NORTH BEACH WATER DISTRICT

PACIFIC COUNTY **WASHINGTON**

CONTRACT PROVISIONS

for

WATER SUPPLY AND TREATMENT PROJECT REBID

THIS PROJECT IS FUNDED IN PART BY
DRINKING WATER STATE REVOLVING FUND

G&O #13224.02
FEBRUARY 2016

Gray & Osborne, Inc.
CONSULTING ENGINEERS

NORTH BEACH WATER DISTRICT

PACIFIC COUNTY **WASHINGTON**

CONTRACT PROVISIONS

for

WATER SUPPLY AND TREATMENT PROJECT REBID

THIS PROJECT IS FUNDED IN PART BY
DRINKING WATER STATE REVOLVING FUND

MICHAEL B. JOHNSON
STATE OF WASHINGTON
36498
REGISTERED
PROFESSIONAL ENGINEER
2/23/16

G&O #13224.02
FEBRUARY 2016

Gray & Osborne, Inc.
CONSULTING ENGINEERS

CALL FOR BIDS

NORTH BEACH WATER DISTRICT

WATER SUPPLY AND TREATMENT PROJECT REBID
ENGINEER'S ESTIMATE: SCHEDULE A: $1,084,000
SCHEDULE B: $ 618,000

Sealed Proposals will be received by the undersigned at the North Beach Water District, 25902 Vernon Avenue, Ocean Park, Washington 98640, up to 1:00 p.m.; local time on Thursday, March 24, 2016, for furnishing the necessary labor, materials, equipment, tools, and guarantees thereof to construct the Water Supply and Treatment Project Rebid.

Schedule A – South Wellfield Improvements

Equip three wells with submersible pumps, flow meters, piping, valves, and controls. Install approximately 500 lf of 8-inch-diameter water pipe. Construct a carbon filter treatment system including chemical feed systems. Modify an existing building including HVAC improvements. Complete electrical, telemetry, and control modifications.

Schedule B – North Wellfield Improvements

Complete site improvements including fencing. Install a new chemical feed system. Modify an existing building. Complete electrical, telemetry, and control modifications.

The Work shall be substantially complete within 140 working days after the commencement date stated in the Notice to Proceed. All bidding and construction is to be performed in compliance with the Contract Provisions and Contract Plans for this project and any addenda issued thereto that are on file at the office of the North Beach Water District, Ocean Park, Washington.

The Proposals will be publicly opened and read aloud shortly after the time and date stated above. Proposals are to be submitted only on the form provided with the Contract Provisions. All Proposals must be accompanied by a certified check, cashiers check, money order, or bid bond payable to the "North Beach Water District" and in an amount of not less than five percent (5%) of the total amount bid.

Contract Provisions and Contract Plans may be ***examined*** at the office of the North Beach Water District, local plan centers in the project area, or the office of the Project Engineer, Gray & Osborne, Inc. Licensed Contractors and Material Suppliers may obtain a copy of the Contract Provisions and Contract Plans, free of charge, in electronic format (PDF on compact disk(s)) along with registration as a planholder ***only*** at the ***Seattle*** office of the Project Engineer, Gray & Osborne, Inc., 701 Dexter Avenue North, Suite 200, Seattle, WA 98109, (206) 284-0860. Request for Contract Provisions and Plans may be faxed ((206) 283-3206) or emailed (grayosborne@g-o.com). Request must

include company name, physical address, phone and fax numbers, and email address. Registration as a planholder **is required** to obtain Contract Addenda. Contract questions shall be directed only to the office of the Project Engineer.

A prebid conference is scheduled for Wednesday, March 9, 2016. The conference will begin at the North Beach Water District office 25902 Vernon Avenue, Ocean Park, Washington at 11:00 a.m. (local time). Any other site visits shall be limited to 8:00 a.m. to 5:00 p.m., Monday through Friday, and shall be coordinated through Mr. Bill Neal, of the North Beach Water District, by calling (360) 665-4144, at least 24 hours in advance of the visit. No unauthorized visits or unscheduled visits will be allowed.

All Work on this Project will be subject to the higher of the prevailing state or federal wage rates.

The North Beach Water District is an Equal Opportunity and Affirmative Action Employer. Small, Minority and Women-owned firms are encouraged to submit bids.

Financing of the Project has been provided by North Beach Water District, Washington and Drinking Water State Revolving Fund Program with federal funds from the Environmental Protection Agency. All Contractors and subcontractors must comply with the DWSRF program requirements and provisions. The North Beach Water District expressly reserves the right to reject any or all Proposals and to waive minor irregularities or informalities and to Award the Project to the lowest responsive, responsible bidder as it best serves the interests of the North Beach Water District.

(Signed) **BILL NEAL**
DISTRICT MANAGER

CONTRACT PROVISIONS

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NORTH BEACH WATER DISTRICT

WATER SUPPLY AND TREATMENT PROJECT REBID

PAGE NO.

PART 1

BID DOCUMENTS

BIDDER'S CHECKLIST

1. REQUIRED FORMS

The Bidder shall submit the following forms, which must be executed in full and submitted with the Proposal.

a.	Proposal (including Statement of Bidder's Qualifications)	(Pages P-1 - P-10)
b.	Bid Deposit or Proposal Bond	(PB-1)
c.	Attachment 3 Certification of Nonsegregated Facilities	
d.	Attachment 6 EPA Form 6100-3-DBE Program Subcontractor Performance Form	
e.	Attachment 7 EPA Form 6100-4-DBE Program Subcontractor Utilization Form	
f.	Bidder's List	(BL-1)

2. AGREEMENT FORMS

The following forms (a., b., and c.) are to be executed and the following Certificates of Insurance (d. and e.) are to be provided after the Contract is awarded and prior to Notice to Proceed.

a.	Agreement	(Pages A-1 - A-3)
b.	Performance Bond	(Page B-1)
c.	Public Works Payment Bond	(Page B-2)
d.	Certificate of Insurance	
e.	Certificate of Builder's Risk Insurance	

WATER SUPPLY AND TREATMENT PROJECT REBID

PROPOSAL

North Beach Water District
25902 Vernon Avenue
Ocean Park, Washington 98640

The undersigned has examined the Work site(s), local conditions, the Contract, and all applicable laws and regulations covering the Work. The following unit and lump sum prices are tendered as an offer to perform the Work in accordance with all of the requirements set forth in the Contract and all applicable laws and regulations.

As required by the Contract, a certified check, bank draft, cashier's check or Proposal bond made payable to the Owner is attached hereto. If this Proposal is accepted and the undersigned fail(s) or refuse(s) to enter into a contract and furnish the required performance bond, labor and material payment bond, special guarantee bonds (if required), required insurance and all other required documentation, the undersigned will forfeit to the Owner an amount equal to five percent of the amount bid.

After the date and hour set for submitting the Proposals, no bidder may withdraw its Proposal, unless the Award of the contract is delayed for a period exceeding 60 consecutive calendar days.

The undersigned agrees that in the event it is Awarded the contract for the Work, it shall employ only Contractors and Subcontractors that are duly licensed by the State of Washington and remain so at all times they are in any way involved with the Work.

The undersigned agrees that the Owner reserves the right to reject any or all Proposals and to waive any minor irregularities and informalities in any Proposal.

The undersigned agrees that the Owner reserves the right to Award the Contract to the lowest responsible, responsive bidder whose Proposal is in the best interest of the Owner. The Owner will determine at the time of Award of the Contract which Additives, if any, will be included in the Contract.

PROPOSAL - Continued

SCHEDULE A: SOUTH WELLFIELD IMPROVEMENTS

NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization and Demobilization	1	LS	$_____	$_____
2.	Minor Changes	1	CALC	$10,000.00	$10,000.00
3.	Locate Existing Utilities	1	LS	$_____	$_____
4.	Trench Excavation Safety Systems	1	LS	$_____	$_____
5.	Sitework	1	LS	$_____	$_____
6.	Special Excavation of Unsuitable Materials	20	CY	$_____	$_____
7.	Erosion Control	1	LS	$_____	$_____
8.	Foundation Gravel	70	CY	$_____	$_____
9.	Crushed Surfacing Top Course	60	TN	$_____	$_____
10.	Crushed Surfacing Base Course	35	TN	$_____	$_____
11.	Bank Run Gravel	255	TN	$_____	$_____
12.	Quarry Spalls	5	TN	$_____	$_____
13.	Restoration	1	LS	$_____	$_____
14.	Reinforced Concrete Slab	1	LS	$_____	$_____
15.	Treatment Building Modifications	1	LS	$_____	$_____
16.	Wiegardt Well 1 Pump	1	LS	$_____	$_____
17.	Wiegardt Well 2 Pump	1	LS	$_____	$_____
18.	Wiegardt Well 3 Pump	1	LS	$_____	$_____
19.	Carbon Filter Treatment System	1	LS	$_____	$_____
20.	Ferric Chloride Feed System	1	LS	$_____	$_____

PROPOSAL - Continued

NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
21.	Potassium Permanganate Feed System	1	LS	$_____	$_____
22.	Piping, Valves and Appurtenances	1	LS	$_____	$_____
23.	Electrical, Telemetry, and Instrumentation	1	LS	$_____	$_____

Subtotal (Schedule A): .....$_____

Washington State Sales Tax (7.8%): .....$_____

TOTAL CONSTRUCTION COST (SCHEDULE A): .....$_____

ADDITIVE ITEM:

NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1.	Wiegardt Wellfield Sitework	1	LS	$_____	$_____
2.	Crushed Surfacing Top Course	135	TN	$_____	$_____
3.	Crushed Surfacing Base Course	265	TN	$_____	$_____

Subtotal (Additive): ..... $_____

Washington State Sales Tax (7.8%): ..... $_____

TOTAL CONSTRUCTION COST (ADDITIVE): ..... $_____

PROPOSAL - Continued

SCHEDULE B: NORTH WELLFIELD IMPROVEMENTS

NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization and Demobilization	1	LS	$_____	$_____
2.	Minor Changes	1	CALC	$5,000.00	$5,000.00
3.	Fence and Gates	1	LS	$_____	$_____
4.	Treatment Building Modifications	1	LS	$_____	$_____
5.	Potassium Permanganate Feed System	1	LS	$_____	$_____
6.	Piping, Valves and Appurtenances	1	LS	$_____	$_____
7.	Electrical, Telemetry, and Instrumentation	1	LS	$_____	$_____

Subtotal (Schedule B): .....$_____

Washington State Sales Tax (7.8%): .....$_____

TOTAL CONSTRUCTION COST (SCHEDULE B): .....$_____

BID SUMMARY

1. TOTAL CONSTRUCTION COST (SCHEDULE A forwarded from page P-3): ..... $_____

2. TOTAL CONSTRUCTION COST (ADDITIVE forwarded from page P-3): ..... $_____

3. TOTAL CONSTRUCTION COST (SCHEDULE B forwarded from page above): ..... $_____

4. TOTAL CONSTRUCTION COST (SCHEDULES A, ADDITIVE, AND B) ..... $_____

Note: A bid must be received on all items.

ALTERNATES TO BID ITEMS

Bidders shall use this page to submit proposals on any alternate types of equipment or materials that bidders recommend the Owner consider using. Contract Award will be made on the basis of equipment and materials that are specified. After Award, the Owner may consider any proposal alternates that, in the opinion of the Owner, will be equivalent to or better than the item specified and/or used as the basis of contract Award. The Owner shall have complete discretion on whether to use any alternates, and the Owner's decision shall not be subject to challenge.

Alternate to Bid Item No.	Schedule	Item	Manufacturer	Amount Bid

ADDITIVE ITEM:

Alternate to Bid Item No.	Item	Manufacturer	Amount Bid

STATEMENT OF BIDDER'S QUALIFICATIONS

Name of Firm: _____

Address: _____

Telephone No. _____ Fax No. _____

Contact Person for this Project: _____

E-mail: _____

Number of years the Contractor has been engaged in the construction business under the present firm name, as indicated above:

_____

Gross dollar amount of work currently under contract: _____

Gross dollar amount of contracts currently not completed: _____

General character of work performed by firm: _____

List of five major projects of a similar nature which have been completed by the Contractor within the last five years and the gross dollar amount of each project, together with the Owner's name and telephone number, and the Engineer's name:

Project Name	Amount	Owner	Phone	Engineer's Name

PROPOSAL - Continued

List five major pieces of equipment which are anticipated to be used on this project by the Contractor and note which items are owned by the Contractor and which are to be leased or rented from others:

_____

_____

Bank Reference: _____

How many general superintendents or other responsible employees in a supervisory position do you have at this time, and how long have they been with the firm?

_____

Identify who will be the general superintendent and/or project superintendent on this project. Also, list the number of years each person identified has been with firm.

_____

Have you changed bonding companies within the last three years? _____

If so, why? _____

_____

Have you ever been a party to a lawsuit or an arbitration proceeding in any way relating to a construction project? _____

Identify the proceeding and parties and describe the claims asserted by all parties. _____

_____

What was the disposition of the case? _____

Do you have any outstanding payments due to the Department of Revenue? _____

If yes, explain. _____

Bidder agrees that the Owner shall have the right to obtain credit reports.

_____ _____

Yes No

WORK COMPLETED BY CONTRACTOR

List the Work and the dollar amount thereof that the Contractor will complete with its forces, if awarded the contract.

Work to be Performed	Dollar Amount

PROPOSED SUBCONTRACTORS (Per RCW 39.30.060)

For Proposals exceeding one million dollars, indicate who (either the Contractor submitting this bid or a subcontractor) will be completing the work for each of the three categories listed below. Information shall include their Washington State Department of Licensing Contractor's Registration No. This information shall be provided with the Proposal or within one hour after the published Proposal submittal time in accordance with RCW 39.30.060.

Work to be Performed	Subcontractor or Prime (Name and Registration Number)
Heating, Ventilation and Air Conditioning	
Plumbing	
Electrical	

ADDENDA RECEIVED

Addendum No.	Date Received	Name of Recipient

NOTE: Bidder shall acknowledge receipt of all addenda. Bidder is responsible for verifying the actual number of addenda issued prior to submitting a Proposal.

Subject to any extensions of the Contract time granted under the Contract, the undersigned agrees to substantially complete the Work required under this Contract within 140 working days (the Substantial Completion Date) and to physically complete the Work required under this contract within 150 working days (the Physical Completion Date) from when Contract Time begins.

The undersigned has reviewed and fully understands the provisions in the Contract regarding liquidated damages and agrees that liquidated damages shall be $1,000.00 per day for each and every working day beyond the Contract time allowed for substantial completion until the Substantial Completion Date is achieved and $500.00 for each and every working day required beyond the Contract Time for physical completion until the Physical Completion Date is achieved.

The undersigned is in, and will remain in, full compliance with all Washington State Department of Licensing requirements for contractors, including but not limited to requirements for bond, proof of insurance and annual registration fee. The undersigned's Washington State:

Dept. of Labor and Industries Workman's Compensation Account No. is _____;
Dept. of Licensing Contractor's Registration No. is _____;
Unified Business Identifier Number is _____;
Excise Tax Registration Number is _____; and
Employment Security Account Number is _____.

The undersigned has reviewed all insurance requirements contained in the Contract and has verified the availability of and the undersigned's eligibility for all required insurance. The undersigned verifies that the cost for all required insurance, has been included in this Proposal.

The undersigned waives any immunity granted under the State Industrial Insurance Law, RCW Title 51. This waiver has been specially negotiated by the parties, which is acknowledged by the undersigned in signing this Proposal.

By signing the proposal, the undersigned declares, under penalty of perjury under the laws of the United States and the State of Washington, that the following statements are true and correct:

PROPOSAL - Continued

1. That the undersigned person(s) or entity(ies) has(have) not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the project for which this Bid is submitted.

2. That by signing the signature page of this Bid, I am deemed to have signed and to have agreed to the provisions of this declaration.

The undersigned agrees that the Owner is authorized to obtain information from all references included herein.

Very truly yours,

_____
Print Company Name

By: _____
Print Name

_____
Sign Name

_____
Title

_____
Date

Amount of bid deposit: $_____ Check No. _____,

or bid bond in the amount of $_____

_____, issued through _____
Name of Bank/Bonding Company

located at _____
Mailing Address

_____
Telephone Number of Bank/Bonding Company

PROPOSAL BOND

KNOW ALL MEN BY THESE PRESENTS, That we _____

_____

of _____ as principal, and the _____

_____

a corporation duly organized under the laws of the state of _____, _____and authorized to do business in the State of Washington, as surety, are held and firmly bound unto the **NORTH BEACH WATER DISTRICT** in the full and penal sum of five percent of the total amount of the bid proposal of said principal for the work hereinafter described, for the payment of which, well and truly to be made, we bind our heirs, executors, administrators and assigns, and successors and assigns, firmly by these presents.

The condition of this bond is such, that whereas the principal herein is herewith submitting his or its sealed proposal for the following construction project, to wit:

WATER SUPPLY AND TREATMENT PROJECT REBID

said bid and proposal, by reference thereto, being made a part hereof.

NOW, THEREFORE, If the said proposal bid by said principal be accepted, and the contract be awarded to said principal, and if said principal shall duly make and enter into and execute said Contract and shall furnish bond as required by the **NORTH BEACH WATER DISTRICT** within a period of 10 days from and after said award, exclusive of the day of such award, then this obligation shall be null and void, otherwise it shall remain and be in full force and effect.

IN TESTIMONY WHEREOF, The principal and surety have caused these presents to be

signed and sealed this_____day of_____, _____.

_____

_____
(Principal)

_____
(Surety)

_____
(Attorney-in-fact)

ATTACHMENT 3
CERTIFICATION OF NONSEGREGATED FACILITIES

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

The federally assisted construction contractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor certified, further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract.

As used in this certification, the term "segregated facilities" means any waiting rooms, work area, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or area, in fact, segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. The federally assisted construction contractor agrees that (except where he has obtained identical certifications from proposed contractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause, and that he will retain such, certification in this file.

_____ _____

Signature Date

_____

Name and title of signer (please type)

[THIS FORM SHALL BE COMPLETED IN FULL AND SUBMITTED WITH THE BID PROPOSAL]

Attachment 6
EPA Form 6100-3-DBE Program Subcontractor Performance Form

EPA United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form

This form is intended to capture the DBE[1] subcontractor's[2] description of work to be performed and the price of the work submitted to the prime contractor. An EPA Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractors bid or proposal package.

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 Submitted to the Prime Contractor Involving Construction, Services, Equipment or Supplies	Price of Work Submitted to the Prime Contractor
DBE Certified By: ___ DOT ___ SBA ___ Other: _____	Meets/ exceeds EPA certification standards? ___ YES ___ NO ___ Unknown	

[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.

EPA United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	**Date**

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.

ATTACHMENT 7
EPA FORM 6100-4-DBE PROGRAM SUBCONTRACTOR UTILIZATION FORM

United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE[1] subcontractors[2] and the estimated dollar amount of each subcontract. An EPA Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

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

I have identified potential DBE certified subcontractors	___ YES	___ NO
If yes, please complete the table below. If no, please explain:		

Subcontractor Name/ Company Name	Company Address/ Phone/ Email	Est. Dollar Amt	Currently DBE Certified?

Continue on back if needed

[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.

EPA United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor 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.

BIDDERS LIST

Per the Drinking Water State Revolving Fund Provisions and 40 CFR Part 33 Part 33.501, all bidders shall complete the form below with the requested information for all firms that bid or quote on subcontracts (including both DBE and non-DBE firms) for this project. The Bidders list shall be submitted with the bid proposal.

Name and Point of Contact	Mailing Address	Phone Number	Email Address	Item of Work Quoted	MBE/WBE (Y/N)

PART 2

AGREEMENT AND BONDS

AGREEMENT

THIS AGREEMENT is entered into by and between the **NORTH BEACH WATER DISTRICT** (hereinafter called the Owner) and _____ (hereinafter called the Contractor).

The Owner and the Contractor agree as follows:

ARTICLE 1. WORK.

Schedule A – South Wellfield Improvements

Equip three wells with submersible pumps, flow meters, piping, valves, and controls. Install approximately 500 lf of 8-inch-diameter water pipe. Construct a carbon filter treatment system including chemical feed systems. Modify an existing building including HVAC improvements. Complete electrical, telemetry, and control modifications.

Schedule B – North Wellfield Improvements

Complete site improvements including fencing. Install a new chemical feed system. Modify an existing building. Complete electrical, telemetry, and control modifications.

ARTICLE 2. CONTRACT TIME.

The Contractor shall substantially complete the Work required by the Contract within _____ working days (the Substantial Completion Date) and physically complete the Work within _____working days (the Physical Completion Date).

ARTICLE 3. LIQUIDATED DAMAGES.

The Owner and the Contractor recognize that time is of the essence and that the Owner will suffer financial loss if the Work is not completed within the time, plus any extensions thereof, allowed in accordance with the Contract. They also recognize the inconvenience, expense, and difficulties involved in a legal proceeding to prove the actual loss suffered by the Owner if the Work is not completed within the time allowed in the Contract. Accordingly, the Owner and the Contractor agree that as liquidated damages for delay, and not as a penalty, the Contractor shall pay the Owner ($_____) per day for each working day beyond the Substantial Completion Date that the Contractor achieves substantial completion of the Work and ($_____) for each working day beyond the Physical Completion Date that the Contractor achieves physical completion of the Work.

ARTICLE 4. CONTRACT PRICE.

The Owner shall pay the Contractor the amount(s) set forth in the Proposal (in United States dollars) for completion of the Work in accordance with the Contract.

ARTICLE 5. CONTRACT.

The Contract, which comprises the entire agreement between the Owner and the Contractor concerning the Work, consists of the following:

- This Agreement;
- The Call for Bids;
- The Contractor's Proposal including the bid, bid schedule(s), information required of bidder, Proposal bond, and all required certificates and affidavits;
- The Performance Bond and the Public Works Payment Bond;
- The Contract Provisions, including 2014 WSDOT Standard Specification as referenced;
- The Plans (or drawings) consisting of _____ sheets, as listed in the index on sheet _____ of the Plans;
- Addenda numbers _____, inclusive; and
- Change Orders issued after the effective date of this Agreement.

There are no Contract Documents other than those listed in this Article 5. The Contract may be amended only in writing by Change Order as provided in the Contract.

ARTICLE 6. MISCELLANEOUS.

The Contractor specifically waives any immunity granted under the State Industrial Insurance Law, RCW Title 51, which is specifically acknowledged by the Contractor. _____(Contractor's initials)

The Contractor shall not assign any rights under or interests in the Contract, including but not limited to rights to payment, without the prior written consent of the Owner. Unless specifically stated in a written consent to an assignment, no assignment will release or discharge the Contractor-assignor from any duty or responsibility under the Contract.

The Contract is binding upon the Owner and the Contractor, and their respective partners, successors, assigns and legal representatives.

IN WITNESS WHEREOF, Owner and Contractor have caused this Agreement to be executed the day and year indicated below.

