sensors, cooling water requirements or maximum time without cooling water limitations, lamp cool-down/warm-up requirements, and air-release/drain line connection details.
 - c. Validation Test Report: Full, detailed report with third party signature, raw data, and documentation of all reactor performance validation testing per the 2006 USEPA UVDGM. Include complete checklists 5.1 through 5.5 of the UVDGM, signed and dated by the Supplier.
 - d. Drawings showing plan layout, cross-sections, dimensions, critical clearances, installation requirements, and all interconnections and interface requirements (power, controls, instrumentations, etc.). Identify separately-mounted components, connections to other work, critical clearance requirements, interconnections and interface requirements, and the validated hydraulic configuration.
 - e. Provide all UV Equipment weights (dry and wet) and equipment anchoring criteria for design of structural support by Engineer.
 - f. Summary of UV System control strategy including UV dose equation or calculations as a function of flow, UVT, Validation Factor, target organism inactivation, lamp age/sleeve fouling factors, and action spectra correction factor. Provide graph or table of min/max RED as a function of flow, UVT, S/So, and ballast intensity.
 - g. Provide summary calculations to show compliance of the minimum required UV dose at the worst-case design conditions that were utilized as the basis for the capital sizing of the UV System.
 - h. Input power voltage, frequency, and phase requirements, total system maximum power load, power quality thresholds, and ballast turndown capabilities.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- i. Specifications for all interconnecting cables between the UV equipment, including voltage ratings, insulation type, conductor material and cable/conductor outside diameter, maximum cable length, and cable terminator type and quantity.
- j. Details of control and power panels including internal and external panel layouts, dimensions, access requirements, materials of construction, bill of materials, electrical schematics, and wiring diagrams. Include software and hardware component details.
- k. Installation List in United States for Cryptosporidium inactivation credit; including regulatory agency/utility for installation, capacity, and date of installation.
- l. Lamp data including watt rating, lumen output data, 3rd party verified lamp aging factors, mercury content and lamp validation information.
- m. Quartz sleeve data including materials of construction, transmittance data, sleeve fouling/aging factors, and sleeve validation information.
- n. Complete description of the automatic lamp sleeve cleaning process and its maintenance requirements.
- o. Details of duty and reference UV intensity sensors including sensor traceability and uncertainty from linearity, temperature response, spectral response, angular response, and long-term drift. Include calibration requirements necessary for compliance with UVDGM requirements.
- p. Complete description of UVT analyzer. Include O&M requirements, layout diagram w/ inlet/outlet piping/valves, and electrical/controls requirements.
- q. Guaranteed lamp life, sleeve life, sensor life and unit cost for replacement parts.
- r. Dimensional UV System pipe layout drawings for Base Bid or Alternate Bid layout to demonstrate it will provide at least 5 straight pipe diameters upstream of the UV reactor's upstream flange, as described in the USEPA 2006 Final Ultraviolet Disinfection Guidance Manual (UVDGM). UV Supplier shall verify that piping arrangement shown in Contract Drawings is acceptable.
- s. CFD Model results per WRF #4376 Guidance (if required). If less than 5 straight pipe diameters provided and/or if hydraulics elements (e.g., straightening vanes) are required to be installed to ensure proper inlet flow conditions, UV Supplier shall include drawings of such elements and include the costs for the elements in the cost of the UV System and CFD analysis to demonstrate UV dose delivery is sufficient, or if additional safety factors must be included to account for hydraulic impacts. UV Supplier shall

- submit computational fluid dynamics (CFD) analysis to demonstrate influent flow characteristics in proposed piping arrangement (with additional hydraulic elements, if required) will provide design log inactivation as required with or without UV dose safety factors included in the dose equation. The CFD modeling work must be in accordance with the requirements of WRF #4376's Appendix J Checklists.
- t. Include a memorandum summarizing the action spectra correction factor (ASCF) to be applied for operation. Use a validation-specific ASCF determined from CFD modeling or the appropriate value from the look-up tables from Appendix B included in Water Research Foundation (WRF) Web Report #4376, 2015, entitled, "Guidance for Implementing Action Spectra Correction with Medium Pressure UV Disinfection." If a validation-specific ASCF is included, the CFD modeling work must be in accordance with the requirements of WRF #4376's Appendix J Checklists. The memorandum must summarize the derivation of the ASCF, its application to this specific project, and describe the value or range of values to be used. The memorandum must also summarize how the UV controls will be programmed to incorporate the ASCF during operation.
2. Package 2 – Due 30 Days from General Contractor Notice to Proceed:
 - a. Detailed description of instrumentation and control system, including a list of all functions monitored, controlled, and alarmed. Describe all automatic shutdown features and interfaces with the Ann Arbor Water Treatment Plant (AAWTP) Supervisory Control and Data Acquisition (SCADA) system.
 - b. Process and instrumentation diagrams and description of all functions monitored, controlled, and alarmed.
 - c. Control system block diagram(s) including the Human Machine Interface (HMI(s)), Programmable Logic Controller (PLC(s)), and control networks. Proposed layouts and development of all HMI screens for control of the UV disinfection system.
 - d. Fully documented input/output (I/O) printouts.
 - e. Equipment delivery, storage, and installation requirements. Include instructions for delivering and installing control/power panels in sub-components and field assembling and wiring.
 - f. Draft Operation and Maintenance Manual.
 - g. Factory Acceptance Test Plan: Provide a narrative of the test plan and data to be recorded and analysis to be completed, including all forms for recording data during the test.
 - h. Functional Test Plan: Provide a narrative of the test plan and data to be recorded and analysis to be completed, including all forms for recording data during the test.

- i. Performance Test Plan: Provide a narrative of the test plan and data to be recorded and analysis to be completed, including all forms for recording data during the test.

B. Quality Control Submittals:

1. Final Factory Acceptance Test data sheets and witness report.
2. UV Supplier's Certificate of Proper Delivery for all UV Supplier supplied equipment.
3. UV Supplier's Certificate of Proper Installation for all UV Supplier supplied equipment, including factory disassembly and field reinstallation instructions.
4. Functional Testing Report: Provide a narrative and data summary of the Functional Testing discussing each element requiring testing, the tests performed, and the results. Functional Testing is not complete until this report is submitted and accepted by the Engineer.
5. Performance Testing Report: Provide a narrative and data summary of the Performance Testing discussing each element requiring testing, the tests performed, and the results. Performance Testing is not complete until this report is submitted and approved by the Engineer.
6. Resume or qualifications for UV system operations trainer.
7. Training agenda and presentation.

C. Contract Closeout Submittals:

1. Final Operation and Maintenance Manuals as specified in the Division 1, including detailed wiring diagrams for panels and equipment.
2. List of all original equipment by model and part number (detailed bill of materials). List manufacturer names, addresses, and phone numbers.
3. Service records for maintenance or calibration reports for calibration performed during construction or testing activities.
4. Spare parts documentation.
5. Warranty information.

1.04 EXTRA MATERIALS

A. Provide the following spare parts:

1. UV Lamps: One set for single UV reactor.
2. Sleeves: Two.
3. Ballasts: Two.
4. Ballast Cooling Fans: Two.
5. Duty UV Sensor: Two.
6. Reference UV Sensor: Three (3) Sensors total for facility.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

7. Complete set of cleaning system wiper assemblies for one reactor.
8. Complete set of special tools to disassemble or adjust the UV System.
9. Complete set of O-rings seals for one reactor.
10. One year's supply of cleaning chemicals or cleaning system parts, (if applicable) based on four wipe cycles per day.
11. Spare parts for 1 year's operation of the UVT analyzer including 100 percent UVT calibration solution.
12. Spare Fuses: One of each size and type provided.
13. Spare parts for programmable controllers:
 - a. One of PLC processor used.
 - b. One of each type of I/O module used.
 - c. One of each type of mounting chassis used.
 - d. One of each type of communications module used.
14. Provide Industrial Ethernet network switches as needed in each panel for Ethernet communications between PLCs and HMIs.
15. Three (3) pairs of eye protective goggles and gloves.
16. One set of spare air filters for electrical cabinets.