NORTH BEACH WATER DISTRICT

By_____

Date_____

CONTRACTOR

License No. _____

By_____

Title_____

Attest_____

Name and Address for giving notices (print)

_____

_____

_____

PERFORMANCE BOND
to NORTH BEACH WATER DISTRICT, WA

Bond No. _____

The **NORTH BEACH WATER DISTRICT**, Washington, (District) has awarded to _____ (Principal), a contract for the construction of the project designated as Water Supply and Treatment Project Rebid in Ocean Park, Washington (Contract), and said Principal is required to furnish a bond for performance of all obligations under the Contract.

The Principal, and _____ (Surety), a corporation, organized under the laws of the State of _____ and licensed to do business in the State of Washington as surety and named in the current list of "Surety Companies Acceptable in Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Dept., are jointly and severally held and firmly bound to the District, in the sum of_____ US Dollars ($_____) Total Contract Amount, subject to the provisions herein.

This statutory performance bond shall become null and void, if and when the Principal, its heirs, executors, administrators, successors, or assigns shall well and faithfully perform all of the Principal's obligations under the Contract and fulfill all the terms and conditions of all duly authorized modifications, additions, and changes to said Contract that may hereafter be made, at the time and in the manner therein specified; and if such performance obligations have not been fulfilled, this bond shall remain in full force and effect.

The Surety for value received agrees that no change, extension of time, alteration or addition to the terms of the Contract, the specifications accompanying the Contract, or to the work to be performed under the Contract shall in any way affect its obligation on this bond, and waives notice of any change, extension of time, alteration or addition to the terms of the Contract or the work performed. The Surety agrees that modifications and changes to the terms and conditions of the Contract that increase the total amount to be paid the Principal shall automatically increase the obligation of the Surety on this bond and notice to Surety is not required for such increased obligation.

This bond may be executed in two (2) original counterparts, and shall be signed by the parties' duly authorized officers. This bond will only be accepted if it is accompanied by a fully executed and original power of attorney for the officer executing on behalf of the surety.

PRINCIPAL		SURETY	
_____		_____	
Principal Signature	Date	Surety Signature	Date
_____		_____	
Printed Name		Printed Name	
_____		_____	
Title		Title	

Name, address, and telephone of local office/agent of Surety Company is:

_____

_____

_____

Approved as to form:

_____

District Attorney, North Beach Water District Date

PUBLIC WORKS PAYMENT BOND
to NORTH BEACH WATER DISTRICT, WA

Bond No. _____

The **NORTH BEACH WATER DISTRICT**, Washington, (City or County) has awarded to _____ (Principal), a contract for the construction of the project designated as Water Supply and Treatment Project Rebid in Ocean Park, Washington (Contract), and said Principal is required under the terms of that Contract to furnish a payment bond in accord with Title 39.08 Revised Code of Washington (RCW) and (where applicable) 60.28 RCW.

The Principal, and _____ (Surety), a corporation organized under the laws of the State of _____ and licensed to do business in the State of Washington as surety and named in the current list of "Surety Companies Acceptable in Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Dept., are jointly and severally held and firmly bound to the District, in the sum of_____ US Dollars ($_____) Total Contract Amount, subject to the provisions herein.

This statutory payment bond shall become null and void, if and when the Principal, its heirs, executors, administrators, successors, or assigns shall pay all persons in accordance with RCW Titles 39.08 and 39.12 including all workers, laborers, mechanics, subcontractors, and materialmen, and all persons who shall supply such contractor or subcontractor with provisions and supplies for the carrying on of such work; and if such payment obligations have not been fulfilled, this bond shall remain in full force and effect.

The Surety for value received agrees that no change, extension of time, alteration or addition to the terms of the Contract, the specifications accompanying the Contract, or to the work to be performed under the Contract shall in any way affect its obligation on this bond, except as provided herein, and waives notice of any change, extension of time, alteration or addition to the terms of the Contract or the work performed. The Surety agrees that modifications and changes to the terms and conditions of the Contract that increase the total amount to be paid the Principal shall automatically increase the obligation of the Surety on this bond and notice to Surety is not required for such increased obligation.

This bond may be executed in two (2) original counterparts, and shall be signed by the parties' duly authorized officers. This bond will only be accepted if it is accompanied by a fully executed and original power of attorney for the officer executing on behalf of the surety.

PRINCIPAL		SURETY	
_____		_____	
Principal Signature	Date	Surety Signature	Date
_____		_____	
Printed Name		Printed Name	
_____		_____	
Title		Title	

Name, address, and telephone of local office/agent of Surety Company is:

_____

_____

_____

Approved as to form:

_____

District Attorney, North Beach Water District Date

PART 3

GENERAL CONDITIONS

PART 4

TECHNICAL SPECIFICATIONS

ENGINEERING SPECIFICATIONS

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DIVISION 1

GENERAL TECHNICAL REQUIREMENTS

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.1 SCOPE OF WORK

The work specified in this Section consists of furnishing all labor, materials, and equipment necessary for construction of the Water Supply and Treatment Project Rebid, as shown on the Plans, and hereinafter specified, at the existing North and South Wellfield Sites. Work shall include, but not be limited to, the following:

A. SCHEDULE A – SOUTH WELLFIELD IMPROVEMENTS

South Wellfield – Wiegardt Wells Site

1. Furnish and install submersible well pumps, flowmeter vaults, flowmeters, piping, valves and appurtenances for South Wellfield Wiegardt Wells 1, 2, and 3.

2. Construct approximately 500 lf of 8-inch raw water main along the Wiegardt Well Site.

South Wellfield – Treatment Site

1. Complete associated sitework including erosion control, clearing, grubbing, excavation, shoring, dewatering, backfill, and grading.

2. Furnish and install piping, valves and appurtenances.

3. Furnish and install a Carbon Filter Treatment System.

4. Furnish and install new double door and rollup door at the Existing Treatment Building.

5. Furnish and install a Ferric Chloride Feed System.

6. Furnish and install a Potassium Permanganate Feed System.

7. Furnish and install HVAC equipment in Chemical Room.

8. Furnish and install all required electrical, telemetry and instrumentation.

9. Restore all disturbed areas.

B. SCHEDULE B – NORTH WELLFIELD IMPROVEMENTS

North Wellfield Site

1. Furnish and install piping, valves and appurtenances.

2. Furnish and install insulation and finish existing walls in the Existing Treatment Building.

3. Furnish and install new double door at the Existing Treatment Building.

4. Furnish and install a Potassium Permanganate Feed System.

5. Furnish and install all required electrical, telemetry and instrumentation.

C. ADDITIVE ITEM

1. South Wellfield - Wiegardt Wellfield complete associated sitework, including fill, grading, CSTC, CSBC and restoration.

1.2 PROJECT INFORMATION

The Contract Documents show the location, arrangement, and type of work to be performed under the proposed project.

The Contractor shall be responsible for proper notification to and coordination with all utility districts, service districts, and all other persons and services that will be affected by this project at least one week in advance of beginning any construction that affects them.

It is the intent and purpose of these Contract Documents to have constructed complete facilities in good working order for the least practical cost to the Owner. Suggestions, recommendations, as well as inquiries from the Contractor that will serve this purpose are welcome and will be given consideration by the Owner and the Engineer.

1.3 WEB-BASED PROJECT COMMUNICATION SYSTEM

The Contractor shall install and use the necessary computer hardware and software to receive and transmit project communications through the Engineer's web-based, online project communications system (G&O Construction Management System). This website will be used by the Engineer, Field Representative, Owner and Contractor to communicate online between these parties to clarify design and construction requirements, to provide information concerning construction issues, and to post certain project documents. The intent of this communication system is to provide an efficient means of communicating between the parties to present project information and answer project-related questions while reducing the amount of paperwork typically involved with project communication and record-keeping.

The web-based project communication system will use the secure website and programming developed by the Engineer. The Engineer will provide the Contractor with the instructions and credentials for access and use of the website. Access to the website will only be available through use of system passwords assigned to each participant. There is no fee charged by the Engineer for use of this website.

The website shall be used for posting and responding to the following communications and documents:

- Submittals
- Request to Sublet
- Progress Estimates
- Requests for Information
- Construction meeting minutes
- Job photos
- Document logs
- Change order proposals
- Weekly Working Day Reports
- Weekly Quantity Reports
- Material Testing Reports

Additional items may be added to the above list at the Owner's option.

The Engineer will administer and maintain the website. The Contractor, Owner and Engineer shall use the website to communicate project information instead of using hard copies and faxes, unless the website is unable to support the desired communication.

The communication system has been designed to operate with Mozilla Firefox (a free browser). The Contractor shall install the current version of Firefox on all PCs involved with the project communications. The Contractor shall provide and maintain the following hardware and software at the Contractor's computers at the project site, and at off-site computers as desired by the Contractor, to use the web-based project communication system:

- Internet/Wireless Services
- Microsoft Office
- Email address
- Sun JAVA (free software)
- Firefox web browser with Adobe Flash plug-in (free)
- Antivirus/anti-spyware software
- Computers with CD/RW burner drives
- Sufficient hardware capability to run the Windows operating system
- Tracker Software PDF X-Change Viewer (free software)
- Color flatbed scanner (or printer/scanner/fax) for PDF, TIFF, or GIF format scanning

1.4 CONTRACTOR USE OF SITE AND PREMISES

Construction operations shall be limited to the areas noted on Sheet G-3 of the Plans and subject to the approval of the Engineer. The Owner has obtained temporary construction easements where shown on Sheet G-3.
The Contractor shall submit a traffic control plan for all site access and egress routes for construction vehicle traffic per Section 01950.

The Contractor shall allow representatives of the funding and regulatory agencies access to the project site at all times.

The Contractor shall be aware that the Owner's archaeologist may observe and sample excavated material for cultural artifacts during Contractor's excavation work. The Contractor shall allow this work without extra compensation.

The Contractor shall notify the Owner at least 48 hours in advance of any proposed water system shut downs. The Contractor shall also be responsible for notifying all impacted water users 48 hours in advance of any water shutoff.

1.5 ORDER OF WORK

The order of work will be at the option of the Contractor, except as noted below, in keeping with good construction practice, time restrictions, requirements of the permits applicable to this project, and the order of work as outlined herein, all

costs of which shall be included in the various bid amounts. The Contractor shall conduct the order of work to allow the existing facilities to remain operational during the construction of the Project and shall coordinate all of his activities through the Engineer with the Owner's operations and maintenance staff. The Contractor shall provide a written plan of activities to the Engineer and Owner each Thursday for the following week, for review and coordination with existing facility operations.

The implementation of any measure required to protect the environment shall supersede any order of work designated within these Specifications. The Contractor shall meet the conditions as outlined in any and all permits and requirements of the Federal, State, County, and City regulatory agencies.

The Contractor shall keep the disruption of the existing facility operations to a minimum. Except as noted below, water system shutdowns shall be limited to 8 hours during any 24-hour period. The Contractor shall be responsible for all temporary pumping to include all connections, piping, pumping equipment, temporary electrical service and controls, and appurtenances.

Access to the existing operations areas shall be maintained. Disruption of this access shall be kept to a minimum and must be prearranged and scheduled through the Engineer with the Owner's operations and maintenance staff.

The following summary shall be used as a general guideline of the construction tasks to be performed. The tasks are generally listed in the order of completion. The tasks, however, can be completed in a different order than listed herein, including performance of two or more tasks concurrently. The Contractor shall prepare a complete project schedule, which shall be provided in accordance with the limitations specified herein.

A. Wiegardt Wellfield and South Wellfield Treatment Facility

The Weigardt Wellfield and South Wellfield Treatment Facility work shall be completed as the first order of work. The South Wellfield Reservoir and Booster Station shall remain in service while the Weigardt Wellfield and South Wellfield Treatment Facility are constructed.

B. North Wellfield Treatment Facility

The North Wellfield Treatment Facility may not be taken off-line until the Weigardt Wellfield and South Wellfield Treatment Facility are constructed, tested, commissioned, and on-line. The North Wellfield Reservoirs and Booster Station shall remain in service while the North Wellfield Treatment Facility is constructed with the exception of one 7 calendar day outage to

allow electrical and control modifications to be completed. This outage shall be scheduled with the Owner and Engineer 7 calendar days in advance. The North Wellfield Treatment Facility and Reservoir and Booster Station shall not be out of service from July 1 to July 31.

C. North Wellfield Backwash Basin

The North Wellfield Backwash Basin may be completed at any time.

***** END OF SECTION *****

SECTION 01150

SURVEYS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes all survey for the project. The Contractor shall provide all construction survey for the Work. The Engineer will provide primary horizontal and vertical control data and monuments, as shown on the Plans.

At the Contractor's request, the Engineer will provide the Plans in electronic format. Electronic files are provided for the Contractor's convenience and are not part of the Contract. Calculations shall be made from the Plans.

During the prosecution of the work, the Contractor shall make all necessary measurements to prevent misfitting, and shall be responsible for the accurate construction of the work.

1.2 DEFINITIONS

The meaning of words and terms used in this provision shall be as listed in "Definitions of Surveying and Associated Terms" current edition, published by the American Congress on Surveying and Mapping, and the American Society of Civil Engineers.

1.3 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01720	Record Drawings

1.4 QUALIFICATIONS

The Contractor shall employ a Professional Land Surveyor (PLS) registered in the State of Washington and acceptable to the Owner. All surveying shall be completed by or under the direct supervision of the PLS.

1.5 SUBMITTALS

The Contractor shall submit the name, address, and license number of the Professional Land Surveyor before starting construction.

1.6 QUALITY ASSURANCE

The Contractor shall ensure a surveying accuracy within the following tolerances:

	Vertical	**Horizontal**
Slope Stakes	±0.1 feet	±0.10 feet
Subgrade Grade Stakes Set 0.04 foot Below Grade	±0.01 feet	±0.5 feet (parallel to alignment) ±0.1 feet (normal to alignment)
Stationing on Roadway	N/A	±0.1 feet
Alignment on Roadway	N/A	±0.04 feet
Surfacing Grade Stakes	±0.01 feet	±0.1 foot (parallel to alignment) ±0.1 feet (normal to alignment)
Roadway Paving Pins for Surfacing or Paving	±0.01 feet	±0.1 feet (parallel to alignment) ±0.05 feet (normal to alignment)
Alignment of sewer and storm manholes and catch basins	±.01 feet	±0.1 feet
Stationing on Structures		±.02 feet
Alignment on structures		±.02 feet
Superstructure elevations	±.01 feet variation from Plan elevation	
Substructure	±.02 feet variation from Plan grades	

When the following items are included in the project, the Contractor shall perform independent checks from different secondary control to ensure that the points staked are within the specified survey accuracy tolerances:

- Piles
- Shafts
- Footings
- Columns

The Owner may spot-check the Contractor's surveying. These spot-checks will not change the requirements for accuracy by the Contractor

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

The Contractor's PLS shall establish all secondary survey controls, horizontal and vertical, as necessary to assure proper placement of all Work based upon the primary control points provided by the Owner. The Contractor shall be responsible for setting, maintaining, and resetting all alignment stakes, clearing limit stakes, slope stakes, and grades for the Work. Except for the survey control data to be furnished by the Owner, calculations, surveying, and measuring required for setting and maintaining the lines and grades shall be the Contractor's responsibility.

Survey records shall be maintained by the Contractor's PLS, including a description of the work performed on each shift, the methods utilized, and the control points used. The record shall be adequate to allow the survey to be reproduced. A copy of each day's record shall be provided to the Engineer within three working days of Engineer's request.

All surveyed points shall be established by placing hubs and tacks with marked stakes in unpaved areas or P.K. nails with painted markings in paved areas. All surveying stakes shall be marked in accordance with WSDOT Standard Plan A-10.10-00. When stakes are needed that are not described in the Standard Plans, then those stakes shall be marked as ordered by the Engineer. The Contractor's surveyor shall maintain and replace survey hubs, stakes, nails and markings immediately if destroyed, removed, or the Engineer determines the stake or pavement markings are illegible.

For monuments to be removed or destroyed as shown on the Plans, the Contractor's PLS shall file all required permit forms with the Department of

Natural Resources (DNR), as required by RCW 58.09.130 and WAC 332-120. The form "Application for Permit to Remove or Destroy a Survey Monument" shall be signed by the PLS, and submitted directly to DNR and the Owner. No work affecting monumentation shall commence until DNR has approved the permit. The form "Completion Report for Monument Removal or Destruction" shall be signed by the PLS and submitted to DNR and the Owner upon completion of work affecting monumentation.

The Contractor shall be responsible for locating and preserving existing monuments within the right-of-way, which shall include existing property corners on the right-of-way lines. In the event the Contractor disturbs or destroys any survey marker, monument, or property corner during the course of construction, not indicated to be removed on the Plans, the Contractor shall bear all costs or survey, resetting, legal claims and filing state forms as required by RCW 58.09.130 and WAC 332-120.

***** END OF SECTION *****

SECTION 01160

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section contains information pertaining to permits and licenses, and use of private property.

1.2 PERMITS AND LICENSES

Except as noted below, the Contractor shall be responsible for obtaining and paying all fees associated with all the necessary permits, licenses, approvals, and construction permits necessary for the execution of this Contract, whether they be City, County, State, or federal permits.

The Owner will be responsible for obtaining the following approvals and permits, and will pay the fees associated with the application and procurement of such approvals and permits. The Contractor is advised to become familiar with these approvals and permits necessary for this project. The Contractor shall comply with all conditions of each approval/permit as if the conditions were detailed herein.

A. WSDOE Construction Stormwater General Permit (obtained by Owner to be transferred to Contractor)

B. Pacific County Right-of Way Permit (obtain by Owner)

C. Pacific County Utility Franchise Amendment (obtain by Owner)

D. Pacific County Building Permit (applied and paid for by Owner, obtained by Contractor)

E. Department of Health Project Approval

1.3 CONSTRUCTION STORMWATER NPDES PERMIT

Upon award of the contract, the Contractor shall complete a Transfer of Coverage Form for the Construction Stormwater NPDES Permit. Upon transfer of coverage, the Contractor shall be responsible for complying with all terms of this permit until project closeout including monitoring and recordkeeping.

1.4 USE OF PRIVATE PROPERTY

The Contractor shall be responsible for all conditions of any arrangements the Contractor makes for the use of any privately owned property.

In the event any dispute occurs and claims for damages are filed by the property owners, the Owner will request that the Contractor give evidence that he has requested his insurance company to make personal contact with the claimants. Any settlement for insurance claims shall be strictly an act restricted to the claimant, the Contractor, and his insurance company.

The Contractor is advised that in the event of any property damage, the Owner reserves the right to withhold monies to protect the property owner.

1.5 PROPERTY RELEASE FORM

The Contractor shall be held responsible for acquiring signed property release forms, in the format provided on the following page, for all properties that have been disturbed or damaged by the Contractor's operations, or utilized by the Contractor for staging, storing, or stock piling of materials or equipment.

This work shall include submitting the form(s), as further shown herein, by certified mail to each property owner effected and further including therein a self addressed stamped envelope for the property owner's use. The enclosed self addressed envelope shall be addressed to: North Beach Water District, P.O. Box 618, Ocean Park, WA 98640. Contractor shall provide evidence of all certified mailings.

***** END OF SECTION *****

PROPERTY RELEASE

_____
(Property Address)

_____

_____

DATE:_____

I, _____, owner of _____
(Property Owner's Name) (Property Description or

_____, hereby release
Address)

_____, from any property
(Contractor's Name)

damage or personal injury resulting from construction adjacent

to or on my property located at _____,
(Property Address)
during construction of the Water Supply and Treatment Project Rebid.

My signature below is my acknowledgment and acceptance that my property, as identified above, was returned to a satisfactory condition.

Name: _____

Signed: _____

Address: _____

_____

Phone: _____

SECTION 01200

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SCOPE

This Section further defines Measurement and Payment for this project.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
GC Section 3.04.12	Measurement and Payment
01290	Schedule of Values
01300	Submittals

1.3 MEASUREMENT

Measurement for all items shall be as indicated in these Specifications for unit price and lump sum price bid items. Bid items are outlined in detail in this Specification Section and listed in the Proposal.

Measurement shall be in accordance with Section 1-09.1 of the WSDOT Standard Specifications. Volumes of gravel materials and concrete volumes shall be measured by the Engineer in the field and quantities will be limited to the relative neat line dimensions shown on the Plans or as approved by the Engineer in the field.

Weighing equipment, scale verification checks, load tickets for quarry spalls, rock riprap, cobbles, gravel materials, hot mix asphalt, bituminous construction materials, etc., shall conform to Section 1-09.2 of the WSDOT Standard Specifications. Load tickets shall include all gravel materials, cast-in-place concrete, cement grout, CDF, hot mix asphalt, ATB, and reinforcing steel. The Owner will pay for no material received by weight unless they have been weighed as required in this Section or as required by another method the Engineer has approved in writing. All costs incidental to weighing shall be merged into the various unit prices bid.

1.4 INDIVIDUAL BID ITEMS

The following is a list of bid items for the project. The contract price for each item constitutes full compensation for furnishing all equipment, labor, materials, appurtenances, and incidentals and performing all operations necessary to

construct and complete the various bid items in accordance with the Contract Documents. Payment for each item shall be considered as full compensation, notwithstanding that minor features may not be mentioned herein. Work paid for under one item will not be paid for under any other item. If a particular item of work shown on the Plans or described in Specifications is not described in a specific bid item, this item of work shall be considered as incidental to the work and the costs for this work shall be merged into the various respective unit price and lump sum bid items.

A. SCHEDULE A – SOUTH WELLFIELD IMPROVEMENTS

1. Mobilization and Demobilization

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for MOBILIZATION AND DEMOBILIZATION shall include all costs for the labor, materials, and equipment required to meet the requirements of Section 01505. Costs shall include survey, complying with regulatory requirements, submittals, project meetings, progress schedules, photographs, temporary facilities, traffic control, field offices and storage sheds, record drawings, cleanup, testing commissioning, and training.

Payment for MOBILIZATION, CLEANUP, AND DEMOBILIZATION shall be as follows:

70% Payment: When Contractor has mobilized on-site and temporary facilities are in place.

100% Payment: When equipment if demobilized from the site and the site is cleaned up and restored.

2. Minor Changes

a. Measurement: Shall be negotiated prior to commencing any such work under this pay item and shall be for work to remedy unforeseen conditions, utility conflicts, minor landscaping, minor drainage improvements, or special surface restoration.

b. Payment: The Contractor shall be paid under MINOR CHANGES as preapproved by the Owner for additional work required to construct this Project due to unforeseen conditions, minor landscaping, minor drainage improvements, special surface restoration, or "other" minor work as may be necessary. The additional work shall be preapproved in writing by the Owner. Only additional work approved in writing shall be subject to reimbursement. When the Owner and Contractor cannot agree to negotiate this work, a formal change order will be prepared. In order to create equity amongst bidders, the Owner has entered an amount for this bid item as listed in the Proposal. It is not to be interpreted by the Contractor that this amount of unforeseen work exists. The Contractor is cautioned that payment for work under this bid item is not guaranteed and will only be utilized when such need (additional work beyond the scope of this project) arises and is authorized by the Owner during the performance of this project.

Where reference is further made herein to "merge and/or include costs in the various items bid," such reference shall not apply to this bid item.

3. Locate Existing Utilities

a. Measurement: Shall be measured by lump sum where existing utilities must be located using potholing where indicated on the Plans or as necessary to adequately identify the location of existing utilities.

b. Payment: The lump sum contract price for LOCATE EXISTING UTILITIES shall include all costs for the labor, materials, and equipment required to carefully excavate or pothole to locate existing utilities and backfill each excavation in locations as shown on the Plans or as necessary to adequately identify the location of existing utilities.

4. Trench Excavation Safety Systems

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for TRENCH EXCAVATION SAFETY SYSTEMS shall include all costs

for labor, materials, and equipment required to provide sheeting, shoring and bracing of trenches and open excavations as required to meet the Washington Industrial Safety and Health Act, Chapter 49.17 RCW and Section 02250, Temporary Shoring and Bracing. These costs shall not be considered incidental to any other bid item.

5. Sitework

   a. Measurement: Shall be measured by lump sum.

   b. Payment: The lump sum contract price for SITEWORK shall include all costs for labor, materials, and equipment required to clear, grub, strip, excavate, dewater, grade, fill, and provide compaction and testing as shown on the Plans and as specified herein.

6. Special Excavation of Unsuitable Material

   a. Measurement: Shall be measured by the cubic yard, in-place and shall be to the limits as approved by the Engineer. There shall be no payment if the Engineer believes removal of materials is needed because of damage caused by the Contractor's operations.

      The Contractor is advised that the excavation of any and all unsuitable material shall be authorized by the Engineer in writing prior to the commencement of said excavation by the Contractor.

      All quantities shall be measured and recorded by the Engineer in his Daily Report and the Contractor shall be responsible for reconciling his quantities with the Engineer on a daily basis.

   b. Payment: All costs for over-excavation, including, but not limited to, loading, hauling and disposing of any and all material below the subgrade identified on the plans for footings and slabs of structures and the subgrade for trenches shall be paid for under the unit price bid per cubic yard for SPECIAL EXCAVATION OF UNSUITABLE MATERIAL.

7. Erosion Control

   a. Measurement: Shall be measured by lump sum.

   b. Payment: The lump sum contract price for EROSION CONTROL shall include all costs for installation and maintenance of all temporary erosion and sediment control measures, best management practices (BMPs), and construction entrance, as shown on the Plans and as further described in Section 02370.

8. Foundation Gravel

   a. Measurement: Shall be measured per cubic yard and shall be to the limits shown on the Plans or as required by encountered subgrade conditions as approved by the Engineer.

   b. Payment: The unit price bid per cubic yard for FOUNDATION GRAVEL shall include all costs for the labor, material, and equipment associated with furnishing, installing, and testing foundation gravel in trenches and below structures as shown on the Plans and as described Sections 02300 and 02700. The quantity of material for payment shall be based volume of material placed within the neat line limits as shown on the Plans and as approved by the Engineer.

      In the event the Contractor overexcavates the trench depth, or if the trench width becomes wider than the pay limit shown on the Plans, all material so placed shall be at the Contractor's sole expense.

9. Crushed Surfacing Top Course

   a. Measurement: Shall be measured per ton, in-place, based on truck tickets and shall be to the limits designated and approved by the Engineer.

b. Payment: The unit price bid per ton for CRUSHED SURFACING TOP COURSE shall include all costs associated with furnishing, installing, and testing crushed surfacing top course as shown on the Plans and as described in Section 02710.

10. Crushed Surfacing Base Course

a. Measurement: Shall be measured per ton, in-place, based on truck tickets and shall be to the limits designated and approved by the Engineer.

b. Payment: The unit price bid per ton for CRUSHED SURFACING BASE COURSE shall include all costs for the labor, material, and equipment associated with furnishing, installing, and testing crushed surfacing base course as shown on the Plans and as described in Section 02710.

11. Bank Run Gravel

a. Measurement: Shall be measured per ton, in-place, based on truck tickets and shall be to the limits designated and approved by the Engineer.

b. Payment: The unit price bid per ton for BANK RUN GRAVEL shall include all costs associated with furnishing, installing, and testing bank run gravel and wastehauling native material as shown on the Plans and as described in Sections 02300 and 02700.

12. Restoration

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for RESTORATION shall include all costs for the labor, material, and equipment associated with furnishing and installing top soil and hydroseeding as specified in Section 02900 and as shown on the Plans.

13. Reinforced Concrete Slab

a. Measurement: Will be measured by lump sum.

b. Payment: The lump sum contract price for REINFORCED CONCRETE SLAB shall include all costs for labor, materials, and equipment to construct the concrete slab for the adsorption carbon filters including, but not limited to, reinforced concrete and anchor bolts, as shown on the Plans and as specified herein.

14. Treatment Building Modifications

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for TREATMENT BUILDING MODIFICATIONS shall include all costs for labor, materials, and equipment to complete the treatment building modifications including, but not limited to, concrete pad, wood framing, trim, siding, doors, hardware, interior finishes, pallet jack, safety equipment, painting, and HVAC in chemical room as shown on the Plans and as specified herein.

15. Wiegardt Well 1 Pump

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum price for WIEGARDT WELL 1 PUMP shall include all costs to modify the well casing and furnish, install, disinfect, and test the well pump, drop pipe, check valve, and appurtenances as shown on the Plans and as indicated in Section 11211 of these Specifications.

16. Wiegardt Well 2 Pump

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum price for WIEGARDT WELL 2 PUMP shall include all costs to modify the well casing and furnish, install, disinfect, and test the submersible well pump, drop pipe, check valve, and appurtenances as shown on the Plans and as indicated in Section 11211 of these Specifications.

17. Wiegardt Well 3 Pump

    a. Measurement: Shall be measured by lump sum.

    b. Payment: The lump sum price for WIEGARDT WELL 3 PUMP shall include all costs to modify the well casing and furnish, install, disinfect, and test the submersible well pump, drop pipe, check valve, and appurtenances as shown on the Plans and as indicated in Section 11211 of these Specifications.

18. Carbon Filter Treatment System

    a. Measurement: Shall be measured by lump sum.

    b. Payment: The lump sum price for CARBON FILTER TREATMENT SYSTEM shall include all costs to furnish, install, disinfect and test the package carbon filter treatment system as shown on the Plans and as indicated in Section 11222 of these Specifications.

19. Ferric Chloride Feed System

    a. Measurement: Shall be measured by lump sum.

    b. Payment: The lump sum contract price for FERRIC CHLORIDE FEED SYSTEM shall include all costs to furnish, install, and test the ferric chloride feed system as shown on the Plans and as indicated in Section 11241 of these Specifications.

20. Potassium Permanganate Feed System

    a. Measurement: Shall be measured by lump sum.

    b. Payment: The lump sum contract price for POTASSIUM PERMANGANATE FEED SYSTEM shall include all costs to furnish, install, and test the potassium permanganate feed system as shown on the Plans and as indicated in Section 11240 of these Specifications.

21. Piping, Valves, and Appurtenances

    a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for PIPING, VALVES, AND APPURTENANCES shall include all costs for the labor, materials, and equipment to furnish and install piping, valves, and appurtenances including, but not limited to trench excavation, dewatering, bedding, backfilling with native material (if allowed), compaction, pipe penetrations, pipe, fittings, valves, pipe supports, thrust blocks, CDF backfill, plumbing, cleanouts, flowmeter vaults, contact tank, venturi injector, hot water tank, connect to existing system, fire hydrants, bollards, painting, disinfection, and testing as shown on the Plans and as specified herein.

22. Electrical, Telemetry, and Instrumentation

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for ELECTRICAL, TELEMETRY, AND INSTRUMENTATION shall include all costs associated with furnishing and installing electrical components of this Project including conduit, wiring, motor control centers, panel boards, receptacles, fixtures, instrumentation, telemetry, and controls as shown on the Plans and as described in Divisions 13 and 16 of these Specifications. Costs shall also include all costs for demolition or abandonment of electrical components.

B. SCHEDULE B – NORTH WELLFIELD IMPROVEMENTS

1. Mobilization and Demobilization

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for MOBILIZATION AND DEMOBILIZATION shall include all costs for the labor, materials, and equipment required to meet the requirements of Section 01505. Costs shall include survey, complying with regulatory requirements, submittals, project meetings, progress schedules, photographs, temporary facilities, traffic control, field offices and storage sheds, record drawings, cleanup, testing commissioning, and training.

Payment for MOBILIZATION, CLEANUP, AND

DEMOBILIZATION shall be as follows:

70% Payment: When Contractor has mobilized on-site and temporary facilities are in place.

100% Payment: When equipment if demobilized from the site and the site is cleaned up and restored.

2. Minor Changes

a. Measurement: Shall be negotiated prior to commencing any such work under this pay item and shall be for work to remedy unforeseen conditions, utility conflicts, minor landscaping, minor drainage improvements, or special surface restoration.

b. Payment: The Contractor shall be paid under MINOR CHANGES as preapproved by the Owner for additional work required to construct this Project due to unforeseen conditions, minor landscaping, minor drainage improvements, special surface restoration, or "other" minor work as may be necessary. The additional work shall be preapproved in writing by the Owner. Only additional work approved in writing shall be subject to reimbursement. When the Owner and Contractor cannot agree to negotiate this work, a formal change order will be prepared. In order to create equity amongst bidders, the Owner has entered an amount for this bid item as listed in the Proposal. It is not to be interpreted by the Contractor that this amount of unforeseen work exists. The Contractor is cautioned that payment for work under this bid item is not guaranteed and will only be utilized when such need (additional work beyond the scope of this project) arises and is authorized by the Owner during the performance of this project.

Where reference is further made herein to "merge and/or include costs in the various items bid," such reference shall not apply to this bid item.

3. Fence and Gates

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for FENCE AND GATES shall include all costs for the labor, material, and equipment associated with furnishing and installing fencing, gates, top soil, and hydroseeding specified in Section 02820 and as shown on the Plans.

4. Treatment Building Modifications

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for TREATMENT BUILDING MODIFICATIONS shall include all costs for labor, materials, and equipment to modify the treatment building including, but not limited to wood framing, trim, siding, insulation, doors, hardware, interior finishes, safety equipment, and painting as shown on the Plans and as specified herein.

5. Potassium Permanganate Feed System

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for POTASSIUM PERMANGANATE FEED SYSTEM shall include all costs to furnish, install, and test the potassium permanganate feed system as shown on the Drawings and as indicated in Section 11240 of these Specifications.

6. Piping, Valves, and Appurtenances

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for PIPING, VALVES, AND APPURTENANCES shall include all costs for the labor, materials, and equipment to furnish and install piping, valves, and appurtenances including, but not limited to pipe penetrations, pipe, fittings, valves, pipe supports, relocating filter and piping, thrust blocks, CDF backfill, combination air and vacuum assembly, connect to existing system, venturi injectors, painting, disinfection, and testing as shown on the Plans and as specified herein.

7. Electrical, Telemetry, and Instrumentation

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for ELECTRICAL, TELEMETRY, AND INSTRUMENTATION shall include all costs associated with furnishing and installing electrical components of this Project including conduit, wiring, motor control centers, panel boards, receptacles, fixtures, instrumentation, telemetry, and controls as shown on the Plans and as described in Divisions 13 and 16 of these Specifications. Costs shall also include all costs for demolition or abandonment of electrical components.

C. ADDITIVE ITEM

1. Wiegardt Wellfield Sitework

a. Measurement: Shall be measured by lump sum.

b. Payment: The lump sum contract price for WIEGARDT WELLFIELD SITEWORK shall include all costs for the labor, materials and equipment required to clear, grub, strip, excavate, dewater, grade, fill, CSTC, CSBC, and provide compaction and testing as shown on the Plans and as specified herein.

2. Crushed Surfacing Top Course

a. Measurement: Shall be measured per ton, in-place, based on truck tickets and shall be to the limits designated and approved by the Engineer.

b. Payment: The unit price bid per ton for CRUSHED SURFACING TOP COURSE shall include all costs associated with furnishing, installing, and testing crushed surfacing top course as shown on the Plans and as described in Section 02710.

3. Crushed Surfacing Base Course

a. Measurement: Shall be measured per ton, in-place, based on truck tickets and shall be to the limits designated and approved by the Engineer.

b. Payment: The unit price bid per ton for CRUSHED SURFACING BASE COURSE shall include all costs for the labor, material, and equipment associated with furnishing, installing, and testing crushed surfacing base course as shown on the Plans and as described in Section 02710.

1.5 PROJECT MATERIALS ON HAND

See General Conditions Section 3.04.12(6).

1.6 PAYMENT

Payment for all work will be made at the contract unit price or lump sum price as indicated in the Proposal, payment of which shall constitute full compensation, for a complete installation.

For items of equipment, acceptable operating and maintenance information shall be delivered to the Engineer before the Contractor will be paid for more than 90 percent of the purchase value of that equipment. Purchase value shall be the net price for the equipment as given on the invoice.

Final operating and maintenance manuals per Section 01300 must be delivered to the Engineer prior to the Project being 90 percent complete. Progress payments for work in excess of 90 percent completion will not be made until the specified acceptable operating and maintenance information has been delivered to the Engineer.

***** END OF SECTION *****

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes requirements that apply to all equipment and materials supplied on the Project.

The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the requirements of the Contract Documents. Submittal documents shall be clearly edited to indicate only those items, models, or series of equipment that are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall ensure that there is no conflict with other submittals and notify the Engineer in each case where his submittal may affect the work of another contractor or the Owner. The Contractor shall ensure coordination of submittals among the related crafts and subcontractors and shall verify such coordination on all submittals.

Where noted in the Contract Documents, the structural, mechanical, and electrical designs associated with the indicated equipment items are specific to the manufacturer and model number specified. Any structural, mechanical, or electrical modifications required to utilize an approved substitution to the specified equipment shall be made by the Contractor at no additional cost to the Owner. Where approved substitutions of specified equipment affect other materials or equipment, mechanical, structural, or electrical work, the Contractor shall note in the equipment submittal any necessary changes to accommodate the substituted equipment. It shall also be the responsibility of the Contractor to coordinate other mechanical, structural, or electrical equipment submittals to make sure that all changes necessary to accommodate the substituted equipment are addressed in these submittals as well. See General Condition 3.04.3.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01720	Record Drawings
01800	Testing, Commissioning, and Training
11000	Equipment General Provisions
16050	Basic Electrical Materials and Methods

1.3 WORK INCLUDED

Submittals required for this work shall include any or all of the following as required by the particular specification section and the submittal schedule:

A. Schedules and Plans

B. PRODUCT SUBMITTALS

1. Manufacturer's Literature
2. Shop Drawings
3. Color and Material Samples
4. Design Calculations
5. Test Reports

C. Equipment Operation and Maintenance Manuals

D. Post-Construction (Record) Drawings (see Section 01720)

1.4 SUBMITTAL INFORMATION

Shop, catalog, and other appropriate drawings and information shall be submitted to the Engineer for review prior to fabrication or ordering of all equipment and materials specified. The number of copies of submittal information to be submitted shall be as indicated below.

All submittal information shall be sent to the Engineer through the Contractor. The Contractor shall assign a separate submittal number to each item or group of items that relate to each specification section. Submittal numbers shall be assigned in consecutive ascending order, with the first project submittal assigned the number "1." Resubmittals shall be numbered using the same number followed by an alphabetical suffix. All submittals shall bear the Contractor's certification that he has reviewed, checked, and approved the submittal information prior to transmitting to the Engineer. The submittal number and related Specification Section shall be marked on each submittal.

PART 2 PRODUCTS

2.1 GENERAL

The Contractor shall submit all submittals on the Web-Based Project Communication System. The Contractor shall submit the specified information as PDF files on the web-based project communication system, with a table of contents bookmarked to provide a navigation link to each section of the submittal.

The PDF shall consist of one submittal for each submittal number and shall not be broken up into separate documents. Three CD ROM PDF version and four hard copies of all final equipment manuals shall be submitted.

2.2 PRODUCT SUBMITTALS

A. GENERAL

When indicated in the Contract Documents, the Contractor shall submit product data for review by the Engineer. Unless otherwise specified, within 14 calendar days after receipt of the submittal, the Engineer shall review the submittal and return three copies of the marked-up submittal. The reproducible original will be retained by the Engineer. The returned submittal shall indicate one of the following actions:

1. If the review indicates that the material, equipment, or work method complies with the project Specifications, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.

2. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED." The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in operation and maintenance data, a corrected copy shall be provided.

3. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "AMEND AND RESUBMIT." Except at his own risk, the Contractor shall not undertake work covered by this submittal until it has been revised, resubmitted, and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

4. If the review indicates that the material, equipment, or work method does not comply with the project Specifications, copies of the submittal will be marked "REJECTED - SEE REMARKS." Submittals with deviations that have not been identified clearly may be rejected. Except at his own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

B. MANUFACTURER'S LITERATURE

Where the contents of submitted literature include data not pertinent to the submittal, the portion(s) of the contents being submitted for the Engineer's review shall be clearly indicated.

C. SHOP DRAWINGS

Shop drawings shall be submitted in the form of blue-line or black-line prints of each sheet. Blueprint submittals will not be acceptable.

All shop drawings shall be accurately drawn to a scale sufficiently large enough to show pertinent features and method of connection or joining. On all shop drawings, figure dimensions shall be used as opposed to scaled dimensions.

D. COLOR AND MATERIAL SAMPLES

All material samples shall be of the exact article proposed to be furnished for the work and shall be submitted in the quantity required. Samples shall be returned to the Contractor, with one retained by the Engineer.

Unless the precise color is specifically described in the Contract Documents, or whenever a choice of color or pattern is available in a specified product, accurate color charts shall be submitted to the Engineer for his review and selection.

E. DESIGN CALCULATIONS

Where required in the Specifications, design calculations shall be submitted to the Engineer. Design calculations shall be complete, concise, and in an easy-to-read format. All design calculations shall be stamped by a Professional Engineer licensed in the State of Washington.

F. TEST REPORTS

Copies of all test reports shall be submitted to the Engineer.

2.3 EQUIPMENT MANUALS

A. GENERAL

For all items of equipment, preliminary manufacturer's equipment operation and maintenance manuals shall be submitted to the Engineer for review. One copy will be returned to the Contractor with comments.

The following information shall be furnished for all items of equipment installed on the project requiring operational and/or maintenance procedures, and for any additional items indicated by the Engineer.

1. Lubrication Information

   This shall consist of the manufacturer's recommendations regarding the lubricants to be used and the lubrication schedule to be followed.

2. Electrical and Control Diagrams

   Diagrams shall show internal and connection wiring.

3. Startup Procedures

   These instructions consist of equipment manufacturer's recommendations for installation, adjustment, calibration, and troubleshooting.

4. Operating Procedures

   These instructions consist of the equipment manufacturer's recommended step-by-step procedures for starting, operating, and stopping the equipment under specified modes of operation.

5. Preventive Maintenance Procedures

   These instructions consist of the equipment manufacturer's recommended steps and schedules for maintaining the equipment.

6. Overhaul Instructions

   These instructions consist of the manufacturer's directions for the disassembly, repair, and reassembly of the equipment and any

safety precautions that must be observed while performing the work.

7. Parts List

   This list consists of the generic title and identification number of each component part of the equipment.

8. Spare Parts List

   This list consists of the manufacturer's recommendations of number of parts, which should be stored by the Owner and any special storage precautions, which may be required.

9. Exploded View

   Exploded or cut views of equipment shall be provided if available as a standard item of the manufacturer's information. When exploded or cut views are not available, plan and section views shall be provided with detailed callouts.

10. Test Documentation

    Reports, records, data and forms documenting the results of equipment factory tests, including pump and blower performance curves, shall be provided, with the operating points for the specific equipment designated. When a special factory test of the supplied equipment is not performed, the manufacturer's standard performance reports and curves, with specified operating points, shall be provided for the supplied equipment.

11. Specific Information

    Where items of information not included in the above list are required, they will be provided as described in the specifications for the equipment.

12. Warranty Information.

13. Maintenance Information Summaries (see below for requirements).

In addition, the following items of equipment shall be provided with Maintenance Information Summaries in each appropriate section of the equipment manuals, prepared according to the format specified herein:

- Submersible Well Pumps
- Adsorption Carbon Filters
- Flowmeters
- Metering Pumps
- Contact Vessel
- Water Tank
- Heating and Ventilation Equipment
- Valves (larger than 1-inch in size)
- Plant Instrumentation, Telemetry and Control Equipment
- Electrical Equipment

Maintenance information summaries shall be prepared on 8-1/2-inch x 11-inch paper only and shall contain the following information compiled from manufacturer's recommendations in the order shown.

1. Description or name of item of equipment.

2. Manufacturer.

3. Name, address, and telephone number of local manufacturer's representative.

4. Serial number (where applicable). The Contractor shall verify that it matches the equipment installed on the project.

5. Equipment nameplate data including model number.

6. Recommended maintenance procedures:

    a. Description of procedures.

    b. Maintenance frequency required.

    c. Lubricant(s) or other materials required (where applicable), including type of lubricant, lubricant manufacturer, and specific compound.

    d. Additional information as required for proper maintenance.

7. Recommended spare parts (where applicable).

The maintenance information summary shall be placed at the beginning of the manual.

All operation and maintenance information shall be comprehensive and detailed, and shall contain information adequately covering all normal operation and maintenance procedures.

For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment specification number as it appears in the project Specifications. The information shall be organized in binders. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information.

Lubricants shall be described in detail, including type, recommended manufacturer, and manufacturer's specific compound to be used.

It shall be the responsibility of the Contractor to ensure that all operation and maintenance materials are obtained. Material submitted must meet the approval of the Engineer prior to project acceptance.

B. EXTRANEOUS DATA

Where the contents of the manuals include manufacturers' standard brochures or catalog pages, the exact item(s) used in this installation shall be clearly indicated and all manufacturers' data which is extraneous shall be clearly deleted.

C. FINAL EQUIPMENT MANUALS

The Contractor shall be responsible for tracking and coordinating each separate manufacturer's equipment operation and maintenance manual submittal and shall resubmit, as necessary, until the Engineer's review indicates that the submittal is acceptable. The Contractor shall maintain equipment manual files until final approval copies are delivered to the Engineer. The Contractor shall be responsible for collating the approved operation and maintenance submittal sections into complete final manufacturers' equipment operation and maintenance manuals bound in post binders which are indexed to the Specifications. The Contractor shall deliver the complete final operation and maintenance manuals to the Engineer prior to project completion. All copies final manufacturers' equipment manuals submitted will be retained by the Engineer or Owner.

PART 3 EXECUTION

3.1 IDENTIFICATION OF SUBMITTALS

A. GENERAL

Each submittal shall be accompanied by a letter of transmittal showing the date of transmittal, specification section, or drawing number to which the submittal pertains, submittal number, and a brief description of the material submitted.