PART 2 PRODUCTS

2.01 GENERAL

- A. Products that will be in contact with potable water shall have NSF 61 certification and comply with NSF/ANSI 372 requirements for lead content. Chemicals used by the UV Supplier shall have NSF 60 certification.
- B. The complete electrical assembly shall meet all requirements of the National Electrical Code (NEC), the National Electrical Manufacturers Association (NEMA), the National Fire Protection Association (NFPA), UL and all applicable local electrical codes.
- C. Components, including equipment, coatings and other parts of the UV System, shall comply with American Water Works Association (AWWA) standards, unless specified otherwise.
- D. All terminal point connections shall be ANSI standard flanges.

2.02 DESIGN CRITERIA

- A. The existing water treatment system at the City of Ann Arbor Water Treatment Plant (AAWTP) includes rapid mixing, flocculation, lime softening, recarbonation, ozonation, filtration, and final disinfection with chloramines. The raw water is sourced from the Huron River and a well field located near the Ann Arbor, Michigan airport.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. The UV System will be located downstream of the filter effluent clearwells.
- C. The UV System will be installed inside the AAWTP transfer pump room for transfer pumps 4-6. All UV system components will be located in the transfer pump room, including the UV Control and Power Panels (CPPs) and ultraviolet light transmittance (UVT) analyzers. The temperature inside the building is expected to be maintained between 50 and 80 degrees F. Relative humidity may range from 30 to 99 percent.
- D. Provide UV System meeting the following design basis:

1.	Total Number of UV Reactors:	1 active; 1 standby
2.	UV System Flow:	Minimum: 5 mgd Average: 15 mgd Maximum: 25 mgd
3.	Reactor Flange Size:	24-inch only
4.	Water Temperature Range:	40 to 81 degrees F
5.	Hardness (mg/L as CaCO ₃):	Average: <133
6.	Iron (mg/L as Fe):	Average: < 0.1
7.	Turbidity (NTU):	Maximum: < 1
8.	pH:	Average: 9.3
9.	Total Chlorine:	Maximum: < 4 mg/L
10.	Design UV RED:	As required to meet pathogen performance
11.	UV Transmittance @ 254 nm:	Minimum (99th percentile): 88% @ 25 mgd Average: 90 percent Maximum: 94 percent
12.	Pathogen Performance:	3.0 LOG Inactivation (min) <i>Cryptosporidium</i> 3.0 LOG Inactivation (min) <i>Giardia</i>

- E. Under the USEPA UVDGM, UV reactor shall be validated to provide minimum pathogen inactivation requirement over the full range of flows, UV dose, and water characteristics at the end of lamp life and under fouled quartz sleeve conditions. Validated operating conditions for the UV System shall include UVT less than or equal to 75 percent, flowrate greater than or equal to 25 mgd, and log inactivation of *Cryptosporidium* and *Giardia* greater than or equal to 3.0.
- F. Validation Testing shall be compliant with the 2006 UVDGM and testing shall be completed, with Validation Test Report available, at the time of bid opening.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- G. The UV System shall have been validated with a minimum flowrate no greater than 1 mgd. The UV System shall have been validated with a maximum UVT of at least 97 percent.
- H. The UV System shall be programmed, consistent with the Final UVDGM, such that UVT greater than the maximum validated UVT shall be considered equal to the maximum validated UVT in the UV System programming and dose calculations. No extrapolation of system performance shall be allowed.
- I. UV Design Dose for UV System Sizing:
 - 1. Reactors must produce a Validated Dose (Dval) equal to or greater than 12 mJ/cm^2 . The calculated Reduction Equivalent Dose (RED) at the design conditions must be greater than the product of the required dose (e.g., 12 mJ/cm^2 for 3.0-log *Cryptosporidium*) and the validation factor (VF) calculated per the 2006 UVDGM for *Cryptosporidium* based on MS-2 bacteriophage.
 - 2. The average value of S/S_0 from all intensity sensors within the reactor shall be utilized when determining the Validated Dose.
 - 3. The product of the end of lamp life aging factor (ELAF) and the quartz sleeve fouling/aging factor (QSFF) shall be incorporated into the UV design dose.
 - 4. The ELAF provided by the UV Supplier shall be based on the 3rd party verified lamp output as a fraction of specified new lamp output after 100 hours of operation. The maximum ELAF allowed is 0.90. If no 3rd party certification is submitted the ELAF shall be no higher than 0.80.
 - 5. If an alternate end of lamp aging factor is used, third-party certification (signed by a registered professional engineer) of the factor and the conditions under which it was determined shall be provided.
 - 6. The QSFF shall be 0.90 for UV Systems with automatic mechanical/chemical cleaning mechanism and 0.8 for UV systems with automatic mechanical cleaning mechanism only.
 - 7. The ASCF for any surrogate organism used in validation of a medium pressure lamp reactor shall be automatically calculated based on validation specific ASCF in 2015 WRF Guidance or more recent if applicable.
- J. UV Reactor Headloss: Maximum of 30 inches measured from inlet to outlet flange at maximum reactor flow rate design flow rate of 25 mgd.
- K. Input Voltage: 480 Volts Alternating Current (VAC), 60 Hz, 3-phase, 3-wire. UV System shall be capable of operating during a 30 percent voltage drop from nominal, without shutting down. UV System shall be capable of operating during an 8 millisecond voltage drop without shutting down.

- L. All reactor components shall be designed to handle pressures of up to 150 psig and shall be fully assembled and hydrotested at 1.5 times the design pressure at the factory prior to shipment and recorded as part of the Factory Test report.
- M. The UV System shall be comprised of the following components:
 - 1. UV Reactor(s) including lamps, quartz sleeves, and appurtenances.
 - 2. Calibrated UV Intensity sensor(s):
 - a. One (1) duty intensity sensor per lamp for medium-pressure UV Systems.
 - b. Reference UV sensor: refer to Section 1.04, Extra Materials. The UV System shall be able to continue providing disinfection while the UV intensity sensor is being calibrated or checked for calibration.
 - 3. Automatic Cleaning System:
 - a. One per reactor, required.
 - b. The UV System shall be able to continue providing disinfection while the automatic cleaning system is in operation.
 - 4. Local Control/Power Panel(s):
 - a. One per UV reactor.
 - b. Includes lamp ballasts, PLC, remote I/O panels, HMI, and interconnecting power and control wiring between UV reactor and local control/power panel.
 - 5. UV Transmittance (UVT) Analyzer Monitor:
 - a. Two units.
 - b. As specified herein.

2.03 UV SUPPLIERS

- A. Materials, equipment and accessories specified in this section shall be products of:
 - 1. Base Bid: Trojan Technologies (London, ON); UVSWIFT Series.
 - 2. Alternate Bid: Calgon Carbon Corporation (Pittsburg, PA); SENTINEL Series.