B. RESUBMITTALS

When material is resubmitted for any reason, it shall be submitted under a new letter of transmittal and referenced to the previous submittal.

3.2 REVIEW OF SUBMITTALS

The Engineer will review all submittals for general conformance with the design and other requirements of the Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Contract Documents. Submittals may be rejected based on inadequate information and/or not meeting the requirements of the Contract Documents. Rejection of submittals requires action on the part of the Contractor to correct the reason for the rejection. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, and for techniques of assembly and installation.

3.3 COORDINATION OF PRODUCT SUBMITTALS

A. GENERAL

Prior to submittal for review by the Engineer, all data shall be fully coordinated, including the following:

1. All field dimensions and conditions.

2. All trades and public agencies involved, including necessary approvals.

3. All deviations from the Contract Documents.

B. GROUPING OF SUBMITTALS

1. All submittals shall be grouped with associated items, unless otherwise specifically permitted by the Engineer.

2. The Engineer may reject the submittals in their entirety or any part thereof, if not in accordance with the Contract Documents.

C. CERTIFICATION

Submittals shall bear the Contractor's certification that he has reviewed, checked, and approved the shop drawings prior to forwarding them to the Engineer.

3.4 TIMING OF PRODUCT SUBMITTALS

A. GENERAL

1. All submittals shall be made far enough in advance of installation to provide all required time for reviews and securing necessary approvals.

2. In scheduling, the Contractor shall allow for the time indicated in Part 2.2A for the Engineer's review following his receipt of the submittal.

B. DELAYS

No additional or separate payment will be made for costs of delays occasioned by tardiness of submittals on the part of the Contractor.

3.5 EQUIPMENT MANUALS

The preliminary copies of the manufacturer's equipment manuals shall be delivered to the Engineer for review not later than the time of equipment delivery to the project site. The Contractor will not be paid for more than 90 percent of the purchase value of an item of equipment until the Engineer has received the preliminary equipment manual for that item of equipment.

Final copies of the manufacturer's equipment manuals shall be delivered to the Engineer at least 10 days prior to requesting payment in excess of 90 percent completion for the project. Progress payments for work in excess of 90 percent completion will not be made until the final equipment manuals have been received and accepted by the Engineer. Prior to submittal of the final equipment

manuals, the Contractor shall check the manuals for accuracy and completeness and shall verify that prior review comments have been addressed.

***** END OF SECTION *****

SECTION 01310

PROJECT MEETINGS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes information pertaining to the various meetings that will be held during the course of constructing this project.

1.2 PRECONSTRUCTION CONFERENCE

As soon as possible following the award of the Contract, a preconstruction conference shall be scheduled for representatives of the Owner, the Contractor, the Engineer, funding agencies, regulatory agencies, and affected utilities.

1.3 PROJECT PROGRESS MEETINGS

The Owner and the Engineer will schedule and attend regular biweekly meetings with the Contractor for coordination, administrative, and procedural requirements of the project. The Contractor shall provide a meeting room with table and chairs at or near the site for project progress meetings.

1.4 CONSTRUCTION MEETINGS

The Contractor shall schedule and hold regular meetings during the project:

A. Safety Meetings (Contractor's subcontractors shall attend if they are working onsite.)

B. Project Progress Meetings

C. Equipment Installation Meetings

D. Coordination Meetings

E. Startup and Testing Meetings

The Contractor shall notify the Owner and Engineer in advance of all meetings. The meetings may or may not be attended by the Owner and Engineer.

***** END OF SECTION *****

SECTION 01320

PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section further defines the progress schedule requirements described in the General Conditions Section 3.04.15(1). This Section specifies the procedures for preparing and revising the cost-loaded construction schedule used for planning and managing construction activities. The schedule provides a basis for determining the progress status of the project relative to the completion time, specific dates, and for determining the acceptability of the progress payment estimates.

1.2 DESCRIPTION

The Contractor shall prepare a time-scale network schedule using a critical path method (CPM). A general guide for preparing such a schedule is contained in "The Use of CPM in Construction, a Manual for Contractors," published by the Associated General Contractors of America.

The schedule shall depict all significant construction activities and all items of work listed in the breakdown of contract prices submitted by the Contractor. Assigned values for each part of the work shall be indicated. The dependencies between activities shall be indicated so that it may be established what effect the progress of any one activity has on the schedule.

Completion time and all specific dates and sequencing requirements shall be shown on the schedule. Activities making up the critical path shall be identified.

No activity on the schedule shall have a duration longer than 14 days, except activities comprising only fabrication and delivery, which may extend for more than 14 days. Activities, which exceed these limits, shall be divided into more detailed components. The scheduled duration of each activity shall be based on the work being performed during the normal 40-hour workweek with allowances made for legal holidays and normal weather conditions.

1.3 SUBMITTALS

The CPM Progress Schedule shall be prepared using a computerized system. The schedule shall be submitted in the form of an arrow diagram or precedence diagram with activity listings. The following shall be included:

A. Network diagram shall show in detail and in order of sequence all significant activities, their descriptions, durations, and dependencies, as necessary and as required to complete all work and each separate part of the work.

B. The activity listing shall show the following information for each activity shown on the network diagram:

1. Description

2. Duration

3. Start and finish dates

4. Total float time and free float time

C. Milestone activity completions shall be shown and clearly defined.

D. The critical path shall be clearly indicated.

E. A legend defining any abbreviations used on the schedule shall be provided.

F. All CPM schedules shall conform to the requirements of the Owner's overall Project schedule and the Contract Documents.

The Contractor shall submit three hard copies plus an electronic file with each schedule submittal. The hard copies shall be 11 inch x 17 inch, 22 inch x 34 inch, or 24 inch x 36 inch in size. All schedule reports shall be 8-1/2-inch x 11-inch format. The Contractor shall provide, in chronological order, a list of constraints used, if any, in the preparation of the schedule.

Within 14 days after receipt of the schedule, the Owner and Engineer will return a copy of the schedule to the Contractor with comments. Review of the schedule is for purposes of evaluating the Contractor's ability to complete the Work within the Contract time. Review shall not constitute approval or acceptance of the Contractor's construction means, methods, or sequencing.

The Contractor shall submit an updated Progress Schedule with each application for payment or whenever actual construction progress deviates significantly from the current schedule.

***** END OF SECTION *****

SECTION 01385

PHOTOGRAPHS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes all photography requirements for the project.

The Contractor shall provide comprehensive preconstruction photographs of the entire construction area and adjacent properties. The photographs shall provide complete coverage of all features in the project area, and in no event shall photographs be more than 50 feet apart.

Prior to construction, photographs shall be taken in the project area where work is to be done. Special attention shall be given to depict existing roadway and property conditions, fences, buildings, trees, ditches, culverts, meter boxes, etc. The photographs shall be of commercial quality and shall indicate the date and location where each photograph was taken. A video shall not be considered an acceptable substitute. Before construction may start, a USB drive with the photos shall be submitted to the Engineer. The photographs shall not be randomly arranged, but shall be arranged in a continuous fashion indicating topographical features from one end of the project to the other. The Contractor shall invite the Engineer to the site during this work.

Photographs shall be taken during a period of good visibility. Unless otherwise directed by the Engineer, photographs will not be allowed during times of precipitation or poor visibility.

Following construction, the Contractor shall provide post-construction photographs of the entire construction area and adjacent properties in a similar format to the preconstruction photographs.

***** END OF SECTION *****

SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the control tests, test sample collection, required field-testing, and special inspections as specified herein, and indicated on the Plans.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
02300	Earthwork
02700	Gravel Materials
02710	Gravel Surfacing
03300	Reinforced Concrete

1.3 PAYMENT

All testing as required by this Section shall be paid for by the Contractor. All costs to prepare and implement the sample and testing program shall be included in the bid prices for the various items associated with the sampling and testing program.

Retesting and reinspection required because of defective work and testing performed for the convenience of the Contractor shall also be paid for by the Contractor.

Testing requirements shall not be cause for claims of delay by the Contractor and all expenses accruing therefrom shall be deemed incidental to the performance of the Contract.

PART 2 PRODUCTS

2.1 GENERAL

The Contractor shall be responsible for all material testing specified in the Contract Documents and any applicable permits and codes. The materials testing laboratory shall be accredited for performing the various testing methods either by AASHTO R18, AASHTO 150/IEC 17025 or the American Association for Laboratory Accreditation and further approved by the Owner. The materials testing laboratory shall send test results directly to the Engineer.

2.2 EARTHWORK AND GRANULAR MATERIALS

A. COMPACTION CONTROL

Optimum moisture content and maximum density tests shall be determined by the following method:

ASTM D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort

B. IN-PLACE TESTS

In-place density and moisture content tests shall be made by an independent testing laboratory according to the following methods:

ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

2.3 AGGREGATES

All aggregates shall be tested in accordance with applicable WSDOT test methods:

Title	**Test Method**
Sampling	AASHTO T2
Sieve Analysis of Fine and Coarse Aggregates	104A
Material Finer than No. 200 Sieve in Aggregates	102A
Percentage of Particles Smaller than 0.025 mm and 0.005 mm	603A
Organic Impurities	111A
Abrasion of Coarse Aggregates by Use of the Los Angeles Machine	101A
Sand Equivalent	109A

2.4 CAST-IN-PLACE CONCRETE

Cast-in-place concrete shall be tested in accordance with applicable parts of Chapter 16 of ACI 301. Concrete reinforcement and concrete special inspections shall be performed in accordance with local Building Official and WABO requirements.

PART 3 EXECUTION

3.1 SAMPLING AND TESTING FREQUENCY

A. GENERAL

The Contractor shall provide the following quality control tests at the number and frequency described herein. On-site testing technicians and testing laboratories shall be WABO-certified. The precise location of the tests shall be designated by the Engineer. The Contractor shall cooperate with laboratory personnel employed to conduct the density testing, sampling of material(s), and special inspections. The Contractor shall provide safe access within the work site for laboratory personnel such that density testing and visual inspection can be performed. The Contractor shall provide samples of materials to be tested in the quantities required and herein specified to the appropriate laboratory personnel. The Contractor shall furnish all labor, equipment, tools, and materials necessary to obtain and deliver samples as herein designated. He shall also provide and repair any test holes required in order to facilitate the testing and sampling and to provide for the testing laboratory's exclusive use for storage and curing of test samples until removed to the laboratory.

Any areas tested and further failing compliance with the Specifications shall be recompacted and retested at the Contractor's expense, until a successful density test indicating compliance with these Specifications has been achieved.

B. SOIL TESTING

The following soil quality control tests shall be completed at the given frequency:

Material	**Test**	**Minimum Sampling & Testing Frequency**
Backfill for foundations, walls, trenches and roads	Gradation[1]	One every 500 cy or one per day for quantities exceeding 25 cy. For trenches, one every 750 feet of trench.

Material	Test	Minimum Sampling & Testing Frequency
	In-Place Density[2,3,4]	One every 500 cy or one per day for each type of soil or fill material with quantities exceeding 25 cy. For trenches, one per day and one every 250 feet of trench.
	Moisture-Density Relationship[3]	One prior to start of backfilling operation, one every 20 densities and any time material type changes.
Pipe Bedding	Gradation[1]	One every 750 feet of trench.
Subgrade and Fills	In-Place Density[2,3]	One every 500 cy of each type material.
	Moisture-Density Relationship	One for every 20 densities for each material.
	Gradation	One for every moisture-density.

1. All acceptance tests shall be conducted from in-place samples.
2. Additional tests shall be conducted when variations occur due to the Contractors, operations, weather conditions, site conditions, etc.
3. The nuclear densometer, if properly calibrated, may be used but only to supplement the required testing frequency and procedures. The densometer shall be calibrated and is recommended for use when the time for complete results becomes critical.
4. Depending on soil conditions, it is anticipated that compaction tests shall be required at depths of 2 feet above the pipe and at each additional 5 feet to the existing surface plus a test at the surface.

C. CONCRETE TESTING

All testing shall conform to applicable portions of ACI. Special inspections of concrete and concrete reinforcement shall comply with WABO requirements.

All concrete must meet the specified requirements for minimum 28-day compressive strength.

All concrete cylinders shall be molded and tested for strength by an independent testing laboratory employed by the Contractor.

The Contractor shall furnish all concrete required for molding of the cylinders. In cases where cylinders are stored at the project site, the

Contractor shall provide storage and protection for the cylinders in accordance with ACI requirements.

Concrete tests and testing frequency shall be in accordance with the more stringent of the testing requirements specified in Section 03300-3.17 of these Specifications, and the following table:

Material	**Test**	**Minimum Sampling & Testing Frequency**
Coarse Aggregate (for each grading size)[1]	Gradation	One test every 500 cy of concrete.
	Deleterious Substances	One test initially and thereafter when appearance makes the material suspect.
	L.A. Abrasion	One every 2,000 tons of aggregate.
	Moisture specific gravity and absorption[1]	One initially and every 250 cy thereafter. One moisture to be conducted prior to any batching and more frequently if hauling and storage does not provide a consistent moisture content.
Fine Aggregate[1]	Gradation and fineness modules	One every 250 cy of concrete.
	Deleterious Substances	(same as coarse aggregate).
	Moisture, specific gravity and absorption[1]	(same as coarse aggregate).
Concrete	Slump	Conduct one test every day of placement and one additional test for every 50 cy placed and more frequently if batching appears inconsistent. Conduct in conjunction with taking concrete cylinders.
	Entrained Air	Conduct with each slump test.
	Ambient and concrete temperatures	Conduct with each slump test.

Material	Test	Minimum Sampling & Testing Frequency
Concrete	Compressive strength and evaluation of results per ACI 214. (includes unit weight of each cylinder)	For all concrete placement, take one set of four cylinders per day and one additional set of cylinders for every 50 cy of each class of structural concrete. Test one cylinder at 7 days and two at 28 days. Fourth cylinder shall be held in reserve. A plot and statistical evaluation shall be maintained in accordance with ACI 214 for compressive strength results. Field cure cylinders shall be made when insitu strengths are required to be known.

1. Aggregate moisture tests are to be conducted in conjunction with concrete strength tests for water/cement (w/c) calculations.

D. SPECIAL INSPECTIONS

Contractor shall perform all required Special Inspections per WABO requirements (Chapter 17 of the IBC). Special inspections include cast-in-place concrete, concrete reinforcement, structural welded connections, bolted connections, compaction testing for building and structure foundations, concrete masonry units (CMU), and epoxy adhesive bolting.

***** END OF SECTION *****

SECTION 01500

TEMPORARY FACILITIES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the temporary facilities required for this project, but not necessarily limited to:

A. Temporary utilities such as water, electricity, telephone, off-site staging, and off-site parking.

B. Temporary piping, pumps, valves, fittings, manholes, vaults, and appurtenances necessary to keep existing facilities fully operational during construction.

C. Sanitary facilities.

D. Temporary enclosures such as fences, tarpaulins, barricades, and canopies.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01510	Maintenance of Treatment Facility
01520	Field Offices and Storage Sheds

PART 2 PRODUCTS

2.1 UTILITIES

A. TEMPORARY ELECTRICITY

The Contractor shall provide temporary power for construction at the project site. He shall make arrangements with the electrical utility (to obtain temporary power) and shall pay all costs and fees charged by the utility associated with connection of temporary power. The Contractor shall provide all special connections, receptacles, panelboards, etc., which are required for temporary service, and are not provided by the utility.

The Contractor shall furnish and install all temporary wiring and associated equipment required to keep all portions of the existing facilities in operation at all times.

Area distribution boxes shall be furnished, installed, and so located that the individual trades may use their own construction-type extension cords to obtain proper power and artificial lighting at all points where required. The Contractor shall provide a main disconnect on all temporary wiring panels, labeled "MAIN DISCONNECT," to ensure the safety of personnel using extension cords and hand tools. Panels shall also be properly grounded and equipped with GFCI breakers in accordance with WISHA requirements.

The Contractor shall provide the Engineer single line diagrams of the temporary wiring showing all circuit breakers. These diagrams shall be provided prior to installation of this wiring. These diagrams are necessary to provide information to Owner personnel for off-hours operation.

The Contractor shall pay all demand, consumption, taxes, and fees associated with the temporary electrical service.

B. WATER

The Contractor shall be responsible for providing water necessary for construction. This includes costs for supplying potable water for hydrostatic pressure leak testing of all water-holding structures and operational testing of all equipment and processes. Water is available from the Owner free of charge, provided that it is used responsibly. The Contractor shall install a meter with backflow prevention device prior to obtaining water from the Owner.

C. TELEPHONE

The Contractor shall provide and pay for telephone service at his construction site office. Telephone service shall be made available for use by the Engineer in the Engineer's trailer. Two telephone lines shall be provided to the Engineer as noted above. The Contractor shall pay the costs of providing telephone service and the monthly service fees including all long-distance charges. Radio-telephone service is not acceptable as a substitute for telephone service.

2.2 TEMPORARY PIPING

The Contractor shall furnish and install all temporary piping and pumping and, upon completion of the work, remove all such temporary piping as required, except as designated on the Plans to remain as a part of the Project. Prior to installation, the Contractor shall submit drawings to the Engineer showing the

proposed installation of temporary piping and pumps, including location, type of pipe, fittings, and valves. The Contractor shall obtain the Engineer's approval for temporary piping and pumping plan prior to installation.

Temporary piping and pumping shall be provided as necessary to maintain the existing facilities in operation until the new facilities are constructed, operational. An effort has been made on the Plans and/or Specifications to note instances and locations where temporary piping and/or pumping may be required; however, this in no way limits the temporary piping and pumping to be provided by the Contractor at these locations.

2.3 SANITARY FACILITIES

The Contractor shall provide toilet and wash-up facilities for his workforce and the Engineer at the site of work. They shall comply with applicable laws, ordinances, and regulations pertaining to the public health and sanitation of dwellings and camps.

2.4 OFF-SITE STAGING AND PARKING

The Contractor shall note that space is limited throughout the construction site. Employees of the Contractor, all subcontractors, vendors, suppliers, and associated personnel shall not be allowed to park onsite during the course of construction. It shall be the responsibility of the Contractor to provide sufficient parking facilities in authorized area(s) other than the construction site for the above-mentioned personnel.

In addition, the Contractor shall not be allowed to stockpile and store equipment and materials throughout the construction site. The Contractor shall coordinate his schedule so that all equipment and materials shall be brought to the construction site only when they are to be installed/utilized.

The Contractor shall provide storage of equipment and materials at an offsite, bonded warehouse, to be approved by the Engineer. The Contractor shall pay all costs associated with off-site delivery, storage, and transfer to the construction site.

2.5 ENCLOSURES

The Contractor shall furnish, install, and maintain during the project time all required scaffolds, tarpaulins, barricades, canopies, warning signs, steps, bridges, platforms, and other temporary construction necessary for proper completion of the work in compliance with all pertinent safety and other regulations.

PART 3 EXECUTION

All temporary facilities and controls shall be maintained as long as required for the safe and proper completion of the work. The Contractor shall remove such temporary facilities and controls as rapidly as progress of the work will permit or as directed by the Owner.

***** END OF SECTION *****

SECTION 01505

MOBILIZATION AND DEMOBILIZATION

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of mobilization and demobilization. Mobilization consists of preconstruction activities and preparatory work for the project necessary to mobilize labor, materials, and equipment to the project site. Demobilization consists of activities to remove materials and equipment from the project site upon project completion, including final cleanup. Items which are not considered mobilization or demobilization include but are not limited to:

A. On-going activities throughout the duration of construction.

B. Profit, interest on borrowed money, overhead, or management costs.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
Division 1	General Technical Requirements

PART 2 PRODUCTS

Products and materials required for mobilization and demobilization are described in the various sections of Division 1 and in other parts of the Contract Documents.

PART 3 EXECUTION

Complete mobilization and demobilization as required by the various sections of Division 1 and other parts of the Contract Documents.

***** END OF SECTION *****

SECTION 01520

FIELD OFFICES AND STORAGE SHEDS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section describes the requirements for field offices on this project.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01500	Temporary Facilities

PART 2 PRODUCTS

2.1 FIELD OFFICES

During the performance of the Contract, the Contractor shall maintain a suitable office at the site of the work, which shall be the headquarters of the Contractor's representative. Office location on the site shall be approved by the Owner and Engineer.

Contractor shall make available a separate 10-feet-wide x 14-feet-long (minimum) office trailer at the project site, approved by the Engineer, for use by the Engineer. The Contractor shall supply the office with:

1. Heat, air conditioning, and thorough ventilation system.

2. Electric lights and power.

3. Touch-Tone Telephone (with dedicated line).

4. Plain paper copier/scanner, which will sort copies and copy up to 11" x 17" paper. The Contractor shall provide all necessary maintenance and service for the copy machine.

5. High speed internet connection with a static IP Address and wireless capabilities.

6. One desk (3' x 5' minimum).

7. Black and white printer with USB connection, toner, and paper.

8. Two desk chairs.

9. One drafting stool.

10. Layout table (4' x 6' minimum).

11. Two four-drawer lockable metal file cabinets.

12. Cylinder door lock and three keys.

13. Sanitary facilities (unless existing facilities are available).

14. Windows and doors shall be reasonably airtight.

15. Coffee maker with filters.

16. Potable water cooler for drinking water.

17. One microwave oven.

2.2 STORAGE SHEDS

The Contractor shall provide storage for the protection of equipment, materials, supplies, and tools and shall ensure that a building be used for the storage of materials that deteriorate when exposed to moisture. Workshops and storage buildings shall be located in the general area of the work and shall be clean and in proper order. Storage of materials at the project sites shall not obstruct access or use by the Owner's employees of existing facilities.

PART 3 EXECUTION

All storage sheds shall be maintained as long as required for the safe and proper completion of the work. The Contractor shall remove such temporary facilities as rapidly as progress of the work will permit or as directed by the Engineer. The Engineer's field office and accessories shall remain in service until the project is accepted by the Owner.

***** END OF SECTION *****

SECTION 01720

RECORD DRAWINGS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the record drawings, which shall be maintained and annotated by the Contractor during construction.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals

1.3 INFORMATION PROVIDED BY THE OWNER

The Contractor will be provided with the following items to maintain record drawings for the project:

A. One full size paper set of Plans.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall maintain the following record drawings for the project:

A. A neat and legibly marked set of Contract Plans showing the final location of piping, equipment, electrical conduits, outlet boxes and cables;

B. Additional documents such as schedules, lists, drawings, and electrical and instrumentation diagrams included in the Contract Documents; and

C. Contractor layout and installation drawings.

Unless otherwise specified, record drawings shall be full size and maintained in a clean, dry, and legible condition. Record documents shall not be used for construction purposes and shall be available for review by the Engineer during

normal working hours at the Contractor's field office. At the completion of the work, prior to final payment, all record drawings shall be submitted to the Engineer.

Marking of the drawings shall be kept current and shall be done at the time the material and equipment are installed. Annotations to the record documents shall be made with an erasable colored pencil conforming to the following color code:

A. Additions - Red

B. Deletions - Green

C. Comments - Blue

D. Dimensions - Graphite

Legibly mark drawings to record actual depths, horizontal and vertical location of underground raceways, cables, and appurtenances referenced to permanent surface improvements.

The Contractor's record drawings (full-size hard-copy) will be reviewed monthly for completeness by the Engineer prior to preparing the progress estimate for payment. If the record drawings do not reflect the work performed, payment for that item of work will not be included in the progress estimate.

***** END OF SECTION *****

SECTION 01740

CLEANUP

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the maintenance of the building, structures, and site(s) in a standard of cleanliness throughout the construction period as described herein.

Throughout the construction period, the Contractor shall maintain the cleanliness of the site and structures as described herein. The Contractor is also to maintain access to all existing, operating equipment such that the equipment may be serviced and operated.

Dust of all kinds, including concrete dust produced by construction activities, shall be controlled to avoid damage to existing, operating equipment. Enclosures, ventilation, and air scrubbing may be required where significant potential for damage is determined by the Engineer.

1.2 RELATED WORK SPECIFIED ELSEWHERE

In addition to standards described in this Section, comply with all requirements for cleaning up when described in other sections of these Contract Documents.

1.3 QUALITY ASSURANCE

A. INSPECTION

The Contractor shall conduct daily site inspections, and more often if necessary, to verify that requirements are being met.

B. CODES AND STANDARDS

In addition to the standards described in this Section, comply with all pertinent requirements of governmental agencies having jurisdiction.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS AND EQUIPMENT

Provide all required personnel, equipment, and materials needed to maintain the specified standard of cleanliness.

2.2 COMPATIBILITY

Use only the cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material or as approved by the Engineer.

PART 3 EXECUTION

3.1 PROGRESS CLEANING

A. GENERAL

Retain all stored materials and equipment in an orderly fashion allowing maximum access, not impeding drainage or traffic, and providing protection.

Do not allow the accumulation of scrap, debris, waste material, and other items not required for this work.

At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the project site.

Provide adequate storage for all materials awaiting removal from the project site, observing all requirements for fire protection and protection of the environment.

B. SITE

Daily, and more often if necessary, inspect the site and pick up all scrap, debris, and waste material. Move these items into a place designated for their storage until disposal becomes available.

Weekly, and more often if necessary, inspect all arrangements of materials stored on the site, restack, arrange, or otherwise service all arrangements to meet the requirements above.

Maintain the site in a neat and orderly condition at all times so as to meet the approval of the Engineer.

C. STRUCTURES

Weekly, and more often if necessary, inspect the structures and pick up all scrap, debris and waste material. Move these items into a place designated for their storage until disposal becomes available.

Weekly, and more often if necessary, sweep clean all interior spaces. "Clean" shall be interpreted to mean free from dust and other materials that can be swept with a broom using reasonable diligence.

In preparing to install succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material. Use all equipment and materials required to achieve the required cleanliness.

D. STREETS

All paved and unpaved streets in the vicinity of the project shall be kept free of material tracked from the project site(s) or dropped from vehicles entering and leaving the site(s). The Contractor shall inspect roads in each active area daily, and all material deposited on the road from the Contractor's activities shall be removed prior to the end of the workday. This shall include sweeping, as required, to collect any mud, dirt and dust from the surface. All catch basins and culverts in the work area shall be inspected before completion and cleaned as directed by the Engineer.

3.2 FINAL CLEANING

A. DEFINITION

Except as otherwise specifically provided, "clean" shall be interpreted as meaning the level of cleanliness generally provided by commercial building maintenance equipment and materials.

B. GENERAL

Prior to final inspection, remove from the jobsite all tools, surplus materials, equipment, scrap, debris, and waste. Conduct final project cleaning as described below.

C. STRUCTURES

1. Exterior

Visually inspect all exterior surfaces and remove all traces of soil, waste, smudges, and other foreign matter. Remove all traces of splashed materials from adjacent surfaces. If necessary to achieve a uniform degree of exterior cleanliness, hose down the exterior of the structure. In the event of stubborn stains not removable with water, the Engineer may require light sandblasting or other cleaning at no additional cost to the Owner.

2. Interior

Visually inspect all interior surfaces and remove all traces of soil, waste, smudges, and other foreign matter. Remove all traces of splashed materials from adjacent surfaces. Remove all paint droppings, spots, stains, and dirt from finished surfaces. Use only appropriate cleaning materials and equipment.

3. Glass

Clean all glass inside and outside.

D. TIMING

Schedule final cleaning as approved by the Engineer to enable the Owner to accept a completely clean project, ready for occupancy.

***** END OF SECTION *****

SECTION 01800

TESTING, COMMISSIONING, AND TRAINING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the installation, testing, commissioning, and training for all mechanical, electrical, and instrumentation systems and completed portions of the work.

See also Section 16050 for additional electrical and instrumentation system testing requirements.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01110	Scope of Work
01300	Submittals
01400	Quality Control
01500	Temporary Facilities
15050	Piping Systems
15400	Plumbing
15700	HVAC
16050	Basic Electrical Materials and Methods

1.3 QUALITY ASSURANCE

A. INSTALLATION

All mechanical, electrical, and instrumentation equipment provided under this Contract shall be installed in conformity with the Contract Documents, including the manufacturer's requirements. Should a manufacturer's installation recommendation conflict with specific requirements of this Contract Document, the Contractor shall bring the matter to the attention of the Engineer. Any additional costs arising out of changes authorized by the Engineer to accommodate manufacturer's installation recommendations will be considered extra work. Any costs incurred by the Contractor through failure to timely notify the Engineer of a difference between Contract Document and manufacturer's installation requirements shall be borne by the Contractor.

B. TESTING

1. General Requirements

All equipment and partially complete or fully completed portions of the work included in this Contract shall be tested and inspected to prove compliance with the Contract requirements. Unless otherwise specified, all costs of testing, including temporary facilities and connections, shall be borne by the Contractor. For the purpose of this Section, equipment shall mean any mechanical, electrical, instrumentation, or other device with one or more moving parts or devices requiring an electrical, pneumatic, or hydraulic connection. Installed leakage tests and other piping tests shall be as specified in Sections 15050 and 15400. Installed tests for heating and ventilation systems shall be as specified in Section 15700. Installed tests for electrical and instrumentation devices and systems shall be in accordance with Division 16.

No tests specified herein shall be applied until the item to be tested has been inspected and approval given for the application of such test.

Tests and inspection shall include:

a. The delivery acceptance test and inspections.

b. The installed tests and inspections. These tests may be performed with water or the process fluid, as described in the accepted test plan.

c. The operational testing of completed sections of the facility. These tests may be performed with water or the process fluid, as described in the accepted test plan.

d. The commissioning of completed sections of the facility by Owner's personnel. The commissioning shall be performed with the process fluid at normal flows.

Tests and inspections, unless otherwise specified or accepted, shall be in accordance with the recognized standards of the industry. The Contractor shall see that scheduling and performance of all tests are coordinated with involved subcontractors and suppliers. The Contractor shall allow for up to two additional setpoint

changes during testing. No extra costs or time allowances shall be provided as long as this setpoint allowance is not exceeded.

The form of evidence of satisfactory fulfillment of delivery acceptance test and inspection requirements shall be, at the discretion of the Engineer, either by tests and inspections carried out in his presence or by certificates or reports of tests and inspections carried out by approved persons or organizations. The Contractor shall provide and use forms that include all test information, including specified operational parameters. The content of the forms used shall be acceptable to the Engineer.

A master test log book shall be maintained by the Contractor, which shall cover all tests including piping, equipment, electrical, and instrumentation. The master test log book shall be provided with loose-leaf pages that shall be copied weekly after updating for transmittal to the Engineer. The master test log book shall be transmitted to the Engineer upon completion of the project.

2. Delivery Acceptance Tests and Inspections

The delivery acceptance tests and inspections shall be at the Contractor's expense for any equipment specified herein and shall include the following:

a. Test of items at the place of manufacture during and/or on completion of manufacture, comprising hydraulic pressure tests, electric and instrumentation subsystems tests, performance and operating tests and inspections in accordance with the relevant standards of the industry and more particularly as detailed in individual clauses of these Specifications to satisfy the Engineer that the items tested and inspected comply with the requirements of this Contract. Tests other than those specified shall be in accordance with Section 01400.

b. Inspection of all items delivered at the site or to any authorized place of storage so that the Engineer may be satisfied that such items are of the specified quality and workmanship and are in good order and condition at the time of delivery. The Contractor shall be prepared to remove all coverings, containers, or crates to permit the Engineer to conduct his inspection. Should the Engineer find, in his opinion, indication of damage or deficient

quality of workmanship, the Contractor shall provide the necessary documentation or conduct such tests deemed necessary by the Engineer to demonstrate compliance.

3. Installed Tests and Inspections

a. General

All equipment shall be tested by the Contractor to the satisfaction of the Engineer before any facility is put into operation. Tests shall be as specified herein and shall be made to determine whether the equipment has been properly assembled, aligned, adjusted and connected. Any changes, adjustments, or replacements required to make the equipment operate as specified shall be carried out by the Contractor as part of the work.

b. Procedures

i. General

The procedures shall be divided into two distinct stages; preoperation checkout and water test. Testing procedures shall be designed to duplicate, as nearly as possible, all conditions of operation and shall be carefully selected to ensure that the equipment is not damaged. Once the testing procedures have been reviewed and approved by the Engineer, the Contractor shall produce checkout, alignment, adjustment and calibration sign-off forms for each item of equipment to be used in the field by the Contractor and the Engineer jointly to ensure that each item of electrical, mechanical and instrumentation equipment has been properly installed and tested. The Contractor is advised that failure to observe these precautions may place the acceptability of the subject equipment in question.

ii. Preoperation Checkout

The installed tests and inspection procedures shall incorporate all requirements of these Specifications and shall proceed in a logical, step-wise sequence to ensure that all equipment has been properly

serviced, aligned, connected, calibrated, and adjusted prior to operation. Preoperation checkout procedures shall include, but not necessarily be limited to:

(1) Piping system pressure testing and cleaning as specified in Division 15.

(2) Electrical system testing as specified in Division 16.

(3) Alignment of equipment.

(4) Preoperation lubrication.

iii. Water Test

Once all affected equipment has been subjected to the required preoperational checkout procedures and the Engineer has witnessed and has not found deficiencies in that portion of the work, individual systems may be started and operated under simulated operating conditions to determine as nearly as possible whether the equipment and systems meet the requirements of these Specifications. Test media for these systems shall either be the intended fluid or a compatible substitute. The equipment shall be operated a sufficient period of time to determine machine operating characteristics, including temperatures and vibration, to observe performance characteristics, including performance throughout the specified range for blowers, and to permit initial adjustment of operating controls. When testing requires the availability of auxiliary systems such as electrical power, compressed air, control air, or instrumentation which have not yet been placed in service, the Contractor shall provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system, at no additional cost to the Owner. Disposal methods for test media shall be subject to review by the Engineer.

If under test, any portion of the work should fail to fulfill the Contract requirements and is adjusted, altered, renewed or replaced, tests on that portion when so adjusted, altered, removed or replaced, together with all other portions of the work as are affected thereby, shall, if so required by the Engineer, be repeated within reasonable time and in accordance with the specified conditions. The Contractor shall pay to the Owner all reasonable expenses incurred by the Owner as a result of repeating such tests.

Once simulated operation has been completed, all machines shall be rechecked for proper alignment, realigned, if necessary, and doweled in place. All equipment shall be checked for loose connections, unusual movement, excessive temperature, noise, and/or vibration or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the Engineer. All machines or devices, which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected. They shall then be repaired or removed from the site and replaced at no cost to the Owner.

Test results shall be within the tolerances set forth in the detailed Specification sections of the Contract Documents. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory installed test, any doubt, dispute, or difference should arise between the Engineer, and the Contractor regarding the test results or the methods or equipment used in the performance of such test, then, the Engineer may order the test to be repeated. If the repeat test, using such modified methods or equipment as the Engineer may require, substantially confirms the previous test, then all costs in connection with the repeat test will be paid by the Owner otherwise the costs shall be borne by the Contractor. Where the results of any installed test fail to comply with the Contract requirements for such test, then such

repeat tests as may be necessary to achieve the Contract requirements shall be conducted by the Contractor at his expense.

Unless otherwise specified, the Contractor shall provide at no expense to the Owner, all water, power, fuel, compressed air supplies, labor and all other necessary items and work required to complete all tests and inspection specified herein. The Contractor shall provide, at no expense to the Owner, temporary heating, ventilating, and air conditioning for any areas requiring it in the case where permanent facilities are not complete and operable at the time of installed tests and inspections. Temporary facilities shall be maintained until permanent systems are in service.

4. Operational Testing

After completion of all installed testing and review by the Engineer that all equipment complies with the requirements of the Specifications, the Contractor shall conduct operational testing. All domestic water, oil, fuel, and chemical systems shall be filled with the specified fluid.

The Contractor shall operate the completed facility for a period of not less than that specified in Part 3.4 of this Section during which all systems shall be operated as a complete facility at various loading conditions, as directed by the Engineer. Should the operational testing period be halted for any reason related to the facilities constructed or the equipment furnished under this Contract, or the Contractor's temporary testing systems, the operational testing program shall be repeated until the specified continuous period has been accomplished without interruption. All process units shall be brought to full operating conditions, including temperature, pressure, and flow.

Record drawings of facilities involved must be accepted and ready for turnover to the Owner at the time of operational testing.

All costs for water, fuel, power, and chemicals required during operational testing shall be borne by the Owner.

5. Commissioning

After completion of the operational testing and certifications by the Engineer that the systems meet all performance requirements, commissioning will begin. The commissioning period for all systems shall be 15 days. The Contractor shall remove all temporary piping that may have been in use during the operational testing and shall assist the Owner with the placement of the facility into its fully operational. The Owner's operations and maintenance personnel will be responsible for operation of the facility or portion of the facility during this period of time. The facility or portion thereof shall be fully and continuously operational, accepting all normal flow called for in design and performing all functions as designed.

The Contractor shall be available, with all appropriate subcontractors and trades, at all times during commissioning periods to provide immediate assistance in case of failure of any portion of the system being tested. This assistance shall be available, if needed, on a 24-hour basis. The Engineer will not issue a certificate of Substantial Completion until the end of the commissioning period (including training) and then only when all corrections required to assure a reliable and completely operational facility have been complete. The Contractor shall be responsible for all costs in excess of the Owner's normal expected costs of operations during the commissioning period. The Contractor shall bear the costs of all necessary repairs or replacements, including labor and materials, required to keep the portion of the plant being commissioned operational.

The commissioning period will be considered completed when the facility has been continuously operated without major interruption, equipment failure, or system breakdown for the specified commissioning period. A major interruption, failure or breakdown shall be a condition or event that prevents the facility from continuously and adequately handling normal flow, cannot be repaired or corrected immediately by the Contractor, and is not caused by improper operation and maintenance of the facilities by the Owner. An interruption of the commissioning period under these circumstances will require a re-start of commissioning once required repairs and corrections are made by the Contractor. Should the commissioning period be halted for any reason related to the facilities constructed or the equipment furnished under this

Contract, the commissioning shall be repeated until the specified continuous period has been accomplished without interruption.

Final O&M manuals for the facilities must be accepted and ready for turnover to the Owner before the start of commissioning.

C. TRAINING

During the phase of water testing of equipment, the Contractor shall make available experienced factory-trained representatives of the manufacturers of all the various pieces of equipment, to train the Owner's personnel in the operation and maintenance thereof. The time required for this training shall be as covered in the specifications for the specific piece of equipment. The Contractor shall notify the Engineer of the time of the training at least 10 days prior to the start time of the training.

1.4 SUBMITTALS

A. STARTUP AND TESTING PLAN

Prior to receipt of any progress payments in excess of 60 percent of the Contractor's total bid for the work, the Contractor shall submit to the Engineer five copies of a startup and testing plan with details of the installed tests and inspection procedures he proposes to adopt for testing and startup of all equipment to be operated singly and together. Final project approval must be received from the Office of Drinking Water prior to substantial completion.

B. TRAINING OUTLINE

The Contractor shall submit five copies of a detailed outline of training activities to be performed by each manufacturer's representative 10 days prior to the start time of the training. This outline shall indicate how the manufacturer's representative is going to allocate the required specified number of training hours to fulfill these contractual obligations.

PART 2 PRODUCTS

2.1 INSTALLATION

Materials employed in the installation shall conform to the requirements of the Contract Documents and the recommendations of the equipment manufacturers.

2.2 TESTING

A. GAUGES, METERS, RECORDERS, AND MONITORS

Gauges, meters, recorders, and monitors shall be provided by the Contractor as required to supplement or augment the instrumentation system provided under this Contract to properly demonstrate that all equipment fully satisfies the requirements of the Specifications. All devices employed for the purpose of measuring the performance of the facility's equipment and systems shall be specifically selected to be consistent with the variables to be monitored. All instruments shall be recently calibrated, and the Contractor shall be prepared at all times to demonstrate, through recalibration, the accuracy of all instruments employed for testing purposes. Calibration procedures shall be in accordance with applicable standards of ASTM, ISA, and IEEE. The adequacy of all gauges, meters, recorders and monitors shall be subject to review by the Engineer.

B. RECORDS

The Contractor shall provide sign-off forms for all installed and operational testing to be accomplished under this Contract. Sign-off forms shall be provided for each item of mechanical, electrical and instrumentation equipment provided or installed under this Contract and shall contain provisions for recording relevant performance data for original testing and not less than three retests. Separate sections shall be provided to record values for the preoperation checkout, as well as signatures of representatives of the equipment manufacturers, the Contractor, and the Engineer.

C. TEMPORARY TEST FACLITIES AND MODIFICATIONS

The Contractor shall provide and install all necessary temporary piping, valves, pumps, tanks, controls, and other facilities and modifications to enable the operational testing of the permanent facility components. Operational testing requiring the recirculation of water or process fluids within the facility shall be performed by the Contractor using temporary facilities, if needed, provided and installed by the Contractor. Temporary facilities shall be removed by the Contractor once the required testing is completed.

PART 3 EXECUTION

3.1 INSTALLATION

All equipment and apparatus used in testing shall be installed by specialists properly skilled in the trades and professions required to assure first-class workmanship. Where required by detailed Specifications, the Contractor shall cause the installation of specific equipment testing items to be accomplished under the supervision of factory-trained installation specialists furnished by the equipment manufacturers. The Contractor shall be prepared to document the skills and training of all workmen engaged in the installation of all testing equipment furnished either by the Contractor or the Owner.

3.2 TESTING

Testing shall proceed on a step-by-step basis in accordance with the Contractor's written testing procedures. The Contractor's testing work shall be accomplished by a skilled team of specialists under the direction of a coordinator whose sole responsibility shall be the orderly, systematic testing of all equipment, systems, structures, and the complete facility as a unit. Each individual step in the procedures shall be witnessed by a representative of the Engineer.

During the facility operational testing period, all equipment and systems in operation shall be operated to the greatest extent practicable, at conditions, which represent the full range of operating parameters as defined by the Contract Documents.

3.3 TRAINING

Training of the Owner's personnel shall be done by experienced technical manufacturers' representatives. Training shall be provided during a scheduled, dedicated session and shall not be combined with other field services such as equipment testing, startup and check-out. When required by these specifications, the training sessions shall be video and audio-taped by the Contractor and the final DVD delivered to the Owner. These manufacturers' representatives shall follow the outline presented here:

GENERAL OUTLINE FOR MANUFACTURER PRESENTATIONS

A. FAMILIARIZATION

1. Overview explaining theory of operation.

2. Show catalog, parts lists, drawings, etc., in the shop drawings and O&M manuals. Clearly identify the model or identification number of the equipment for which training is being provided.

3. Check out the installation of the specific equipment items.

4. Demonstrate the unit and show that all parts of the Specifications are met.

5. Answer questions.

B. SAFETY

1. Point out safety references.

2. Discuss proper precautions around equipment.

C. OPERATION

1. Point out reference literature.

2. Explain all modes of operation (including emergency).

3. Check out Owner's personnel on proper use of the equipment. (Let them do it).

D. PREVENTIVE MAINTENANCE (PM)

1. Pass out PM list including:

a. Reference material.

b. Daily, weekly, monthly, quarterly, semi-annual, and annual jobs.

2. Show how to perform PM jobs.

3. Show Owner's personnel what to look for as indicators of equipment problems.

E. CORRECTIVE MAINTENANCE

1. List possible problems.

2. Discuss repairs - point out special problems.

3. Open up equipment and demonstrate procedures, where practical.

F. PARTS

1. Show how to use parts list and order parts.

2. Check over spare parts on hand. Make recommendations.

G. LOCAL REPRESENTATIVES

1. Where to order parts: Name, address, telephone, fax, e-mail.

2. Service problems:

a. Who to call.

b. How to get emergency help.

***** END OF SECTION *****

SECTION 01900

SALVAGE AND DEMOLITION

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section covers the demolition of existing structures, piping, equipment, and sitework, and the salvage of existing materials and equipment as indicated on the Plans and as specified herein.

All areas and facilities of the existing facility, which are not to be removed, must remain in continuous operation during the work in accordance with Section 01110. Demolition and salvage work shall create a minimum of interference with the operation of the facility.

The Plans show the major items to be demolished and removed. The Contractor shall, however, remove any other incidental above-grade items, which are not to be used in the completed project.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01110	Summary of Work

1.3 SALVAGE

Salvageable equipment and material shall be removed with care so as not to impair future uses and shall include all equipment and material so indicated on the Plans. Salvaged equipment and material not reused or rejected by the Owner shall be cleaned and protected from corrosion and weather and delivered by the Contractor to the Owner at shop.

Reuse of salvageable equipment and material by the Contractor will not be permitted except where specifically indicated on the Plans and Specifications or where approved by the Engineer and Owner. Salvageable equipment and materials rejected in writing by the Owner shall become the property of the Contractor and be disposed of away from the site without additional cost to the Owner.

1.4 DEMOLITION

The Contractor shall be responsible for compliance with current City, County, State, and Federal codes and regulations related to demolition.

The Contractor shall notify all affected utilities and comply with their respective requirements for abandonment of such utilities including power, telephone, natural gas, water, sanitary sewer, and storm sewer utilities.

The Contractor shall maintain access for the Owner's employees during the demolition period and provide barricades, fences, etc., as required for job site safety.

Demolition of concrete, masonry, roofing, asphalt, and other materials shall be done so as to avoid damage to existing structures intended to remain. Demolition or cutting required to add to or modify existing structures shall be done in such a manner that the appearance and utility of the existing structure is not impaired and so that a neat transition from new to old material may occur.

All piping and appurtenances located less than 4 feet below finished grade shall be removed and hauled to an approved disposal site. All piping and appurtenances located four feet or more below finished grade may be abandoned in place, unless shown otherwise on the Plans, as long as Contractor fully seals all pipe and appurtenance openings with grout.