2.04 UV SUPPLIER SCOPE OF SUPPLY

- A. The UV System shall be furnished by the UV Supplier, complete with all:
 - 1. Validated UV reactors.
 - 2. UV reactor power supplies.
 - 3. Power cables between the power panels and the reactors.
 - 4. UV lamps.
 - 5. Quartz sleeves.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

6. Lamp power ballasts.
 7. Calibrated duty and reference UV intensity sensors.
 8. Automatic cleaning system.
 9. Cleaning chemicals (if applicable).
 10. Electrical and control wiring and programmable controllers within the UV reactor and power/control cabinet(s).
 11. UV transmittance analyzers.
 12. UV reactor temperature and level switches, for a complete and operable UV System.
 13. CFD modeling of piping, if required, to show UV dose delivery meets or exceeds validation testing and hydraulic impacts have been accounted for in UV dose delivery.
- B. UV supplier shall be provide factory testing, installation assistance, functional testing, and performance testing as defined herein:
1. Coordination with Installing Contractor to ensure UV equipment and piping arrangement meets minimum requirements for UV hydraulics, equipment access, and bracing.
 2. Assistance during product installation to include observation, guidance, instruction of Installing Contractor's assembly, erection, installation, or application procedures.
 3. Completion of field wiring inside UV control panels to facilitate delivery and installation of panels in sub-pieces.
 4. Inspection, checking, and adjustment as required for the product to function as warranted by the UV Supplier and as necessary to furnish written approval of the installation.
 5. Revisiting the site to correct problems until installation and operation are acceptable.
 6. Resolution of assembly or installation problems attributable to or associated with the UV Supplier's products and systems.
 7. Conducting or assisting in equipment and system testing as specified.
 8. Training of personnel in the O&M of products provided as specified.

2.05 SCOPE OF SUPPLY FOR INSTALLING CONTRACTOR

- A. Installing Contractor shall be responsible for supplying and installing all the necessary materials, equipment and appurtenances not supplied as part of the scope of supply for the UV System, but required for a complete, functional and operational UV System including, but not limited to:
1. Structural supports required to install the UV reactors or piping.
 2. UV reactor drain and vent valves/piping.

3. All the hardware, fasteners, anchor bolts, nuts, plates and angles necessary for the installation of the UV System. All hardware, fasteners, anchor bolts, nuts, plates, angles, etc. shall be Type 316 stainless steel.
4. All mating flanges, insulating flanges, couplings, gaskets, bolts, nuts, and all necessary piping specialties to install the reactors, and analyzers, supplied by the UV Supplier. Mating flanges shall be as required in the pipe schedule. All bolts, nuts shall be Type 316 stainless steel. Gaskets shall be ethylene propylene diene monomer rubber (EPDM).
5. All conduit, fittings, supports, hubs and wiring including wire terminations and terminators necessary for the complete installation of the UV reactors, CPPs, instruments, analyzers, devices and HMIs supplied as part of the UV System.
6. All the equipment supports, U-bolts, and all necessary hardware to install all the ancillary equipment supplied by the UV Supplier. Ancillary equipment shall include UVT analyzers, control and power panels, and other equipment needed for a fully functional and validated UV System.
7. Power supply wiring and conduits to the UV CPPs.
8. UV master control panel and system integration to AAWTP SCADA.
9. Provide on-site assistance to UV Supplier during Equipment Delivery, Installation, Functional Testing and Performance Testing as defined in the Performance Test Procedures developed by the UV System Supplier and approved by the Engineer.

- B. Installing Contractor shall refer to the UV Supplier's Submittal's for additional requirements.

2.06 UV REACTOR

A. General Requirements:

1. **Materials of Construction:** The UV reactor shall be welded Type 316L stainless steel, pickled, passivated, and bead blasted for uniform external finish. Each reactor shall be supplied with American National Institute (ANSI) Class 150 flanged, 24-inch nominal pipe size inlet/outlet connections. All metal parts in the reactor shall be constructed of Type 316L, pickled and passivated stainless steel. All nonmetallic materials in the reactor shall be suitable for continuous exposure to UV light.
2. Quartz sleeves shall be high purity, rated for maximum possible UV transmittance, and accounted for in UV dose and validation.
3. Each lamp shall be enclosed in an individual quartz sleeve, sealed with compressed O-rings.
4. Each quartz sleeve shall be independently sealed within the reactor.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

5. The UV reactor shall be designed such that AAWTP operating personnel can change the lamps without draining the reactor.
6. The UV reactor shall be provided with an access port for easy maintenance of the quartz sleeves, cleaning system, and sensor calibration and maintenance.

B. UV Lamps:

1. The UV lamps shall be medium pressure (MP).
2. The filament shall be rugged to withstand shock and vibration.
3. The lamp bases shall be resistant to UV.
4. The lamps shall be operated by electronic or electromagnetic ballasts with multiple power settings ranging from at least 40 percent to 100 percent maximum power using at least 1 percent power setting steps as validated conditions.
5. The UV lamps shall be guaranteed for a minimum number of operation hours prior to lamp output reaching the ELAF. A minimum of four on/off cycles shall be allowable for the lamps every 24 hours. For medium pressure lamps, the minimum lamp life shall be 5,000 hours.
6. Manufacturer's unit cost for replacement lamps shall include cost to accept and properly dispose of used lamps.

C. UV Lamp Quartz Sleeves:

1. Manufacturer:
 - a. General Electric Type 214, fully annealed clear fused quartz tubing.
 - b. General Electric Type 021A, dry synthetic clear fused quartz tubing.
 - c. Or equal.
2. The open end(s) of the lamp sleeve shall be sealed by means of an O-ring and Type 316 stainless steel compression plate.
3. The UV lamp sleeves shall be guaranteed for a number of operation years. At the end of guaranteed sleeve life, sleeve output shall be greater than or equal to 90 percent of new sleeve output immediately after sleeve cleaning.

D. UV Intensity Sensor(s):

1. Only germicidal UV sensors, as defined in the UVDGM, shall be allowed.
2. A minimum of one duty UV sensor is required per MP lamp.
3. "Wet" Intensity Sensors shall not be used.

E. Automatic Lamp Sleeve Cleaning System:

1. Each UV reactor shall be equipped with an automatic quartz sleeve cleaning system.
2. The cleaning system shall provide cleaning abilities for the lamp sleeves and UV sensor.
3. Automatic cleaning systems shall be:
 - a. Fully operational while still providing disinfection.
 - b. Complete with an automatically initiated and controlled cleaning cycle.
 - c. Field adjustable timing via the operator interface.
 - d. Manual cleaning system operator control shall be available through the operator interface.
4. Cleaning system components/fluids used shall be NSF 60 approved.

2.07 UV SYSTEM CONTROL AND POWER PANELS (CPP)

A. General:

1. All electrical components are to be housed in stainless steel, NEMA 4X or greater rated enclosures, unless indicated otherwise.
2. Prewire CPP to the extent possible. Enclosures shall be designed for modular assembly in the field, rather than being assembled in the factory and shipped and installed as a whole unit. Provisions for field wiring and testing shall be included in the design.
3. For communication circuits, provide cable and connectors per device manufacturer's recommendations. Provide measurements to verify lead length limitations on communication circuit cabling have not been exceeded.
4. Electrical cables shall have jackets that will not degrade after prolonged exposure to UV light.
5. Provide removable eye bolts to facilitate sling handling of each panel. Eyebolt mounting shall be part of structural support bracing to distribute stresses and enclosure weight while sling handling enclosures during installation.
6. Panel-mounted computers shall be installed in field and are not to be shipped with panel.