All waste materials from demolition or cutting shall become the property of the Contractor and shall be removed from the site and hauled to an approved waste disposal site, if declared surplus by the Owner. All materials and equipment, however, are property of the Owner unless declared surplus. Some equipment and materials scheduled for salvage and delivery to the Owner are noted on the Plans.

***** END OF SECTION *****

SECTION 01950

TRAFFIC CONTROL

PART 1 GENERAL

1.1 SCOPE

Temporary traffic control refers to the control of all types of traffic, including vehicles, bicyclists and pedestrians (including pedestrians with disabilities). The Contractor, utilizing contractor labor and contractor-provided equipment and materials (except when such labor, equipment, or materials are to be provided by the Owner as specifically identified in the Contract Documents), shall plan, manage, supervise and perform all temporary traffic control activities need to support the work of the Contract.

The Contractor shall provide flaggers, signs, and other traffic control devices not otherwise specified as being furnished by the Owner. The Contractor shall erect and maintain all construction signs, warning signs, detour signs, and other traffic control devices, necessary to warn and protect the public at all times from injury or damage as a result of the Contractor's operations which may occur on highways, roads or streets. No work shall be done on or adjacent to the roadway until all necessary signs and traffic control devices are in place.

The traffic control resources and activities shall be used for the safety of the public, the Contractor's employees, the Owner's personnel and to facilitate the movement of the traveling public. Traffic control resources and activities may be used for the separation or merging of public and construction traffic when in accordance with a specific approved traffic control plan.

Upon failure of the Contractor to immediately provide flaggers; erect, maintain, and remove signs; or provide, erect, maintain, and remove other traffic control devices when ordered to do so by the Owner, the Owner may, without further notice to the Contractor or the Surety, perform any of the above and deduct all of the costs from the Contractor's payment.

The Contractor shall be responsible for providing adequate flaggers, signs and other traffic control devices for the protection of the work and the public at all times regardless of whether or not the flaggers, signs, and other traffic control devices are ordered by the Owner, furnished by the Owner, or paid for by the Owner.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01160	Regulatory Requirements
01300	Submittals

1.3 REFERENCES

This Section references the latest revisions to the following documents:

Reference	Title
MUTCD	*Manual of Uniform Traffic Control Devices* *Washington State Modifications to the MUTCD* *Quality Guidelines for Temporary Traffic Control Devices*
ANSI 107	*High Visibility Garment Standard*

1.4 TRAFFIC CONTROL MANAGEMENT

A. GENERAL

It is the Contractor's responsibility to plan, conduct, and safely perform the work. The Contractor shall manage temporary traffic control with his or her own staff. Traffic control management responsibilities shall be formally assigned to one or more company supervisors who are actively involved in the planning and management of field Contract activities. The Contractor shall provide the Engineer with a copy of the formal assignment. The duties of traffic control management may not be subcontracted.

The Contractor shall designate an individual or individuals to perform the duties of the primary Traffic Control Supervisor (TCS). The designation shall also identify an alternate TCS who can assume the duties of the primary TCS in the event that person's inability to perform. The TCS shall be responsible for safe implementation of approved Traffic Control Plans provided by the Contractor.

The primary and alternate TCS shall be certified as worksite traffic control supervisors by one of the organizations listed herein. Possession of a current TCS card and flagging card by the primary and alternate TCS is mandatory. A traffic control management assignment and a TCS designation are required on all projects that will utilize traffic control.

The Contractor shall maintain 24-hour telephone numbers at which the Contractor's assigned traffic control management personnel and the TCS can be contacted and be available upon the Engineer's request at other than normal working hours. These persons shall have the resources, ability and authority to expeditiously correct any deficiency in the traffic control system.

B. The duties of the Contractor's traffic control management personnel shall include:

1. Overseeing and approving the actions of the Traffic Control Supervisor (TCS) to ensure that proper safety and traffic control measures are implemented and consistent with the specific requirements created by the Contractor's work zones and the Contract. Some form of oversight shall be in place and effective even when the traffic control management personnel are not present at the jobsite.

2. Providing the Contractor's designated TCS with approved Traffic Control Plans (TCPs), which are compatible with the work operations, and traffic control for which they will be implemented.

3. Discussing proposed traffic control measures and coordinating implementation of the Contractor-adopted traffic control plan(s) with the Owner.

4. Coordinating all traffic control operations, including those of subcontractors, suppliers, and any adjacent construction or maintenance operations.

5. Coordinating the project's activities (road closures and lane closures) with appropriate police, fire control agencies, city or county engineering, medical emergency agencies, school districts, and transit companies.

6. Overseeing all requirements of the Contract, which contribute to the convenience, safety, and orderly movement of vehicular and pedestrian traffic.

7. Having the latest adopted edition of the MUTCD including the Modifications to the MUTCD for Streets and Highways for the State of Washington and applicable standards and specifications available at all times on the Project.

8. Attending all Project meetings where traffic management is discussed.

9. Being present onsite a sufficient amount of time to adequately accomplish the above-listed duties.

C. TRAFFIC CONTROL SUPERVISOR

A Traffic Control Supervisor (TCS) shall be on the Project whenever traffic control labor is required or less frequently, as approved by the Owner.

The TCS shall personally perform all the duties of the TCS. The TCS's duties shall include:

1. Inspecting traffic control devices and nighttime lighting for proper location, installation, message, cleanliness, and effect on the traveling public. Traffic control devices shall be inspected each work shift except that Class A signs and nighttime lighting need to be checked only once a week. Traffic control devices left in place for 24 hours or more should also be inspected once during the nonworking hours when they are initially set up (during daylight or darkness, whichever is opposite of the working hours).

2. Ensuring that corrections are made if traffic control devices are not functioning as required. The TCS may make minor revisions to the approved traffic control plan to accommodate site conditions as long as the original intent of the traffic control plan is maintained and the revision has concurrence of the TCM and/or Owner.

3. Attending traffic control coordinating meetings or coordination activities as authorized by the Owner.

4. Ensuring that all needed traffic control devices are available and in good working condition prior to the need to install those devices.

5. Ensuring that all pedestrian routes or access points, existing or temporary, are kept clear and free of obstructions and that all temporary pedestrian routes or access points are detectable and accessible to persons with disabilities as provided for in the approved plans.

6. Having a current set of approved TCPs and applicable contract provisions as provided by the TCM and the latest adopted edition

of the MUTCD including the *Washington State Modifications to the MUTCD* and applicable standards and specifications.

1.5 TCM AND TCS QUALIFICATIONS

The TCM and TCS shall be certified by one of the following:

The Northwest Laborers – Employers Training Trust
27055 Ohio Avenue
Kingston, Washington 98346
(360) 297-3035

Evergreen Safety Council
401 Pontius Avenue N.
Seattle, Washington 98109
(800) 521-0778 or (206) 382-4090

The TCS and all flaggers shall have a current flagging card from the State of Washington, Oregon, or Idaho.

1.6 SUBMITTALS

A. TRAFFIC CONTROL PLAN

The Contractor shall prepare and submit five copies of a Traffic Control Plan(s). All construction signs, flaggers, spotters, and other traffic control devices shall be shown on the traffic control plans. The Contractor shall designate and adopt in writing the specific traffic control plan or plans required for their method of performing the work. The traffic control plan(s) shall be in accordance with the established standards for plan development as shown in the MUTCD, Part VI.

The Traffic Control Plan shall meet the specific requirements of the franchise agreements and right-of-way permits required for this project. In addition, the Traffic Control Plan shall meet the following requirements:

- Maintain at least one-way traffic on through roads.

The Contractor, at the end of each day, shall leave the Work area in such condition that it can be traveled without damage to the Work, without danger to traffic, and without one-way traffic control.

PART 2 PRODUCTS

2.1 TRAFFIC CONTROL DEVICES

Flagging, signs and all other traffic control devices furnished or provided shall conform to the standards established in the latest WSDOT adopted edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) published by the U.S. Department of Transportation and the *Washington State Modifications to the MUTCD*. Requirements for pedestrian traffic control devices are addressed in the MUTCD.

2.2 CONSTRUCTION SIGNS

All construction signs required by the approved traffic control plan(s) as well as any other appropriate signs prescribed by the Owner shall be furnished by the Contractor. The Contractor shall provide the posts or supports and erect and maintain the signs in a clean, neat, and presentable condition until the necessity for them has ceased. All non-applicable signs shall be removed or completely covered with either metal or plywood during periods when they are not needed. When the need for any of these signs has ceased, the Contractor, upon approval of the Owner, shall take down these signs, post, or supports.

Construction signs will be divided into two classes. Class A construction signs are those signs that remain in service throughout the construction or during a major phase of the work. They are mounted on posts, existing fixed structures, or substantial supports of a semi-permanent nature. Sign and support installation for Class A signs shall be in accordance with the WSDOT Standard Plans. Class A signs shall be designated as such on the Traffic Control Plan. Class B Construction signs are those signs that are placed and removed daily, or are used for short durations which may extend for 1 to 3 days. They are mounted on portable or temporary mountings.

Tripod-mounted signs in place more than 3 days in any one location, unless approved by the Engineer, shall be required to be post-mounted and shall be classified as Class A construction signs. Where it is necessary to add weight to the signs for stability, sandbags or other similar ballast may be used but the top of the ballast shall not be more than 4 inches above the road surface, and shall not interfere with the breakaway features of the device. The Contractor shall follow the manufacturer's recommendations for sign ballasting.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall provide all labor and equipment to execute the Traffic Control Plan. It is the Contractor's responsibility to plan, conduct, and safely perform the work.

The TCS shall be responsible for safe implementation of approved Traffic Control Plans provided by the TCM.

3.2 TRAFFIC CONTROL LABOR

The Contractor shall furnish all personnel for flagging, spotting, for the execution of all procedures related to temporary traffic control and for setup, maintenance and removal of all temporary traffic control devices and construction signs necessary to control traffic during construction operations.

Vests and other high-visibility apparel shall be in conformance with ANSI 107.

Flaggers and spotters shall be posted where shown on the approved Traffic Control Plan. Flaggers and spotters shall possess a current flagging card issued by the State of Washington, Oregon, or Idaho. The flagging card shall be immediately available and shown upon request by the Owner.

During hours of darkness, flagging stations shall be illuminated in a manner that insures that flaggers can easily be seen but that does not cause glare to the traveling public. Flagger station illumination shall meet the requirements of the MUTCD.

Flaggers shall be equipped with portable two-way radios, with a range suitable for the project. The radios shall be capable of having direct contact wit project management (foreman, superintendents, etc.)

The Contractor shall furnish flagger Stop/Slow paddles conforming to the requirements of the MUTCD, except the minimum width shall be 24 inches.

***** END OF SECTION *****

DIVISION 2

SITEWORK

SECTION 02050

LOCATE EXISTING UTILITIES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the anticipated conflicts, which may exist with existing utilities. A reasonable attempt has been made to locate the existing utilities; however, the exact location, and/or depth are unknown in most instances. Locations and dimensions shown in the Plans for existing facilities are in accordance with available information obtained without uncovering, measuring, or other verification. It shall be the responsibility of the Contractor to locate existing utilities and their depth.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
02250	Temporary Shoring and Bracing
02300	Earthwork

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall determine the difficulties to be encountered in constructing the Project and his locate effort based upon the information provided on the Plans, field investigation, and the Contractor's contacts with the existing utility companies. The Contractor shall determine the extent of exploration required to first prevent damage to those existing utilities, and secondly to determine if the proposed improvements are in conflict with existing utilities.

The Contractor shall locate existing utilities sufficiently ahead of construction so that the Engineer can modify the alignment, or grade prior to construction. Where the alignment of the proposed utility cannot be adjusted to miss the existing utility without installation of additional pipe or fittings, the Contractor may be entitled to additional compensation to reroute the proposed utility.

The Contractor shall call the Utility Location Request Center (One Call Center), for field location, not less than 2 nor more than 10 business days before the scheduled date for commencement of excavation that may affect underground utility facilities, unless otherwise agreed upon by the parties involved. A business day is defined as any day other than Saturday, Sunday, or a legal local, State, or Federal holiday. The telephone number for the One Call Center for this project is (800) 424-5555. If no one-number locator service is available, notice shall be provided individually to those owners known to or suspected of having underground facilities within the area of the proposed excavation.

The Contractor is alerted to the existence of Chapter 19.122 RCW, a law relating to underground utilities. Any cost to the Contractor incurred as a result of this law shall be at the Contractor's expense.

No excavation shall begin until all know facilities in the vicinity of the excavation area have been located and marked.

***** END OF SECTION *****

SECTION 02230

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the clearing, grubbing, and stripping of the proposed project areas in preparation of foundations, embankment construction, and pipeline installation.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
02305	Wet Weather Earthwork
02300	Earthwork
02370	Erosion Control

1.3 DEFINITIONS

"Clearing, grubbing, and stripping debris" as hereinafter used shall be considered as all material removed by the clearing, grubbing, and stripping operations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 DISPOSAL OF CLEARING AND GRUBBING DEBRIS

Clearing and grubbing debris shall be disposed of by hauling to waste and disposal sites approved by the Owner.

3.2 CLEARING AND GRUBBING

Clearing and grubbing shall be performed as required to complete the work shown on the Plans to a minimum depth of 8 inches in order to remove the root zone of existing vegetation.

This work shall include removal and disposal of all trees, logs, brush, stumps, roots, and minor manmade structures to include but not limited to concrete,

asphalt abandoned metal and equipment, rubbish and debris to the limits indicated on the plans or as required and approved by the owner. This work shall be to a depth necessary to remove stumps, large roots and all other objectionable material. This work shall also include the protection from injury or defacement of trees, bushes, shrubs, and other objects designated to remain.

***** END OF SECTION *****

SECTION 02240

DEWATERING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes dewatering excavations of any kind and location, including but not limited to groundwater, surface water, and precipitation, until backfilling has been completed to finished grade.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01160	Regulatory Requirements
01200	Measurement and Payment
01300	Submittals
02300	Earthwork
02370	Erosion Control

1.3 SUBMITTALS

Prior to the start of construction, the Contractor shall submit a dewatering plan in accordance with Section 01300 containing both a graphical and narrative presentation identifying proposed methods, equipment sizes and contingency plans should dewatering cause settlement of any adjacent facilities. The dewatering plan shall show specific locations, in plan and section, where dewatering is expected as well as a general discussion of methods to be employed should water be encountered in other locations. The plan shall detail the depth, diameter and anticipated flow for dewatering wells, well points or sumps.

Acceptance by the Owner of the method, installation, and operation and maintenance details submitted by the Contractor shall not in any way be considered to relieve the Contractor from full responsibility for errors therein or from the entire responsibility for complete and adequate design and performance of the system in controlling the water level in the excavated areas, and for control of the hydrostatic pressures to the depths specified herein. The Contractor shall be solely responsible for the proper design, installation, proper operation, maintenance, and any failure of any component of the dewatering system.

1.4 REFERENCES

"Rossum J.R., 1954, *Control of Sand in Water Systems,* Journal American Water Works Association, Volume 46, pp. 123-132"

Geotechnical Report, Ocean Park, Washington, Landau Associates, August 26, 2013

Construction Stormwater Permit

1.5 QUALITY CONTROL

It shall be the sole responsibility of the Contractor to control the rate and effect of the dewatering efforts to avoid all objectionable settlement and subsidence. The Contractor shall comply with local codes and ordinances of governing authorities with regard to disposal of water pumped from dewatering operations.

Proposed discharge points shall be approved by the Owner prior to implementation of dewatering. The Contractor shall be responsible for taking all reasonable precautions necessary to ensure continuous, successful operation of the system.

PART 2 PRODUCTS

Dewatering shall be in accordance with the guidance stated in the Geotechnical Report for this Project.

The Contractor shall have sufficient pumping equipment and/or other machinery available onsite before operations begin to assure that the operation of the dewatering system can be maintained. This shall include providing backup pumps of similar capacity and a standby generator of the capacity required to continuously operate the Contractor's dewatering system.

PART 3 EXECUTION

3.1 INSTALLATION AND APPLICATION

During excavation, the installation of piping, conduits and structures and during the placing of backfill, excavations shall be kept free of water, subsurface or otherwise. The Contractor shall furnish all equipment necessary to dewater the excavations and shall dispose of the water so as not to cause a nuisance or menace to the public. The dewatering system shall be installed and operated by the Contractor so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. The

release of groundwater to its static levels shall be performed so as to maintain the undisturbed state of the foundation soils, prevent disturbance of backfill and prevent movement of all structures and pipelines.

Design implementation and maintenance of any dewatering system shall be the responsibility of the Contractor.

The Contractor shall construct all dewatering wells in accordance with WAC 173-160. The dewatering system shall be sufficient to maintain the groundwater level at an elevation to protect the surface of the trench bottoms, the base of the bedding course or other foundation, and shall be accomplished prior to pipe laying and jointing or placement of reinforcing steel for concrete.

If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering. The dewatering operation, however accomplished, shall be carried out so that it does not destroy or weaken the strength of the soil under or alongside the excavations.

The Contractor shall design filters and screen slot sizes for all sumps, wells and well points which prevents the movement of fines during pumping. The Contractor shall develop the wells such that they produce no more than 10-ppm silica as measured with a Rossum Sand Tester (Rossum, 1954) or equivalent.

3.2 MONITORING

The Contractor shall install water level observation wells in dewatered areas sufficient to determine whether groundwater levels are maintained as per Part 3.1 of this Section.

3.3 FIELD QUALITY CONTROL

A continual check by the Contractor shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation. The Contractor shall test all dewatering discharge using a Rossum Sand Tester or equivalent to determine the silica content of the discharge. The Contractor shall notify the Owner at least 24 hours prior to testing. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement that could develop.

Should settlement be observed, the Contractor shall cease dewatering operations and implement contingency plans as outlined in the Contractor's approved dewatering plan. The responsibility for conducting the dewatering operation in a manner that protects adjacent structures and facilities rests solely on the

Contractor. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor. Permanent piping systems, existing or new, shall not be incorporated into the Contractor's dewatering system.

***** END OF SECTION *****

SECTION 02250

TEMPORARY SHORING AND BRACING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the temporary shoring and bracing for excavations including the trench excavation safety systems as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals

1.3 GEOTECHNICAL REPORT

A Geotechnical Report New Backwash Basin at North Wellfield, Landau Associated, August 2013.

1.4 WORK INCLUDED

The extent of temporary shoring and bracing work includes, but is not limited to:

A. Temporary shoring and bracing necessary to protect the following against loss of ground or caving embankments: existing structures, buildings, roads, walkways, utilities, electrical transmission towers and support wiring, other facilities and improvements where required to comply with codes and authorities having jurisdiction.

B. Trench excavation safety systems, pursuant to RCW Chapter 49.17 and WAC 296-155-655.

C. Maintenance of shoring and bracing.

1.5 QUALITY ASSURANCE

A. SHORING CONSULTANT

The Contractor shall engage the services of a qualified geotechnical engineer and qualified structural engineer registered in the State of

Washington to design temporary shoring and bracing when required by applicable regulations.

B. SHORING DESIGN

The Contractor shall provide layout and design drawings and specifications for shoring and bracing when a trench box is inadequate for the purpose or will not be used and trench depth exceeds 4 feet and back sloping will not be used. Temporary shoring and bracing system design and calculations shall be prepared, stamped, and signed by a Professional Engineer registered in the State of Washington.

C. REGULATIONS

The Contractor shall design sheeting, shoring and bracing in accordance with the Washington State Safety Code and any local codes and ordinances of governing authorities having jurisdiction. Pile driving will not be allowed on the site; drilling shall be required for all required piles.

1.6 SUBMITTALS

The Contractor shall submit shoring and bracing layout and design drawings, calculations and other backup data to the Owner for review in accordance with Section 01300 prior to the start of construction.

1.7 PROJECT CONDITIONS

A. SOILS INFORMATION

A Geotechnical investigation has been conducted for this project and a copy of the report is included in the Appendix B.

B. SITE SURVEY

The background survey information provided on the Plans is shown for clarity only. The Contractor shall determine, before commencing work, the exact location of all existing features that may be disrupted by new construction, including existing underground utilities. The Contractor shall be fully responsible for any and all damages, which might be caused by the Contractor's failure to exactly locate and/or preserve existing site features. Prior to commencing work, the Contractor shall check and verify governing dimensions and elevations.

The Contractor shall survey adjacent structures and facilities, establishing exact elevations at fixed points to act as temporary bench marks to

monitor potential settlement from the contractor's ongoing operations. Clearly identify temporary bench marks and record existing elevations from the control points shown on the Plans.

During excavation, the Contractor shall resurvey bench marks weekly. The Contractor shall maintain and make available at the job site an accurate log of surveyed elevations for comparison with original elevations, and promptly notify the Owner if changes in elevations occur or if cracks, sags or other damage is evident.

1.8 EXISTING UTILITIES

The Contractor shall protect existing active sewer, water, gas, electrical, and other utility services and structures that may be present. This shall also include all pipelines, services, and structures that are the property of the Owner.

PART 2 PRODUCTS

The Contractor shall provide suitable shoring and bracing materials, which shall support loads imposed. Materials for shoring systems need not be new, but shall be in serviceable conditions.

PART 3 EXCAVATION

3.1 VERIFICATION OF CONDITIONS

The Contractor shall notify the Owner immediately if, during construction, subsurface conditions are different from those encountered in the exploratory holes or as described in the Geotechnical Report.

3.2 INSTALLATION AND APPLICATION

The Contractor shall provide shoring systems adequately anchored and braced to resist earth and hydrostatic pressures at locations as needed to support excavations during construction. The Contractor shall locate required bracing to clear all permanent work. Bracing which must be relocated shall be installed prior to the removal of original bracing. The Contractor shall not place bracing where it will be cast into or included in permanent concrete work, except as otherwise acceptable to the Owner. The Contractor shall maintain bracing until structural elements are rebraced by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.3 REMOVAL

The Contractor shall remove shoring and bracing in stages to avoid disturbances to adjacent and underlying soils and damage to structures, pavements, facilities and utilities. The Contractor shall repair or replace, as acceptable to the Owner, adjacent work damaged or displaced through the installation or removal of shoring and bracing work.

3.4 EXCAVATION SAFETY SYSTEMS

All work shall be carried out with due regard for public safety. Open trenches shall have proper barricades and at night they shall be distinctly indicated by adequately placed lights, as provided for elsewhere in the Specifications.

The Contractor is reminded that the Owner has not so delegated, and the Owner's Representative does not purport to be a trench or excavation system safety expert, is not so engaged in that capacity under this Contract, and has neither the authority nor the responsibility to enforce construction, safety laws, rules, regulations, or procedures or to order the stoppage of work for claimed violations of trench or excavation safety.

The furnishing by the Owner of resident representation and inspection personnel shall not make the Owner responsible for the enforcement of such laws, rules, regulations, or procedures, nor shall such make the Owner responsible for construction means, methods, techniques, sequences, procedures, or for the Contractor's failure to properly perform the work necessary for proper trench and excavation safety.