B. Fabrication:

1. Construct with structural reinforcements to ensure a plane surface, limit vibration, and to provide rigidity during shipment, installation, and operation without distortion or damage. Cabinets and internal components shall be secured and reinforced to permit a 90 degree rotation for transporting and installation.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Panel seams shall be continuously welded and ground smooth to be undetectable after painting.
3. Cabinets shall have a total clearance of not less than 2 inches from face of backplate mounted devices to rear of door mounted devices.
4. On backplate, provide interior LED light fixture with door switch and white duplex convenience outlet with on/off circuit breaker powered from 120V ac control transformer.
5. Construct panel layout and equipment spacing to allow for device removal, calibration, and maintenance without disassembly of adjacent devices.
6. Do not perforate external surface of enclosure for purpose of mounting enclosure components (both internal and external) without prior permission of Engineer. Enclosure components requiring such fixation shall utilize fusion welded capacitor discharge type studs.
7. Isolate electrical components from wetted parts.
8. Arrange components in enclosure such that failure of a component requires removal of failed component only.
9. Systems where groups of components are enclosed and serviced as a subsystem will not be permitted.
10. Internal wiring shall run through ducts.
11. Provide separate 120V ac plant UPS circuit within each enclosure to power PLCs, and HMIs, and a white duplex outlet on backplate for panel use of electronic instruments.
12. Terminal Blocks:
 - a. Install terminal blocks, relays, and other wiring and devices on panel backplate.
 - b. Separately mount and identify terminal strips used for power, analog inputs, analog outputs, digital inputs, and digital outputs.
 - c. Order of terminal block sections, one for each card, shall match order of cards as they appear in rack. Each terminal block section shall match numbering convention of card.
 - d. Provide terminal blocks for used and spare PLC I/O cards.
13. Coordinated breaker protection required from a control panel main breaker, to downstream distribution breakers.
14. Digital, analog and power devices such as relays, terminals and wire must be separated and clearly marked.
15. Control Wiring:
 - a. Segregated within each panel based on voltage.
 - b. Voltages above 120 volts shall be separated by a solid metal barrier.
 - c. Analog and discrete control wiring shall be kept separate from 120V ac, and 480V ac and higher.
 - d. Control: Minimum 14 AWG for 120V ac.
 - e. Analog: Minimum 16 AWG.

- f. Size wire for connected loads and include calculations for verification, showing appropriate derating, where needed.
16. HMI:
- a. Devices mounted on front door shall be suitable for application and selected to match each other and present a coordinated aesthetically pleasing functional arrangement.
 - b. Symmetrically arrange devices and functionally group devices to enable operators to easily locate groups of devices or individual devices to control the process.
 - c. Install devices mounted on enclosure front door rigidly and within view level heights.
 - d. Center of HMI shall be installed at approximately 5 feet above surrounding floor for ease of operation. Arrange other devices such as selector switches, pushbuttons and indicating devices below.
- C. Safety Interlock:
- 1. Prevents panel from being opened when main panel electrical disconnect is closed. Alternatively, interlock may be provided to disconnect power from panel when door is opened.
 - 2. In accordance with panel ratings of UL, local ordinances, and plant safety rules noted herein.
 - 3. Manufacturer and Product: Square D, Class 9422 Cable Operator.
- D. Emergency Stop Pushbuttons:
- 1. Each Panel: Push-to-stop, pull-to-reset, lockable, large diameter red mushroom head, heavy-duty, corrosion-resistant, NEMA 4X pushbutton.
 - 2. Manufacturer and Product: Allen Bradley; Type 800H.
- E. Enclosure:
- 1. House electrical components in NEMA 4X enclosure.
 - 2. Provide with flush hinges and automotive-type latch capable of accepting a shackle padlock.
 - 3. Doors:
 - a. Open through 180 degrees without restriction.
 - b. Provide three-point latch assembly for 3-foot-high and larger doors.
 - 4. Construct to accommodate accessories such as power, power supplies, mounting hardware, terminal blocks, and signal conditioning or conversion equipment that may be necessary for monitored and controlled equipment mounted in enclosure.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

5. Internal Back Panel: Removable type, mounted 2 inches clear from rear of panel.
 6. Do not install devices on side plates.
 7. Supply enclosures containing PLCs or HMIs with print pockets, located on inside bottom of enclosure door. Make and color of print pocket shall be same as enclosure interior.
 8. Factory Finish:
 - a. Exterior: Powder-coated ANSI grey.
 - b. Interior: Gloss white.
- F. Harmonics:
1. Limits: In accordance with IEEE 519.
 2. Provide harmonic mitigation in order that total harmonics, both voltage and current, do not exceed 5 percent, and individual harmonics do not exceed 3 percent, at input terminals of panel.
- G. Cooling and Heating:
1. General: Refer to Section 2.02 for details on expected environmental conditions.
 2. Maximum Temperature:
 - a. Provide cooling to prevent high temperatures from shortening life of equipment mounted inside.
 - b. No location within panel or interior of equipment mounted inside shall reach temperatures higher than 40 degrees C.
 3. Minimum Temperature:
 - a. Electric heating to prevent low temperatures from causing condensation or freezing of equipment mounted inside.
 - b. No location within panel or interior of equipment mounted inside shall reach temperatures below 5 degrees C.
 4. Air Ventilated Panels:
 - a. Furnish with louvers and forced ventilation as required to prevent temperature buildup from equipment mounted inside panel or on panel.
 - b. For panels with backs against wall, furnish louvers on top and bottom of panel front.
 - c. Louver Construction: Stamped sheet metal.
 - d. Ventilation Fans:
 - 1) Furnish where required to provide adequate cooling.
 - 2) Create positive internal pressure within panel.
 - 3) Motor: 120V ac, 60 Hz, thermostatically controlled.

- e. Air Filters:
 - 1) Washable aluminum.
 - 2) Manufacturer and Product: Hoffman; Series A FLT.

H. Power Transformer:

- 1. CPPs of each UV system shall be powered by 480 volt plant electrical supply.
- 2. Dry type, copper winding, and emit noise at less than 82 dBA.
- 3. UV supplier shall include, if necessary, transformer to supply required voltage for CPP within CPP or in separate enclosure of equal construction.

2.08 INSTRUMENTATION AND CONTROL

A. Instrumentation and Controls - General:

- 1. One CPP is provided for each UV reactor. All control hardware and software for a given reactor is contained within the associated CPP.
- 2. Provide instrumentation and control for the UV System, which allows for the UV disinfection process to be fully automated and deliver the required UV dose under conditions of varying flow rates, UV lamp intensity and varying UV transmittance.
- 3. Program functions, I/O addresses, and internal registers within PLCs shall be accessible by Owner's SCADA system or master control panel.
- 4. Coordinate register units, ranges, and conventions to facilitate data exchange.
- 5. Provide hard and native format electronic copies of software installed in UV supplier's PLC and HMIs, annotated to carefully detail program instruction functions and purposes. Minimum control, monitoring and alarm signals/information are detailed in Paragraph Functional Requirements.

B. The graphic display screens for the UV System HMIs shall match the color usage configuration of the AAWTP SCADA workstations. General formatting and screen navigation shall be manufacturer standard.

C. Programmable Logic Controllers (PLCs):

- 1. Communications:
 - a. Serial A-B DF1 full-duplex and 10/100 Mbps EtherNet/IP communications ports.
 - b. Utilize Serial communications for UV dosimeter communications.
 - c. Utilize 10/100 Mbps EtherNet/IP communications for HMIs and plant SCADA.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Power Supply Module: As required.
3. Digital Input Module: Provide isolated inputs.
4. Digital Output Module: Provide relay outputs.
5. Analog Input Module: Provide 4-20 mA, isolated.
6. Analog Output Module: Provide 4-20 mA isolated.
7. Spare I/O: Provide 20 percent spare I/O capacity for each PLC, minimum.
8. Manufacturer and Product: Allen-Bradley; CompactLogix 1769 L35E b/c Series, or equal.