***** END OF SECTION *****

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the earthwork, including trench excavation and backfill for piping, excavation and backfill for structures, and finish grading.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
01500	Temporary Facilities
02240	Dewatering
02250	Temporary Shoring and Bracing
02305	Wet Weather Earthwork
02370	Erosion Control
02700	Gravel Materials
02900	Landscaping

PART 2 PRODUCTS

2.1 GRAVEL MATERIALS

All gravel materials shall conform to Section 02700.

PART 3 EXECUTION

3.1 PREPARATION

Excavation may commence once all erosion control measures are in place in accordance with the Plans and Section 02370 and to the satisfaction of the Owner.

3.2 GENERAL REQUIREMENTS

Excavation, compaction and backfill for structures, pipelines and the final site contours shall be formed by either excavating or compacting fill, as required, to provide the cross-sections as shown on the Plans.

All excavation performed on this Project shall be considered unclassified. Excavation shall consist of the removal of any and all material encountered, including debris, rubble, concrete, metal, topsoil, cutting and removal of existing surfacing, tree stumps, trees, logs, abandoned rail ties, abandoned piping, piling, riprap, etc.

Excavations shall be kept free of water, both surface water and groundwater, during the excavation, installation of pipelines and structures, and the placement of backfill. For additional requirements see Section 02240.

The Contractor's attention is also called to the depth of the structures and piping; for this reason, special shoring and bracing may be required. All shoring and bracing or sheeting required to perform and protect the excavation and to safeguard the employees, shall be furnished by the Contractor. For additional requirements see Section 02250.

No timber bracing, lagging, sheathing or other lumber shall be left in any excavation except with permission of the Engineer and in the event such permission is granted, no separate payment shall be allowed for burying such material.

All stockpiles shall be covered with plastic and no stockpile shall be higher than 6 feet above existing grade.

3.3 EXCAVATION AND BACKFILL FOR STRUCTURES

Excavation and backfill for structures shall be in conformance with Section 2-09 of the WSDOT Standard Specifications, and as further described herein. All excavation for structures shall be done to the dimensions and levels indicated on the Plans or specified herein. Excavation shall be made to such width outside the lines of the structures to be constructed as may be required for proper working methods, the erection of forms and the protection of the work.

Excavation shall consist of the removal of any and all material encountered to the elevations shown on the Plans. Excavations for structures shall be continued down to the subgrade which is defined as 6 inches below concrete mat foundations, concrete footings, and slab on grade floors for the installation of foundation gravel material, unless otherwise noted on the Plans.

Fill material placed under structures, including footings and floor slabs, shall be foundation gravel free from debris and organics, as specified in Section 02700.

In the event unsuitable material is encountered below the subgrade shown on the Plans and described herein, the Contractor, as required by the Engineer, shall over-excavate until a suitable foundation is reached. If over-excavation of

unsuitable material is required by the Engineer, it will be under the unit price bid item entitled "UNSUITABLE EXCAVATION," as described in Section 01200. The Contractor shall then replace the material with compacted foundation gravel, as specified in Section 02700. If imported foundation gravel is required; it will be paid under the unit price bid item titled "FOUNDATION GRAVEL", as specified in Section 01200. Quantities, if any, shall be calculated by neat line measurement to the depth agreed to in the field by the Engineer.

The Contractor shall notify the Engineer when excavation for compacted fill or structures is complete. No forms, reinforcing steel, or concrete shall be placed until the excavation has been inspected by the Engineer.

There is no warranty that the native material is suitable for backfill or is suitable, as excavated, for placement and compaction as required by these Specifications. In the event that the Contractor is unable to find onsite, sufficient native material to accomplish the structure backfilling, the select material that he shall furnish and install shall be Gravel Borrow, as specified in Section 02700.

3.4 PROTECTION OF FOUNDATION SURFACES

Care shall be taken to preserve the foundation surfaces shown on the Plans in an undisturbed condition. If the Contractor unnecessarily over excavates or disturbs the foundation surfaces shown on the Plans or specified herein without written authorization of the Engineer the Contractor shall replace such foundations with concrete fill or other suitable material approved by the Owner in a manner which will show by test an equal bearing capacity with the undisturbed foundation material. No additional payment shall be made for the added quantity of concrete fill or other suitable material used because of unnecessary over excavation caused by the Contractor or his operations.

3.5 EXCAVATION AND BACKFILL FOR TRENCHES

Excavation and backfill for trenches shall be in conformance with Sections 7-08 and 7-09 of the WSDOT Standard Specifications, and as further described herein. The following pipe materials shall be considered flexible:

- PVC
- Polyethylene Tubing
- FRP
- HDPE
- Polyethylene
- Corrugated Polyethylene

All other pipe materials shall be considered rigid.

Upon completion of work each day, all pipeline open trenches shall be completely backfilled, leveled, and temporarily patched or graveled, as herein specified. Under certain conditions, the trench may be left open at the last length of pipe laid during the day to avoid re-excavation the following morning, provided that the opening is adequately plated or covered for vehicle traffic. Special attention shall be given to barricading to keep vehicular traffic away from newly-backfilled trench areas until restored for traffic.

The Engineer reserves the right to restrict the Contractor in the amount of trench for pipeline that can be opened during the working day. Should the Contractor, in the Engineer's opinion, fail to diligently pursue backfilling, an allowable limit of open trench shall be 100 lineal feet and shall be strictly enforced.

The width of the trench at or below a point 12 inches above the top of the outside diameter of the pipe shall be carefully controlled and maintained to ensure the strength of the pipe and prevent pipe failures. Backfilling shall proceed as follows:

A. SUBGRADE PREPARATION

The subgrade for piping is defined as the elevation of the bottom of the pipe bedding material as shown on the Plans.

In the event unsuitable material is encountered below the subgrade shown on the Plans and described herein, the Contractor, as required by the Engineer, shall over-excavate until a suitable foundation is reached. If over-excavation of unsuitable material is required by the Engineer, it will be paid for under the unit price bid item entitled "UNSUITABLE EXCAVATION," as found in the Proposal. The Contractor shall then replace the material with compacted foundation gravel, as specified in Section 02700. Imported foundation gravel is required, it will be paid under the unit price bid item titled "FOUNDATION GRAVEL."

Quantities, if any, shall be calculated by neat line measurement to the depth agreed to in the field by the Engineer.

B. BEDDING FOR RIGID PIPE

Above the foundation material, if any, the bedding material shall be suitable native or Bank Run Gravel, as specified in Section 02700. This material shall be placed in lifts of approximately 8 inches up to a point 12 inches above the pipe. This material shall be hand shoveled in place and carefully worked under and around the pipe.

C. BEDDING FOR FLEXIBLE PIPE

Above the foundation material, if any, Gravel Backfill for Pipe Bedding, as specified in Section 02700, shall be placed in lifts of approximately 8 inches up to a point 12 inches above the pipe. This material shall be hand shoveled in place and carefully worked under and around the pipe.

D. BACKFILL FOR TRENCHES

Partial backfill to protect the pipe will be permitted immediately after the pipe has been properly laid in accordance with the Plans and these Specifications. Complete backfilling of trenches will not be permitted until the section of pipe installed has been inspected by the Engineer.

From the point 12 inches above the top of the pipe barrel, the backfill material to be used in the trench section shall be suitable native material or Bank Run Gravel, as specified in Section 02700, except where required or shown on the Plans to use other material. The Contractor shall place backfill in horizontal lifts not to exceed 8 inches in thickness. All backfill shall be free of large rocks, organic matter, stumps, trees, pieces of pavement, broken concrete and other deleterious substances.

The Contractor shall remedy, at his expense, any defects that appear in the backfill prior to final acceptance of the work. Cleanup operations shall progress immediately behind backfilling to accommodate the return to normal use of the trench area.

During placement of the initial lifts, the backfill material shall not be bulldozed into the trench or dropped directly over the pipe with less than 3 feet of backfill material above the top of the pipe.

3.6 ROCK EXCAVATION

It is not anticipated that solid rock will be encountered. Should such material be encountered, however, it will be paid for change order as directed by the Engineer and approved by the Owner. Boulders or broken rock less than 2 cubic yards in volume as measured in the field by the Engineer, will not be classified as rock, nor will so-called “hard-pan” or cemented gravel, even though it may be advantageous to use explosives in its removal if blasting were allowed. For the purpose of this contract, rock excavation shall be defined as mineral matter in place and of such hardness and texture that, when it is encountered, cannot be loosened by three passes of a ripper tooth mounted on the larger of a tracked backhoe of at least 25,000 pounds operating weight and 75 horsepower or the largest backhoe being utilized on the job by the Contractor. Where rocks occur as boulders that are smaller than the larger of: (1) 2 cubic yards in volume, or (2) the

volume that can be readily handled by the largest backhoe being utilized on the job by the Contractor, they shall be considered incidental to excavation.

Where removal of a boulder results in a void below the desired elevation of the intended excavation, backfilling of the void shall be handled in the same manner as the replacement of unsuitable excavated material.

3.7 REUSE AND DISPOSAL OF EXCAVATED MATERIAL

Excavated materials shall be properly protected and reused where possible. Excavated materials not used for fill shall be hauled to an approved waste site(s), as selected by the Contractor. The Contractor shall submit a list of approved waste haul site(s) to the Owner prior to the commencement of hauling of waste materials. Any permits required for waste haul and disposal shall be the responsibility of the Contractor.

3.8 FINAL SITE GRADING

The site shall be graded consistent with the elevations shown on the Plans. The slopes between elevations shall be uniform or as shown on the Plans. Excavations and backfill shall be to the elevations required for the placement of all surface restorations, such as asphalt, concrete, gravel surfacing, or landscaping. All areas shall be graded to provide proper drainage. The final ground surface shall be smooth, raked free of debris and stones, and prepared for restoration as specified in Section 02900.

3.9 STRUCTURE COMPACTION

The foundation gravel material placed underneath all structures shall be moisture conditioned to within 3 percent of optimum moisture content and shall be placed in loose, horizontal layers. The thickness of layers placed before compaction shall not exceed 8 inches for heavy equipment compactors and shall not exceed 4 inches for hand-operated mechanical compactors. Water settlement is not allowed for compaction.

Layers shall be compacted to a dense state equaling at least 95 percent of the maximum dry density, using the Modified Proctor, per ASTM D1557. Prior to the placement of fill below structures, any and all groundwater and surface water shall be drained or pumped from areas to be filled.

Wall backfill material shall be compacted to at least 90 percent of the maximum dry density, using the Modified Proctor, per ASTM D1557 within 5 feet of all walls and shall be compacted to at least 95 percent of the maximum dry density, using the Modified Proctor, per ASTM D1557 beyond 5 feet of all walls. Any

and all compaction within 5 feet of all walls shall be accomplished by means of hand-operated mechanical equipment rather than heavy equipment compactors.

3.10 TRENCH COMPACTION

Trench backfill materials shall be moisture conditions to within three percent of optimum moisture content. Water settlement is not allowed for compaction.

Pipe bedding materials, for both rigid and flexible pipes, shall be compacted to at least 95 percent of the maximum dry density, using the Modified Proctor, per ASTM D1557.

Compaction of the backfill above the bedding material in all trenches in non-structural and non-paved areas shall be performed by using mechanical equipment to at least 90 percent of the maximum dry density, using the Modified Proctor, per ASTM D1557.

Compaction of the backfill above the bedding material in all trenches in structural or paved areas shall be performed by using mechanical equipment to at least 95 percent of the maximum dry density, using the Modified Proctor, per ASTM D1557.

***** END OF SECTION *****

SECTION 02305

WET WEATHER EARTHWORK

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the procedures to be followed if earthwork is to be accomplished in wet weather or in wet conditions where control of soil moisture is difficult.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
02300	Earthwork
02370	Erosion Control
02700	Gravel Materials

PART 2 PRODUCTS

The size or type of construction equipment shall be selected as required to prevent soil disturbance. In some instances, it may be necessary to limit equipment size or to excavate soils with a backhoe, Gradall, or equivalent type of equipment to minimize subgrade disturbance caused by construction traffic.

Material used as structural fill during wet weather earthwork shall generally consist of clean granular material containing less than 5 percent fines (material passing the U.S. Standard No. 200 sieve), based on wet sieving the fraction passing the 3/4-inch sieve. The fines shall be non-plastic.

PART 3 EXECUTION

3.1 WET WEATHER EXCAVATION AND FILL PLACEMENT QUALITY CONTROL

Excavation and placement of fill or backfill material will be observed on a full-time basis by the Owner, to determine that all work is being accomplished in accordance with these Specifications.

3.2 WET WEATHER EARTHWORK PROTECTION

The ground surface shall be sloped away from construction areas to promote the rapid runoff of precipitation and prevent ponding of water.

Earthwork shall be accomplished in small sections to minimize exposure to wet weather. Excavation or the removal of unsuitable soil shall be followed immediately by the placement and compaction of a suitable thickness (generally 8 inches or more if approved by the Owner) of clean foundation gravel.

No soil shall be left uncompacted and exposed to moisture. A smooth drum vibratory roller, or equivalent, shall be used to seal the ground surface after placement of fill or backfill materials.

All wet weather work shall meet local, state and federal codes as specified herein and as indicated on the Plans.

***** END OF SECTION *****

SECTION 02370

EROSION CONTROL

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the temporary erosion and sedimentation control (TESC) in and around the site caused by the actions of the Contractor as shown on the Plans and as specified herein.

Work under this Section shall be directed towards site areas disturbed during construction as well as all off-site storage and parking areas maintained by the Contractor.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01160	Regulatory Requirements
01200	Measurement and Payment
01300	Submittals
02240	Dewatering
02300	Earthwork

1.3 CERTIFIED EROSION AND SEDIMENT CONTROL LEAD (CESCL)

The Contractor shall designate a Certified Erosion and Sediment Control Lead (CESCL) for this project. The CESCL shall have, for the life of this Contract, a current Certificate of Training in Construction Site Erosion and Spill Control signed by the WSDOT Water Quality Program Manager.

Duties of the CESCL shall include, but are not limited to:

A. Inspecting temporary erosion and spill control Best Management Practice (BMPs) for proper location, installation, maintenance, and repair. Inspections shall be made as noted on the Plans and after each significant precipitation event, including those that occur during weekends and after working hours. A Temporary Erosion and Spill Control Inspection Report shall be prepared for each inspection and shall be included in the Temporary Erosion and Spill Control file. The inspection report shall include, but not be limited to:

1. When BMPs are installed, removed or changed;

2. Repairs needed or made;

3. Turbidity monitoring results;

4. Observations of BMP effectiveness and proper placement;

5. Recommendations for improving performance of BMPs.

B. Prepare and maintain a Temporary Erosion and Spill Control file on site that includes but is not limited to:

1. Temporary Erosion and Spill Control Inspection Reports;

2. Contractor's Stormwater Pollution Prevention Plan (SWPPP);

3. Spill Prevention, Control, and Countermeasures (SPCC) Plan;

4. All project permits, including but not limited to grading permits,

5. Manufacturer instructions for all products used for TESC BMPs;

6. Washington State Department of Ecology's Stormwater Management Manual for Western Washington, Chapter 4, Volume II, current edition. Washington State Department of Ecology's Stormwater Management Manual for Eastern Washington, Chapter 7.

1.4 STORMWATER POLLUTION PREVENTION PLAN

The CESCL Contractor shall be responsible for preparing a Stormwater Pollution Prevention Plan (SWPPP). The intent of the SWPPP is to reflect the Contractor's operations by supplementing the TESC Drawings, details, and notes shown on the Plans to provide comprehensive pollution control at the construction site, staging areas, stockpiles, and borrow sites. The SWPPP shall be prepared by the CESCL for the project and submittal in accordance with Section 01300. The SWPPP shall be submitted to the Owner for approval at the preconstruction conference. **No work shall begin until the Contractor's SWPPP, as approved by the Owner, is implemented.** The SWPPP shall address, at least, the following items:

- Identification of construction haul routes and location of BMPs (e.g., stabilized construction entrance, silt fences, storm drain inlet protection).

- Waste disposal methods and locations.

- Detailed construction sequence and schedule, including identifying dates scheduled for BMP installation, removal, clearing, grading, seeding, and landscaping.

- Details for any temporary flow diversions, dewatering systems, and BMPs (in accordance with the current edition of the Washington State Department of Ecology's Stormwater Management Manual for Western Washington) proposed by the Contractor.

- Calculations for temporary sedimentation ponds, if used

- A list of products to be used, including Material Safety Data Sheets.

- Identification of stockpile and staging areas, and BMPs to be implemented at these locations.

The SWPPP shall be prepared in accordance with details shown on the Plans, these Specifications, and Chapter 4, Volume II Chapter 7– BMPs from the current edition of the Washington State Department of Ecology's Stormwater Management Manual for Western Washington, which are hereby referenced and made a part of the Contract Documents. Only those sections of the Stormwater Management Manual for Western Washington that address preparation, implementation, and maintenance of permanent and temporary erosion and sedimentation control BMPs are applicable.

The SWPP shall include best management practices to control windblown dust.

PART 2 PRODUCTS

2.1 SILT FENCES

Silt fences shall conform to the details shown on the Plans and the fabric shall conform to the following properties:

Property	Test Method	Result
Polymeric Mesh AOS	ASTM D4751	0.6 mm max. for slit film wovens (#30 sieve). 0.3 mm max. for all other geotextile types (#50 sieve). 0.15 mm for all fabric types (#100 sieve).
Water Permittivity	ASTM D4491	0.02 sec^{-1} min.
Grab Tensile Strength	ASTM D4632	180 lbs. min. for extra strength fabric 100 lbs min. for standard strength fabric
Grab Tensile Elongation	ASTM D4632	30% max.
UV Resistance	ASTM D4355	70% min.

2.2 STRAW BALES

Straw bale dams shall conform to the details shown on the Plans.

PART 3 EXECUTION

3.1 PREPARATION

Site preparation work shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped.

3.2 BEST MANAGEMENT PRACTICES (BMPS)

Silt fences and straw bale dams shall be constructed to control erosion and migration of soils disturbed during construction. The fences and dams shall provide temporary protection and shall be removed only upon approval of the Owner.

All areas or drainage ways downstream of the construction site shall have Best Management Practices (BMPs) installed prior to the beginning of any clearing activities. Runoff from cleared or disturbed area shall be directed through the BMPs. Disturbed ground shall be stabilized at the end of each work day. Permanent soil stabilization and erosion and sedimentation control shall be implemented upon reaching finish grade. Slope protection shall be immediately

implemented upon any soils showing signs of erosion. This shall be done in a manner approved by the Owner.

All BMPs shall be inspected, maintained and kept in a condition sufficient to provide effective erosion and sedimentation control at all times. The site shall be inspected to ensure the BMPs are properly located, constructed and operating as designed during the first storm. Any necessary adjustments or repairs shall be made immediately and be approved by the Owner. The BMPs shall be inspected thereafter as noted on the Plans and after all significant storm events. Turbidity monitoring will be held on a weekly basis at a minimum, or more frequently if necessary as determined by the CESCL.

All BMPs shall be removed no later than 30 consecutive calendar days after final site stabilization has been achieved as determined by the Owner. BMPs such as storm drain inlet protection, straw bales, silt fences and supports and plastic coverings shall be removed and properly disposed of offsite by the Contractor. Areas disturbed by removal of these BMPs shall be immediately stabilized in a manner approved by the Owner.

***** END OF SECTION *****

SECTION 02510

TESTING AND DISINFECTION

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes disinfection of potable water piping, distribution mains, filter basins, and structures; testing; and reporting results.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
Division 15	Mechanical

1.3 REFERENCES

A. AWWA B300 - Standard for Hypochlorites.

B. AWWA B301 - Standard for Liquid Chlorine.

C. AWWA B302 - Standard for Ammonium Sulfate.

D. AWWA B303 - Standard for Sodium Chlorite.

E. AWWA C651 - Standards for Disinfecting Water Mains.

F. AWWA C653 – Standards for Disinfecting Water Treatment Plants

1.4 SUBMITTALS

A. TEST REPORTS

Indicate results comparative to specified requirements.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01300.

B. DISINFECTION REPORT; RECORD

1. Type and form of disinfectant used.

2. Date and time of disinfectant injection start and time of completion.

3. Test locations.

4. Initial and 24-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.

5. Date and time of flushing start and completion.

6. Disinfectant residual after flushing in ppm for each outlet tested.

C. BACTERIOLOGICAL REPORT; RECORD

1. Date issued, project name, and testing laboratory name, address, and telephone number.

2. Time and date of water sample collection.

3. Name of person collecting samples.

4. Test locations.

5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.

6. Coliform bacteria test results for each outlet tested.

7. Certification that water conforms, or fails to conform, to bacterial standards of the Department of Health.

8. Bacteriologist's signature and authority.

1.6 QUALITY ASSURANCE

Perform Work in accordance with AWWA C651 and C653.

1.7 REGULATORY REQUIREMENTS

Final project approval from the Office of Drinking Water is required prior to substantial completion and placement of the new facilities into service.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping system has been cleaned, inspected, and pressure tested.

B. Perform scheduling and disinfection activity prior to startup, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 WATER PIPE DISINFECTION

A. Provide and attach required equipment to perform the work of this Section.

B. Inject treatment disinfectant into piping system.

C. Maintain disinfectant in system for 24 hours.

D. Replace permanent system devices removed for disinfection.

E. Water for disinfection must be obtained by the Contractor by arrangement with the Owner. The following describe specific procedures to be used by the Contractor in maintaining a satisfactory environment for prevention of contamination of the proposed water system installation, the cleanliness of the pipe and fittings and the actual method of disinfection.

F. When the line is completed and ready to disinfect, water shall be allowed to flow in slowly, until it appears at the far end of the line so as not to displace the disinfecting agent. The system shall then be allowed to stand for at least 24 hours. The line shall then be flushed through the drain stations until a test shows no more than two parts per million of available chlorine.

G. In all instances, the Contractor shall utilize a state approved double check valve type backflow prevention device to protect the potable water supply while filling, flushing and disinfecting the particular water main.

H. Where connections are made to existing facilities and it is impractical to use the methods described herein to disinfect the section between the existing water main and the point of isolation of the new water main (valve or temporarily plugged line) or where pipes and fittings require immediate use, cleaning and disinfecting shall be directed by the Owner.

I. The Contractor is herein advised that prior to making any restorations or permanent connections to the existing water mains, that the Contractor shall first demonstrate to the Owner, that the new water main has adequately passed a pressure test, been adequately flushed, and finally passed the required bacteriological test.

J. In all disinfection processes, the Contractor shall take particular care in flushing and wasting the chlorinated water from the mains to assure that the flushed and chlorinated water does no physical or environmental damage to property, streams, storm sewers or any waterways. The Contractor shall chemically or otherwise treat the chlorinated water to prevent damage to the effected environment, particularly aquatic and fish life of receiving streams. The method and the time of flushing is to be approved by the Owner.