D. Human-Machine Interface Unit (HMI):

1. Panel-mounted graphical operator interface capable of bidirectional communication with PLC-based control system.
2. Mount in each CPP.
3. Include cables and ports to interface with PLC control system, personal computers, and external compact flash drives.
4. Graphic Display Screens: Match configuration of plant control system workstations with respect to color usage conventions, general formatting, and screen navigation.
5. Manufacturer and Product: Allen-Bradley; Panel mount touch-screen PC with factory talk view me.

E. Control System Hierarchy:

1. UV supplier shall apply through hardware and PLC/HMI software the following standard control hierarchy/modes to SCADA controlled devices:
 - a. LOCAL:
 - 1) When controlled device's physical LOCAL/REMOTE switch is placed in LOCAL, operator has direct control over each device by means of its physical controls, situated at device.
 - 2) Mode prevents SCADA manual and automatic control functions.
 - 3) SCADA system retains device status monitoring functions under control mode.
 - 4) Switching between LOCAL and REMOTE shall be bumpless, retaining last operational status.
 - b. REMOTE MANUAL (MANUAL):
 - 1) When device's physical LOCAL/REMOTE switch is placed in REMOTE, device control has been turned over to SCADA system, disabling local controls, except emergency stop and safety related control functions such as hardwired interlocks.

- 2) A device's AUTO/MANUAL control mode state is retained within its controlling PLC, switchable by software means through HMI based controls.
 - 3) MANUAL software controls mimic device control features available locally at device, allowing direct remote control over individual devices.
 - 4) Under normal circumstances, switching between MANUAL and AUTO shall be bumpless, unless current process state satisfies predefined AUTO control conditions, in which a device or set of devices may start or stop immediately.
 - 5) Operator shall have capability of start/stop equipment set in MANUAL control mode.
- c. REMOTE AUTO (AUTO):
- 1) With device's LOCAL/REMOTE physical switch remaining in REMOTE position and its SCADA based control placed in AUTO, a device or a set of associated devices in a larger process unit, shall be automatically controlled by logic and associated setpoints within PLC(s), generally without user intervention.
 - 2) MANUAL controls are disabled.
 - 3) Switching between AUTO and MANUAL shall be bumpless.
 - 4) Operator shall have capability to adjust control setpoints and parameters of equipment set in AUTO control mode.
2. Operator shall have capability to open/close valves or adjust position when applicable.
 3. Provide safeguards and warnings to prevent accidental change of state.
 4. Functional Requirements:
 - a. UV control system shall calculate UV RED based on flow rate through UV reactor, UV transmittance, and UV intensity measurements in UV reactor.
 - b. UV control system shall apply VF, calculated if required, and report Dval and log inactivation of *Giardia* and log inactivation of *Cryptosporidium*.
 - c. UV reactor flow rate shall be read by CPP's PLC from a specific register in plant PLC, to which flow meters are wired.
 - d. UV transmittance signal shall be read by CPP's PLC from a specific register in plant PLC to which UV transmittance analyzer is wired.
 - e. UV control system shall maintain required UV dose and log inactivation and send an alarm to plant control system if it is unable to maintain dose and log inactivation setpoints.
 - f. UV control system shall monitor for equipment failure or malfunction and shut down reactor in response to such a failure.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- g. Emergency STOP pushbutton shall shut down reactor and send shutdown signal to plant control system.
 - h. Plant main SCADA shall provide permission to start a UV reactor. If permission is given, UV reactor shall be allowed to warm up.
 - i. UV supplier shall provide monitoring of influent and effluent valves.
 - 1) Coordinate with Owner's System Integrator regarding details of interfacing and communications with influent and effluent valves and transfer pumps.
 - 2) Provide UV reactor status and request for valve open or close depending on UV reactor status.
 - j. UV supplier and Owner's System Integrator shall provide synchronization mechanisms and logic within their systems such that UV control system HMI and SCADA alarm display and acknowledgement maintains synchronization.
5. UV PLC shall communicate signals with plant PLC by way of the following protocol:
- a. Where data from one PLC is needed by another PLC over a network connection, noncached message commands are used to READ data between PLCs. In order to avoid overwriting local control commands in a receiving PLC, use of WRITE messages is not allowed.
 - b. Analog data shall be written to a Real data array, and discrete data written to a Double Integer data array in remote PLC then READ by receiving PLC.
 - c. Arrays shall not exceed 125 elements, as this corresponds to 500-byte limit for a single schedule connection between Logix processors.
 - d. UV PLC Outputs:
 - 1) Write monitoring signal values to independent "Output File" resident in UV PLC.
 - 2) Plant PLC shall read monitoring signal from independent "Output File" resident in UV PLC.
 - e. UV PLC Inputs:
 - 1) Plant PLC shall write control instruction signal value to independent "Output File" resident in plant PLC.
 - 2) UV PLC shall read control signal values from independent "Output File" resident in plant PLC and move data into independent "Input File" resident in UV PLC.

F. Inputs / Outputs:

1. The following signals shall be available to the UV System from the UV Master Control Panel (by Others) through PLC Ethernet Network as a minimum:
 - a. Effluent Valve Open Status.
 - b. Influent Valve Open Status.
 - c. UV Reactor Run Enable Permissive.
 - d. Feed Water UV Transmittance.
 - e. UV Dose Target or Inactivation Target Setpoint.
 - f. Backup UV Reactor Status (Standby, Offline).
2. The following signals are to be sent to the UV Master Control Panel (by Others) via Ethernet/IP:
 - a. Monthly and Daily Cumulative Flow (MG).
 - b. Monthly and Daily Cumulative Off-Spec (MG).
 - c. UV Reactor Instantaneous Flow Rate (MGD)
 - d. UV Reactor Runtime (in disinfection mode) Hours per Day and Month.
 - e. Wiper Revolutions per Hour or Day Counter Setpoint.
 - f. Ballast ON/OFF.
 - g. Ballast Power Level.
 - h. Lamp ON/OFF status (each lamp).
 - i. Remote ON/OFF Control (e.g., from AAWTP SCADA or UV MCP).
 - j. Reactor Running Status (disinfecting on-spec, disinfecting – off-spec (alarm), warming, shutdown, ready standby, offline).
 - k. Critical Alarm Out.
 - l. Major Alarm Out.
 - m. Minor Alarm Out.
 - n. Effluent Valve: Open Command.
 - o. Effluent Valve: Close Command.
 - p. Wiper Extend (Motor Control).
 - q. Wiper Retract (Motor Control).
 - r. System Ready.
 - s. UV Intensity (per lamp).
 - t. Reduction Equivalent Dose (MS2 and T1).
 - u. Validated Dose (mJ/cm²).
 - v. Log Inactivation of *Giardia*.
 - w. Log Inactivation of *Cryptosporidium*.
 - x. Lamp Run Time (Hours).
 - y. UV Dose Manual Safety Factor (1.XX).

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

3. As a minimum, the UV System shall provide the following minor alarms to the UV MCP, but will not automatically shut-down the UV reactor:
 - a. Lamp run time hours exceeded.
 - b. UV intensity sensor calibration check required.
 - c. Measured UVT above validated range (Revert to max. validated UVT).
 - d. Loss of UVT signal (Revert to min. design UVT).
 - e. Loss of Flow signal (Revert to max. design flow).
 - f. Measured flow below validated range, revert to minimum validated flow.
 - g. SCADA communication failure (Revert to design UVT and flow).
4. As a minimum, the UV System shall provide the following major alarms to the UV MCP but will not shut-down the UV reactor:
 - a. Measured UVT below validated range (Off-specification event).
 - b. Low UV dose (Off-specification event).
 - c. UV intensity sensor signal loss (Off-specification event).
 - d. Measured flow below validated range (Revert to min. validated flow).
 - e. Off-specification Water Produced (other conditions as required).
 - f. Wiper Revolution Proximity Fault.
 - g. Wiper Travel Time Exceeded.
 - h. Wiper Home Limit Fault.
 - i. Single or multiple lamp failure, but standby UV lamp banks operated to maintain validated operating conditions.
5. As a minimum, the UV System shall provide the following critical alarms to the UV MCP and will automatically shut-down the duty UV reactor and activate the standby UV reactor:
 - a. GFI or System Ground Fault.
 - b. Single or multiple lamp failure resulting in non-validated operating condition.
 - c. UV reactor leak or lamp break alarm (if available)
 - d. Ballast failure.
 - e. Low water level.
 - f. Cabinet high temperature.
 - g. High reactor/lamp temperature.
 - h. Ballast high temperature.
 - i. E-Stop Alarm/ CPP emergency stop.
6. All alarms generated by the UV CPP shall be logged and displayed on the CPP HMI. Each alarm shall be time and date stamped when it occurs.

G. Field Instruments:

1. Online UVT Analyzer, Type A:
 - a. Provide one (1) continuous reading, UVT spectrophotometer probe suitable for measurement of UVT utilizing 180 degree absorption measurement methods for the purposes of calculating UV Dose for UV disinfection reactors. The analyzer shall also be capable of simultaneous measurement of EPA 180.1 turbidity utilizing 90 degree scattering measurement method. The unit shall include a lamp, sensor, analyzer, and transmitter.
 - b. Performance:
 - 1) UVT Range: 0 to 100 percent UVT or 0 – 2 UVA at 254 nm based on nominal 1-cm path length.
 - 2) UVT Accuracy: +/- 1% UVT.
 - 3) Turbidity Range: 0 to 5 NTU.
 - 4) Turbidity Accuracy: 0.02 NTU.
 - 5) TOC Range: 0-25 mg/L TOC.
 - 6) TOC Accuracy: 0.1+/- mg/L TOC.
 - 7) Lamp Life: 3 years, min.; 5,000 hrs min.
 - 8) Measurement Frequency: 1 per 60 seconds min.
 - c. Accessories:
 - 1) Automatic or manual calibration options for flowrate.
 - 2) Automatic mechanical cleaning system with manual option.
 - 3) Fixed position flow cell independently mounted to support panel and supply piping, with wiper.
 - 4) 10 ft, IP68 cable with plug to connect analyzer to local monitoring panel/transmitter for signals and power.
 - d. Mechanical:
 - 1) Sample Flow Rate: 0.25 - 2 gpm.
 - 2) Sample Pressure: 2 - 20 psig.
 - e. Environmental:
 - 1) Operating Temperature (Sample): 0.5 degrees C to 35 degrees C.
 - 2) Operating Temperature (Ambient): 0 degrees C to 60 degrees C.
 - 3) Humidity: 0 to 100 percent Condensing.
 - f. Required Spare Parts/Support:
 - 1) 2-person days installation/start-up support and operator training by UVT analyzer supplier.
 - 2) 2 additional days and 2 trips allowance for additional commissioning assistance and troubleshooting for the UV system integration.
 - 3) 3 year manufacturer standard warranty.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- g. Manufacturer/Model:
 - 1) I::scan NTU/FTU + 254 equivalent TOC (mg/L) and UV transmittance (% transmittance per 1 cm),S::can Inc., Cambridge, MA.
 - 2) No "or equals."
- 2. Online UVT Analyzer, Same as Type A:
- 3. Local Indication/Transmitter:
 - a. Source Power: 120 VAC.
 - b. Electrical Enclosure: IP65/NEMA 4, wall mountable enclosure, PP plastic.
 - c. Touch screen interface.
 - d. Signal Outputs to SCADA:
 - 1) Ethernet; RS 485 Modbus RTU; 420mA; relay.
 - 2) Low lamp output.
 - 3) System fault.
 - 4) Other data as defined by Owner.
 - e. Inputs:
 - 1) UVT Analyzer Type A1 data.
 - 2) UVT Analyzer Type A2 data.
 - f. Manufacturer/Model;
 - 1) S:can Con:cube. S::can, Cambridge, MA.
 - 2) No "or equals".
- 4. Portable UVT Analyzer:
 - a. Provide one (1) portable or handheld, NIST traceable UVT analyzing device to verify UVT analyzer performance in field, as recommended by the 2006 UVDGM.
 - b. Manufacturer:
 - 1) RealTech.
 - 2) Or equal.

2.09 SAFETY EQUIPMENT

- A. Provide face shield that blocks UV light wavelengths between 200 and 400 nm.
- B. Provide acid resistant gloves and face shields for the operators for use with the cleaning equipment.

2.10 ACCESSORIES

- A. Equipment Identification Plate: 16 gauge stainless steel with 6 mm die-stamped equipment tag number securely mounted in a readily visible location.
- B. Lifting Lugs: Equipment weighing over 100 pounds.
- C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer.

PART 3 EXECUTION

3.01 GENERAL

- A. UV Equipment shall be factory tested and delivered on-site within 12 weeks after approval of Submittal package 2. UV equipment shall not commence fabrication until all Submittal package 1 and 2 has been reviewed and approved by the Engineer.

3.02 SHIPPING REQUIREMENTS

- A. All packages to be clearly identified as to project destination and contents. Package and/or crate to protect all equipment from damage during shipping.
- B. Deliver the equipment and appurtenances to the location designated by the Owner.
- C. Polish and protect all surfaces from corrosion and damage during shipment, normal handling and installation.
- D. Carefully pack all equipment for shipment and protect all electrical equipment from moisture damage.
- E. Package UV equipment in subcomponents in size/weight that allows for field assembly by the Installing Contractor. Coordinate maximum allowable dimensions and weights with Installing Contractor.
- F. Each component shall be identified with durable labeling other than paper that is resistant to sunlight exposure and moisture. A UV Supplier representative will be available for assistance as follows:
 - 1. Inspecting the equipment upon arrival at the site to ensure all equipment has been delivered in good order and that no damage has occurred during delivery.
 - 2. Identification of and notification to the Owner and the Engineer of discrepancies between the shipping lists and the equipment received.

3.03 EQUIPMENT DELIVERY AND OFF-LOADING

- A. Each component will be identified with durable labeling other than paper that is resistant to sunlight exposure and moisture. A UV Supplier representative will be available for assistance during this time if requested by the Owner. The UV Supplier shall assist the Installing Contractor as follows:
 - 1. Inspecting the equipment upon arrival at the site to ensure all equipment has been delivered in good order and that no damage has occurred during delivery.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Identification of and notification to the Installing Contractor and the Engineer of discrepancies between the shipping lists and the equipment received.
 3. Identification of all equipment to ensure all equipment is installed in its intended place.
- B. The UV Supplier shall complete the Manufacturer's Certificate of Proper Delivery upon satisfactory installation of the UV System.

3.04 INSTALLATION

- A. The UV Supplier shall furnish instructions and supervise the work of the Installing Contractor regarding installation of the UV System. The Installing Contractor shall install the UV System in strict accordance with UV Supplier's instructions. Due to necessity to install UV system CPP in subcomponents, UV Supplier shall be responsible for completing any field wiring within the UV CPP necessary to provide a complete system to the Owner.
- B. The UV Supplier shall provide direct supervision of the work of the Installing Contractor of the installation of the UV System if requested by the Owner, including but not limited to:
1. Direct supervision of installation of the UV Reactor, Control Power Panel segments, and interconnecting control/power wiring.
 2. Direct supervision of the work of the Installing Contractor of the installation of UV System HMI computers (Panel-mounted computers are not to be shipped with the panel).
 3. Verify all field wiring I/O connections made by the Installing Contractor.
 4. Inspect, test and verify all communications links from the respective CPPs to UV MCP. Inspect, test and verify all LAN communications connections between the CPP and the communication switches.
 5. Installing Contractor shall provide and install anchor bolts, fasteners, washers, and templates needed for installation of UV Equipment. The UV Supplier shall design and locate anchor bolts and submit this information as part of the UV equipment shop drawings, calculations and installation instructions submissions.
- C. The UV Supplier shall complete the Manufacturer's Certificate of Proper Installation upon satisfactory installation of the UV System.
- D. Refer to General Conditions specifications for additional requirements.

3.05 TESTING - GENERAL

- A. The UV Supplier is required to complete the following tests:
 - 1. Factory Acceptance Testing.
 - 2. Functional Testing.
 - 3. Performance Testing.
- B. The UV Supplier shall calibrate all instruments, sensors, and meters supplied for testing, including the UVT analyzers, UV intensity sensors, and power consumption meters.

3.06 FACTORY ACCEPTANCE TEST

- A. The UV Supplier shall be responsible for the Factory Acceptance Testing (FAT) that shall be conducted by the UV Supplier after the shop drawings are approved and before UV System is shipped to the Site.
- B. The UV Supplier shall factory test all major UV System components of the UV System during a single test session for compliance with the construction and functional requirements specified herein.
- C. The UV Supplier shall submit a FAT Plan, for approval by Engineer that will demonstrate the full operability of UV Reactors. The test plan shall include, but is not limited to the testing of the delivery of the UV dosage, the lamps, the intensity sensors, the cleaning system, CPP for each of the UV reactors, and the instrumentation and controls for each of the reactors, and operator interface units. The test will verify the functions of the UV System via simulation or other methods. The PLC and HMI hardware and software is to be set up to allow thorough testing of controls and communications. The scope of the FAT shall demonstrate that each individual component of the UV System operates as specified.
- D. For the FAT, the UV Supplier is to assemble all CPPs to demonstrate the complete UV System. Provide all necessary communications links between the respective panels and computers to simulate the complete UV System. The UV Supplier shall provide 3 weeks' advance notice prior to conducting the FAT. The Owner and/or Engineer may elect to witness the FAT. Costs to witness the FAT shall be the responsibility of the Owner.
- E. The UV Supplier shall submit a FAT Report discussing the tests performed, items witnessed, and the results for the approval of the Engineer within 14 days following conclusion of the Factory Test.
- F. The UV System components shall not be shipped until the final FAT Report is approved.

3.07 FUNCTIONAL TEST

- A. The UV Supplier shall submit a Functional Test Plan, for approval by Engineer that will demonstrate the full operability of UV System after on-site installation. The test plan shall include, but is not limited to the testing the full functionality of the UV System. The test will verify the functions of the UV System as installed. The scope of the Functional Test shall demonstrate that each individual component of the UV System operates as specified and that the UV System operates with the complete treatment plant as specified.
- B. The Installing Contractor with assistance from the UV Supplier shall complete all functional testing to the satisfaction of the Engineer and the Owner prior to commencing the Facility Startup. The purpose of the Functional Test shall be to demonstrate the effectiveness of all UV System components and control features in all modes of control. Testing shall include:
1. Automatic “start/stop” of each UV reactor by the UV MCP.
 2. Manual “start/stop” of each UV reactor by the UV MCP.
 3. Local start/stop of each UV reactor.
 4. Automatic shutoff and alarms for various failure modes for UV reactor, including but not limited to loss of UVT or flowrate signals, lamp or ballast failure, low water level in reactor, high temperature, cleaning system failure etc.
 5. Monitoring and trending of operating data.
 6. Monitoring and control from a remote workstation.
 7. Bumpless switchover from normal power to emergency power, and emergency power to normal power.
 8. Operation of UV reactor cleaning systems
 9. Operation of all monitoring instruments.
 10. All control functions, both at the CPP and remote HMI.
 11. Modifying lamp output to verify that UV intensity sensors can detect changes in UV intensity.
 12. Modifying flow and UVT to verify UV System can modify and maintain adequate UV dose.
 13. All specified communications and alarms between the CPP and the UV MCP.
 14. Confirming interlock with upstream and downstream process equipment including transfer pumps, isolation valves, chemical feed systems, and water quality analyzers.
 15. Confirmation of UVT and flow meter operation.

3.08 PERFORMANCE TEST

- A. The UV Supplier shall submit a Performance Test Plan for approval by Engineer that will demonstrate the full operability of UV System. The test plan shall include, but is not limited to demonstrating automatic, manual, and local modes of operation of the UV System and continuous operation without the production of off-specification water due to failure of any UV System component.
- B. Performance Test shall not commence until after successful completion of Functional Test, approval by Owner/Engineer of Performance Test Plan, and minimum operating time of entire UV System (e.g. lamps, ballasts) at 100 percent power level. UV Supplier shall be responsible for replacing failed components of the UV System during this burn-in period at no additional cost to the Owner. Duration of burn-in period for UV equipment shall be defined by the UV Supplier.
- C. Successful completion of the Performance Test shall be defined as 30 calendar days of continuous operation per UV reactor without the production of off-specification water due to failure of any UV System component and demonstration that UV System meets all performance requirements established herein. Downtime resulting from Plant's operation, including flow or UVT outside of UV reactor's validated range, will not be counted against the criteria of "continuous days of operation."
- D. The Performance Test shall include normal starts, stops, and changeover to backup UV reactor. Performance Test shall verify normal and emergency (i.e., reactor failure or loss of UVT signal) operation of each installed UV reactor without malfunction.
- E. The Performance Test shall include headloss check, power consumption check, UVT and intensity sensor calibration checks, power consumption at guaranteed set points, power factor measurements, harmonics measurements, lamp output verification, sleeve output verification, and UV System dose check (based on UV System CPP readings and calculations). Specifically include:
 - 1. One (1) UVT analyzer calibration and reading stability check weekly for each UVT analyzer provided with the use of the Owner's laboratory spectrophotometer and UV Supplier's portable UVT analyzer, and prepare documentation on its compliance with the 2006 UVDGM requirements.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

2. Sensor calibration checks of all supplied/installed duty and reference sensors weekly. Provide uncertainty calculations based on field evaluations. Compare sensor uncertainty based on field evaluations with that provided in the third-party validation. Prepare documentation on the duty UV sensors' compliance with the 2006 UVDGM requirements.
- F. The UV Supplier shall be responsible for coordination and inclusion in the report of all data and results required to meet the reporting requirements whether raw data is contained in UV Supplier's PLC or Plant PLCs or SCADA. As a minimum, results shall be provided as follows:
1. Daily tabulated data (provide range and average if applicable) of recorded information.
 2. Energy:
 - a. Average and range of energy consumption per day (data provided by Owner).
 - b. Average energy consumption per volume of net water treated.
 - c. Harmonic testing results showing UV System performance measured at 50 percent, 75 percent and 100 percent of ballast rated load with harmonics (Voltage and Current) measured to the 35th harmonic. Results shall show that the harmonics are below IEEE 519 standards with a Point of Common Coupling (PCC) at the input terminals of the UV CPP on utility and emergency generator power.
 - d. Power Factor tests results showing that the UV reactor maintain a 0.90 or greater power factor throughout the full operating range.
 3. Headloss: Headloss across each reactor at available flowrate vs. validated headloss curve.
 4. Other:
 - a. Quantity of sleeve cleaning cycles and estimated quantity of cleaning materials consumed (if applicable).
 - b. Photographs of clean vs. sleeves in service before and after a cleaning cycle after 24 hours of continuous operation at 100 percent power setting.
 - c. Complete list of parts replaced and reasons for replacement.
 - d. Complete list and results of calibration or other maintenance activities performed and reasons.
 - e. Summary of off-specification occurrences, daily volume, total volume per UV reactor.
 - f. Results from off-site lamp output, sleeve transmittance, and UV intensity sensor verifications.

3.09 TRAINING OF OWNER'S PERSONNEL

- A. General:
1. Provide for training of designated Owner's personnel in the operation and maintenance of the UV System including all components provided under this Contract.
 2. Training shall consist of both classroom and hands-on sessions conducted at time and location acceptable to the Owner.
 3. Designate a person responsible for scheduling and coordinating all training.
 4. Training sessions will be videotaped. Supplier shall be responsible for providing all necessary videotaping equipment.
- B. UV Manufacturer's personnel shall provide detailed system training including, as a minimum, the following:
1. System operations philosophy.
 2. System Control:
 - a. Loop Functions: The understanding of loop functions including interlocks.
 - b. Loop Operation: For example, adjusting process variable set points, and control, annunciator acknowledgment and resetting, etc.
 - c. Interfaces with other loops and subsystems.
 3. Operator interface/system set points.
 4. Component performance requirements.
 5. Component functions.
 6. Component maintenance.
 7. Component troubleshooting.
 8. Instrument operation, maintenance, troubleshooting, replacement, and calibration procedures.
- C. Classroom training shall be conducted during regular working hours on weekdays at a location to be designated by the Owner. Hands-on training may be conducted during and as a part of startup. Training shall occur on two separate, equal visits approximately three weeks apart to accommodate Owner's employee's schedules. Each training session shall require at most 6 hours. Provide 30 paper copies of all overheads and slides and one electronic copy used for training.
- D. Manufacturer's representative shall be familiar with plant O&M requirements as well as with the specified equipment.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- E. Coordinate training periods with Owner's operating personnel and manufacturer's representatives, and with submittal of O&M Manuals.
 - 1. Initial training shall be completed at least 14 days prior to actual startup, but not more than 45 days prior to startup.
 - 2. O&M Manuals shall be reviewed, accepted, and resubmitted in accordance with this section before start of training. Any modifications resulting from startup of the facility shall be incorporated into the final manuals.

3.10 UV SUPPLIERS' SERVICES

- A. Provide qualified and approved by Owner UV Supplier's Representative at site for installation assistance, inspection and certification of proper installation, functional testing assistance, performance testing assistance, and training of Owner's personnel for specified component, subsystem, equipment, or system.
- B. UV Supplier's Representative: Present at project site or classroom designated by the Owner for minimum person-days listed below, travel time excluded:
 - 1. 5 person-days in 1 trip for Installation Assistance.
 - 2. 10 person-days in 2 trips for Functional Testing.
 - 3. 14 person-days in 2 trips for Performance Testing.
 - 4. 2 person-days in 2 trips for pre-startup training of UV System for Owner's personnel. Each training shall not exceed 6 hours.
 - 5. 1 person-day in 1 trip for post-startup training of UV System for Owner's personnel. Training shall not exceed 6 hours.
- C. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the Owner.
- D. Requirements for testing and training in Division 1 of these specifications apply to the UV System.

3.11 EQUIPMENT GUARANTEE

- A. Guarantee each item of mechanical and electrical equipment, instruments and device furnished under this Contract against defects including, but not limited to, the following:
 - 1. Defective material or workmanship of both.
 - 2. Leakage, breakage or other failure which might occur under normal and proper operation of the equipment under the specified conditions.
 - 3. UV Reactor/Component Failure, as defined herein, during the Guaranteed Life.

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

- B. Provide a guarantee for a period of one (1) year from acceptance of the Performance Test based on an approved Test Report and Substantial Completion.
- C. Replace each item of equipment or part thereof proving to be defective.
- D. Bear the entire expense of replacement including, but not limited to, the cost of all necessary labor, supervision, traveling, replacement parts, transportation and shipping cost. Supplier to coordinate and facilitate all work.
- E. The UV Supplier shall provide Guaranteed Lamp Replacement Prices, Guaranteed Quartz Sleeve Replacement Prices, Guaranteed Ballast Replacement Prices, Guaranteed Duty Sensor Calibration Prices, Guaranteed Reference Sensor Calibration Prices, and Guaranteed Duty Sensor Replacement Prices, as a cost per individual item and as a cost for the total system. The UV Supplier shall guarantee that items may be purchased by the Owner at this price or lower any time up to 20 years following Substantial Completion of the installation contract, with the guaranteed prices being adjusted by the Consumer Price Index (CPI). Freight charges to the Owner's plant for this supply are not to be included.
- F. The UV Supplier shall warrant the Lamps, Quartz Sleeves, Ballasts, and Duty and Reference UV Intensity Sensors for the Guaranteed Life following final acceptance after Substantial Completion. If the UV Supplier is not the item's Manufacturer, the Warranty shall be provided, in writing, directly to the Owner by the item's Manufacturer.
- G. UV Lamps:
 - 1. MP UV lamps shall be warranted for at least 5,000 hours or the time provided in the Bid Form, whichever is greater; prorated after 1,000 hours. If a lamp fails within the initial prorated period, the UV Supplier shall provide a replacement lamp to the Owner free of charge. If a lamp fails after the initial prorated period (e.g. 1,000 hours) and before the guaranteed life (e.g. 5,000 hours), the following formula will be used to determine the discounted price for replacement lamps:

$$\text{Lamp Price} = ((\text{Lamp Operating Hours} - \text{Initial Proration}) / [\text{Guaranteed Life} - \text{Initial Proration}] \times \text{Guaranteed Price})$$
- H. Ballasts:
 - 1. The ballasts shall be warranted for at least 10 years or the time provided in the Bid Form, whichever is greater; prorated after 2 years. If a ballast fails within the initial prorated period, the UV Supplier shall provide a

WTP UV DISINFECTION SYSTEM
CITY OF ANN ARBOR, MI

replacement ballast to the owner free of charge. If a ballast fails after the initial prorated period (e.g., 2 years) and before the guaranteed life (e.g., 10 years), the following formula will be used to determine the discounted price for replacement ballast:

$$\text{Ballast Price} = ((\text{Ballast Age} - \text{Initial Proration}) / [\text{Guaranteed Life} - \text{Initial Proration}] \times \text{Guaranteed Price})$$

I. Quartz Sleeves:

1. The quartz sleeves shall be warranted for at least 10 years or the time provided in the Bid Form, whichever is greater; prorated after 1 year. If a quartz sleeve fails within the initial prorated period, the UV Supplier shall provide a replacement quartz sleeve to the owner free of charge. If a quartz sleeve fails after the initial prorated period (e.g. 1 year) and before the guaranteed life (e.g. 10 years), the following formula will be used to determine the discounted price for replacement quartz sleeve:

$$\text{Quartz Sleeve Price} = ((\text{Quartz Sleeve Age} - \text{Initial Proration}) / [\text{Guaranteed Life} - \text{Initial Proration}] \times \text{Guaranteed Price})$$

J. UV Sensors:

1. The duty and reference UV sensors shall be warranted for a minimum of 5 years or the time provided in the Bid Form, whichever is greater; prorated after 1 year. If a sensor fails within the initial proration period, the UV Supplier shall provide a replacement sensor to the owner free of charge. If a sensor fails after the initial proration period (e.g. 1 year) and before the guaranteed life (e.g. 5 years), the following formula will be used to determine the discounted price for replacement quartz sleeve:

$$\text{Sensor Price} = ((\text{Sensor Age} - \text{Initial Proration}) / [\text{Guaranteed Life} - \text{Initial Proration}] \times \text{Guaranteed Price})$$

END OF SECTION

APPENDIX

LEAD AND ASBESTOS SURVEY