K. Before placing the lines in service, satisfactory results must be obtained on samples collected from representative points in the new system and submitted to a State DOH approved laboratory. The Owner shall collect all samples for the bacteriological tests. However, the Contractor shall notify the Owner for collection of samples two days in advance, and schedule on days wherein samples can be conveniently processed by State DOH approved laboratory. If any of the pipeline materials are replaced thereafter, then that section shall again be disinfected and tested for bacteriological count.

If disinfection of mains by the above methods, prove unsatisfactory and the lab report indicates any type of bacteria count, then the Owner may direct the Contractor to use one of the following two disinfection methods until a satisfactory report is obtained. No additional compensation will be made to the Contractor for any work necessary to achieve a satisfactory bacteriological test result.

L. METHOD NO. 1

A chlorine gas-water mixture, or dry chlorine gas may be applied by means of a chlorinator, or the gas may be fed indirectly from a chlorine cylinder equipped with the proper devices for regulating the flow, and the effective diffusion of gas within the pipe. (Use of the chlorinator is preferred to direct feed from the cylinder.)

1. Point of Application

The preferable point of application for the chlorinating agent is at the beginning of the pipeline extension, or any valved section thereof, and through a corporation cock inserted in the horizontal axis of the pipe may be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension.

2. Rate of Application

Water from the existing distribution system, or other source of supply, shall be controlled to flow very slowly into the newly laid pipeline during application of the chlorine. The rate chlorine gas-water mixture or dry gas feed shall be in such proportion to the rate of water entering the newly laid pipe that the dose applied to the water entering the newly laid pipe will be at least 50 parts per million. A color comparator set shall be used to determine chlorine residual.

3. Cross-Connection Prevention

A cross-connection control device (DOH approved) shall be utilized to prevent potential cross-connections.

4. Retention Period

Treated water shall be retained in the pipe at least 24 hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least 5 parts per million.

5. Chlorinating Valves and Hydrants

In the process of chlorinating newly laid water pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

6. Final Flushing and Chlorine Residual Test

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its length, upon test, shows the absence of chlorine (or in the event chlorine is normally used in the source of supply, then the tests shall show a residual not in excess of that carried by the system). A state-approved bacteriological test shall then be conducted.

7. Repetition of Procedure

Should the initial treatment prove ineffective, the chlorination procedure shall be repeated until tests show that the water sample from the newly laid pipe conforms to the requirements of these Specifications.

M. METHOD NO. 2

1. Calcium or Sodium Hypochlorite or Chlorinated Lime in Water

A mixture of either calcium or sodium hypochlorite or chlorinated lime of known chlorine content and water may be substituted as an alternative for liquid chlorine. (Typical commercial products of this type are Perchloron, Chlor, Purex, etc.)

2. Proportions of Chlorine Compound and Water Mixtures

Prepare a solution containing approximately 5 percent available chlorine by weight. In the case of Perchloron, at 70 percent available chlorine, use 6 pounds per 10 gallons of water. In the case of Chlor, at 15 percent available chlorine, add 2 parts water to 1 part of Chlor. For other strength compounds, adjust the dilution accordingly.

3. Preparation and Application of Chlorine Compound

To prepare the chlorine compound-mixture, first make a paste, and then thin to a slurry to ensure getting all active ingredients into solution. The prepared solution shall be injected by means of a hypochlorinator, or hand or engine operated pump. Pumping into the newly laid pipe shall follow the conditions outlined under Method No. 1 for chlorine applications to provide a residual of 50 ppm. See Item Nos. (a) to (3) inclusive under Method No. 1.

For solutions containing approximately 5 percent available chlorine, the rate of bleeding the main to be sterilized should be 1,000 times the rate of feed or injection of the chlorine solution.

4. Further Procedure

Provisions for final flushing and bacteriological testing under this alternative should be the same as those described in Item Nos. (L) under Method No. 1 above.

3.3 DISINFECTION OF TREATMENT FACILITIES

Water treatment facilities shall be disinfected in accordance with AWWA C653.

3.4 QUALITY CONTROL

Samples shall be taken and tested in accordance with AWWA C651 and C653.

*****END OF SECTION*****

SECTION 02511

CONNECTION TO EXISTING SYSTEM

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the connection of pipelines being constructed under this project to existing water mains as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
Division 15	Mechanical

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

All cut-in connections to the existing system shall be made after a successful pressure test of the new main has been witnessed by the Owner and after a purity test has been satisfactorily evidenced except as allowed by the Owner.

The location, type and size of existing facilities have been determined from available records and are approximate. It is anticipated that connections to these existing facilities may be made, in general, as shown on the Plans except adjustments may be required for vertical and horizontal alignment.

It shall be the responsibility of the Contractor to determine the exact location and ascertain the type and size of the existing facilities prior to starting work on each connection and to provide any alternations as required in the connection detail.

Connections to existing facilities shall be made with the use of fittings, valves, flexible couplings, solid sleeves, shackling and other miscellaneous fittings, and thrust blocks as shown on the or with additional pipe or fittings as approved by the Owner and as indicated in Piping Systems to connect the new construction under this Project to the existing pipelines.

All pipe and fittings used for the connection shall be clean and disinfected with a minimum 5 percent chlorinated solution immediately prior to making said connection. The Contractor shall take extra precautions to ensure the tightness of the connections, nuts, and bolts. The existing water main shall be placed back into service by the Owner and the connection observed by the Owner prior to backfilling the pipe.

All valves shall be operated by Owner personnel only. Where it is necessary to shut off the existing mains to make a connection, the Contractor shall notify the Owner and all water customers affected 48 hours in advance of such shut off, and the Owner will shut off the mains. Once the water has been shut off, the Contractor shall diligently pursue the connection to completion so that the time required for the shut off is held to a minimum.

All connections to existing mains shall be completed the same day as they are started. The Contractor shall time its operations so that the water will not be shut off overnight or over weekends or during holidays.

***** END OF SECTION *****

SECTION 02530

UTILITY STRUCTURES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes precast concrete vaults, manholes, catch basins, castings, and steps for a complete installation as shown on the Plans and specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
02300	Earthwork
08310	Access Hatches

PART 2 PRODUCTS

2.1 GENERAL

The exterior finish of all precast concrete utility structures shall be smooth with no imperfections larger than 1/8 inch in diameter. The interior finish of all precast concrete utility structures shall be smooth and sacked with non-shrink cementatious materials and epoxy bonding agent. No bug holes, fins, projections, or other defects are acceptable.

2.2 PRECAST VAULTS

Precast concrete vaults shall be cast in an established precast yard. Precast vaults shall be designed for H-20 loads. Submit design calculations and shop drawings for review and approval prior to fabrication. Shop drawings shall detail wall thickness, concrete strength, reinforcing requirements, and shall include all appurtenances, such as access hatches, floor drains, and other items called for on the Plans.

All vaults shall be constructed with a minimum of 4-inch-thick solid walls.

The access hatches shall be as specified in Section 08310.

PART 3 EXECUTION

3.1 FINAL ADJUSTMENT AND CLEANUP

After installation is complete, the Contractor shall cleanout all precast structures prior to placing the new facilities into service. The adjustment of castings shall be done in a manner satisfactory to the Owner. Adjustment shall be done only with precast grade rings. Bricks are unacceptable. Grouting and final adjustment of castings shall be done with non-shrink grout.

***** END OF SECTION *****

SECTION 02700

GRAVEL MATERIALS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the various types of granular materials that are to be used in trenches and other excavations as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
02300	Earthwork
02305	Wet Weather Earthwork
02710	Gravel Surfacing

1.3 SUBMITTALS

The Contractor shall provide certificates of laboratory tests in accordance with Section 01300, indicating particle size distribution for review for each type of granular material furnished and proctor test reports for all material to be placed as pipe bedding material, trench backfill, backfill under and around structures and underneath crushed surfacing and asphalt concrete pavements.

The certificates and proctor test reports shall be provided to the Owner at least 5 calendar days prior to placement.

PART 2 PRODUCTS

2.1 FOUNDATION GRAVEL

Foundation gravel shall be Class A Gravel Backfill for Foundations in conformance with Section 9-03.12(1)A of the WSDOT Standard Specifications.

2.2 GRAVEL BACKFILL FOR PIPE BEDDING

Gravel backfill for pipe bedding shall meet the requirements of Section 9-03.12(3) of the WSDOT Standard Specifications except that no more than 5 percent passing shall pass the No. 200 Sieve.

2.3 BANK RUN GRAVEL FOR TRENCH BACKFILL

Bank run gravel for trench backfill shall be free from organic matter or other deleterious materials and in conformance with Section 9-03.19 of the WSDOT Standard Specifications.

2.4 CRUSHED SURFACING

Crushed surfacing base course and top course shall conform to Section 9-03.9(3) of the WSDOT Standard Specifications.

PART 3 EXECUTION

3.1 FOUNDATION GRAVEL

Foundation gravel shall be placed and compacted underneath all structures to a minimum depth of 12 inches unless indicated otherwise on the Plans, and to a greater depth where foundations are unstable and excess suitable excavated material is unavailable to stabilize such foundations.

In the event the Contractor unnecessarily overexcavates the pipe trench or structure foundation, or if the width of the pipe trench becomes wider than the pay limit shown on the Plans, all material so placed shall be at the Contractor's sole expense.

3.2 GRAVEL BACKFILL FOR PIPE BEDDING

Bedding material shall be placed simultaneously on both sides of the pipe for the full width of the trench in lifts not exceeding 6 inches. To assure uniform support, the material shall be carefully worked underneath the pipe haunches with a tool capable of preventing the formation of void spaces around the pipe. In the event the Contractor overexcavates the pipe trench, or if the width of the pipe trench becomes wider than the pay limit shown on the Plans, all material so placed shall be at the Contractor's sole expense.

3.3 CRUSHED SURFACING

Crushed surfacing base course and/or top course shall be placed underneath asphalt paving, to the lines and grades shown on the Plans or as required by the Plans and shall be compacted to a dense, unyielding state of at least 95 percent of the maximum dry density, using the modified Proctor, per ASTM D1557.

***** END OF SECTION *****

SECTION 02710

GRAVEL SURFACING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the installation of crushed surfacing materials.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
02300	Earthwork
02700	Gravel Materials

1.3 SUBMITTALS

The Contractor shall provide the Owner with a certificate of laboratory test indicating gradation of each material provided in accordance with Section 01300. The certificate shall be provided to the Owner 5 days prior to placement of any materials.

PART 2 PRODUCTS

2.1 GRAVEL MATERIALS

All gravel materials shall conform to the requirement of Section 02700.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be prepared as per Section 2-06.3 of the WSDOT Standard Specifications. As the rolling of the subgrade proceeds, all soft or spongy areas shall be removed and the resulting holes filled with ballast material or crushed surfacing base course as shown on the Plans. The Contractor shall dispose of excess materials resulting from the preparation of the subgrade. Rollers shall not be operated adjacent to structures where such use may cause damage. Where the subgrade abuts structures and compaction with a roller is not possible for practical

reasons, the area shall be compacted with mechanical tampers or other approved equipment.

3.2 GRAVEL MATERIAL

Gravel materials shall be placed in the layers and thickness as shown on the Plans. Gravel materials shall be placed in accordance with Section 4-04.3 of the WSDOT Standard Specifications.

The Contractor shall place gravel materials in a uniform layer over the entire area to receive gravel materials without segregation of sizes, to such depth that when compacted with the power roller, the course shall have the required thickness. The maximum layer thickness for compaction with a roller shall be 6 inches for ballast or base course and 4 inches for crushed surfacing. The gravel material shall be bladed with a grader and rolled while damp with a power roller until the course is thoroughly and uniformly compacted and until its surface is smooth and conforms to grade and crown requirements shown on the Plans. The cross-section of the finished surface shall be subject to reasonable variations as approved by the Owner to meet the varying conditions encountered. The surface shall be maintained in its finished condition until the succeeding layer is placed.

The roller shall not be operated adjacent to structures where such use may cause damage. Where the gravel materials abuts structures and compaction with a roller is not possible for practical reasons, the area shall be compacted with mechanical tampers or other approved equipment.

3.3 COMPACTION

All materials shall be compacted to a dense, unyielding state of at least 95 percent of the maximum dry density, using the modified Proctor, per ASTM D1557.

*****END OF SECTION*****

SECTION 02820

CHAIN LINK FENCE AND GATES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the furnishing and installing of chain link fencing and gates conforming to the lines, grades, and details and at the locations as shown on the Plans.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
03300	Cast-in-Place Concrete

PART 2 PRODUCTS

2.1 FENCING

The fence shall have continuous chain link wire, tension wire and three strands of barbed wire supported on angled extension arms. The chain link shall have a 2-inch diamond mesh and 9-gauge core wire, meeting ASTM 668, Class 2b. The total height of the fence shall be as shown on the Plans. The fence shall be heavy steel guard fence with top rail and bottom tension wire. Top and bottom selvages of chain link fabric are to have a twisted and barbed finish. Chain link fencing shall conform to Section 9-16 of the WSDOT Standard Specifications, and shall be a Type 3 fence per WSDOT Standard Plan.

Rails, posts, and accessories shall be galvanized with 1.8 ounces per square foot and then powder coated with 3 mils of black TGIC polyester as applied by Powder Coat Northwest or equal.

2.2 GATES

Gates shall be installed for the full opening shown on the Plans as per the manufacturer's recommendations. The Contractor shall furnish padlocks and keys for gates, which comply with Owner standards. Gates shall conform to WSDOT Standard plan L-30, the Plans, and ASTM F900.

Gate posts shall be provided in accordance with ASTM F900 and have a ball top.

PART 3 EXECUTION

3.1 TEMPORARY FENCING

The Contractor shall furnish and install temporary fencing around the site so as to protect the site and prevent unauthorized entry into the site. The Contractor shall also maintain the temporary fencing throughout the course of the construction and provide any and all security necessary for site safety and protection during periods when sections of the fence may be down or open. Temporary fencing shall be removed by the Contractor only after receiving written authorization from the Owner for its removal.

3.2 FENCING INSTALLATION

The chain link fencing shall be erected in straight lines between angle points by skilled workmen experienced in this type of construction, in accordance with the manufacturer's recommendations and these Specifications. The new fence installation shall not commence until final grading is complete and finish grade elevations are established. The new fence shall be constructed to provide security for the site. There shall not be any gaps between finish elevations and the bottom links of the fence, which would allow entrance into the site.

The site fence shall be constructed in conformance with Section 8-12 of the WSDOT Standard Specifications. The maximum spacing for line posts shall be 10-feet on center. Post holes shall be a minimum depth of 3 feet below finished grade; holes for line posts shall be 10 inches in diameter; holes for gate, corner, and pull posts shall be four times the diameter of the post. Posts shall be set plumb in true line and to the depth of 3 feet and the remainder of the hole filled with concrete that must extend around the posts to a point 2 inches above finished grade. The top surface shall have a crowned watershed finish.

Concrete shall be proportioned to provide at least 2,500 psi strength at 28 days. Materials, methods of proportioning, mixing, transporting and placing shall conform to Section 03300. After the concrete has set, accessories shall be installed; chain link fabric shall be fastened to end posts with stretcher bars and clamps and to line posts and top rail with wire or bands at approximately 14-inch centers and 24-inch centers, respectively.

3.3 GATE INSTALLATION

Install gateposts in accordance with manufacturer's instructions.

Gate posts shall be diagonally braced to adjacent line posts to ensure stability. Gates shall be hung and all hardware adjusted so that gates operate satisfactorily from open or closed position.

Concrete set gateposts: Drill holes in firm, undisturbed or compacted soil. Holes shall have diameter four times greater than outside dimension of post, and depths approximately 6-inches deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 inches below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour, tamp for consolidation. Trowel finish around post and slope to direct water away from posts. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

Install gates plumb, level, and secure for full opening without interference.

Attach hardware by means which will prevent unauthorized removal. Adjust hardware for smooth operation.

*****END OF SECTION*****

SECTION 02900

LANDSCAPING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the installation of all landscaping work as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
02230	Clearing and Grubbing
02300	Earthwork

1.3 QUALITY ASSURANCE

A. FERTILIZER

Conform to Washington State Department of Agriculture Laws and Federal Specification O-F-241D pertaining to commercial fertilizers.

B. SEED

Conform to the standards for "certified"-grade seed or better.

Furnished in standard container on which the following information is shown: seed name, lot number, net weight, percentage of purity, germination, weed seed and inert material.

Furnish to the Owner duplicate copies of a statement signed by the vendor, certifying that each lot of seed has been tested by a recognized seed testing laboratory within 6 months before the date of delivery on the Project.

Seed that is wet, moldy, or otherwise damaged in transit or storage will not be accepted.

PART 2 MATERIALS

2.1 SEEDING, FERTILIZING, AND MULCHING

All areas that have been cleared and grubbed, graded, and where restoration is required, shall receive seeding, fertilizing and mulching. These areas shall be leveled, acceptable to the Owner, existing topsoil broken up to a depth of 6 inches and hydroseeded. Graded areas shall receive 6 inches of imported Class A topsoil prior to hydroseeding.

For those areas in which hydroseeding would be difficult, the Contractor may request approval from the Owner to hand-apply the hydroseeding mix. Approval shall be granted for hand-application only after reviewing and approving the procedure that the Contractor recommends.

Seeding, fertilizing and mulching shall be installed using an approved-type hydroseeder.

The seed mixture shall have the following composition, proportion and quality:

Kind and Variety of Seed in Mixture	Percent By Weight	Minimum Percent of Pure Seed	Minimum Percent of Germination
Colonial Bent Grass (Highland or Astoria)	10%	9.8%	85%
Creeping Red Fescus (Illahee Rainier or Pennlawn)	40%	39.2%	90%
Perennial Rye Grass	30%	29.4%	90%
White Clover (Pre-inoculated)	20%	19.6%	90%
Maximum Percentage of Weed Seed	1.0%		
Maximum Inert and Other Crops	1.0%		

The seed shall be applied at a minimum rate of 120 pounds per acre.

A commercial fertilizer of the following formulation shall be furnished as specified, and all fertilizer shall be premixed prior to use on the job. The fertilizer shall be applied at the rate of 500 lbs. per acre.

Nitrogen (Inorganic) as N_2	Nitrogen (Organic) Ureaformaldehyde	Phosphorous as P_20_5	as K_20	Potassium lbs/Acre
10%	38%	20%	20%	500

Wood cellulose fiber mulch shall be applied at the rate of 2,000 pounds per acre.

PART 3 EXECUTION

3.1 SEED INSTALLATION

Seeding, fertilizing and mulching shall be installed in conformance with Sections 8-01 and 9-14 of the WSDOT Standard Specifications.

The seed materials will be applied in two applications.

The first application shall consist of seed and a non-toxic tracer.

The second application shall consist of a homogenous mixture of fertilizer and wood cellulose fiber mulch, and shall be uniformly applied over the seed within 48 hours of the seed application unless otherwise directed by the Owner.

When weather conditions are not conducive to satisfactory results from seeding operations, the Owner may order the work suspended and it shall be resumed only when the desired results are likely to be obtained.

Inspection is required for each area when seeding and fertilizing is complete, and again after mulching is complete.

Areas not receiving a uniform application of seeding at the specified rate as determined by the Engineer shall be reseeded at the Contractor's expense prior to mulching or payment.

3.2 CONSTRUCTION ACCEPTANCE

Construction acceptance shall be subject to a well-established groundcover that fulfills the requirement of the approved construction plans. The Contractor shall protect and care for all seeded areas until fully established and healthy. Care shall include equipment and labor necessary to provide sufficient and continuous watering of all seeded areas until final acceptance.

The Contractor shall guarantee landscape materials and workmanship for a period of 2 years following the date of project acceptance. During the 2-year guarantee

period, should any seed areas showing signs of failure such as dead or dying areas of grass or bare spots, the Contractor shall repair or replace all deficient areas to the satisfaction of the Owner.

The Contractor shall mow all newly established lawn areas a minimum of two mowings. The first mowing shall be performed only after an established and healthy stand of grass is judged to have grown. The second mowing shall occur upon establishment of second healthy stand of grass (4 inches in height).

***** END OF SECTION *****

DIVISION 3

CONCRETE

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes reinforcement and associated items for all concrete, including, but not necessarily limited to: reinforcing steel bars, wire fabric, and accessories for cast-in-place concrete.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
01400	Quality Control
03300	Cast-In-Place Concrete

1.3 REFERENCES

This Section references the latest revisions of the following documents:

Reference	Title
ACI 301	Structural Concrete for Buildings
ACI 318	Building Code Requirements for Structural Concrete
ACI SP-66	American Concrete Institute - Detailing Manual
ANSI/ASTM A82	Cold Drawn Steel Wire for Concrete Reinforcement
ANSI/ASTM A185	Welded Steel Wire Fabric for Concrete Reinforcement
ANSI/AWS D1.4	Structural Welding Code for Reinforcing Steel
ASTM A615	Deformed and Plain Billet Steel Bars for Concrete Reinforcement

1.4 SUBMITTALS

Submit in accordance with provisions of Section 01300.

A. SHOP DRAWINGS

Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.

B. MANUFACTURER'S CERTIFICATE

Certify that reinforcing bar and welded wire fabric meet or exceed specified requirements.

Submit certified copies of mill test reports of reinforcement materials analysis.

1.5 QUALITY ASSURANCE

Perform Work in accordance with ACI 301.

1.6 COORDINATION

Coordinate with placement of formwork, formed openings, and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. REINFORCING STEEL

ASTM A615, deformed bars: Grade 40 for #3 bars and smaller, Grade 60 for #4 bars and larger, unless noted otherwise on the Plans.

B. WELDED STEEL WIRE FABRIC

ASTM A185 Plain Type; in flat sheets; plain.

2.2 ACCESSORY MATERIALS

A. TIE WIRE

Minimum 16-gauge annealed type.

B. CHAIRS, BOLSTERS, BAR SUPPORTS, SPACERS

Sized and shaped for strength and support of reinforcement during concrete placement conditions including load-bearing pad on bottom where required to prevent vapor barrier puncture.

C. SPECIAL CHAIRS, BOLSTERS, BAR SUPPORTS, SPACERS ADJACENT TO WEATHER EXPOSED CONCRETE SURFACES

Plastic-coated steel type; size and shape as required.

D. MECHANICAL BAR SPLICES

Comply with ACI 318 requirement of minimum tensile strength of 125 percent of specified yield for reinforcement.

Subject to compliance with the requirements and approval of the Engineer, products ,which may be incorporated into the work include, but are not limited to, the following:

BAR-LOCK (MBT) Coupler Systems
"ERICO" REBAR SPLICING

E. ADHESIVE ANCHORS

Injection adhesive system shall consist of a dual-cylinder adhesive refill pack, a mixing nozzle, and dispenser. The adhesive shall be formulated to include resin and hardeners.

1. Subject to compliance with the requirements, products which may be incorporated in the work include, but are not limited to, the following:

   a. HIT RE 500 Injection Adhesive Anchor, Hilti, Inc.

   b. HIT HY 150 Injection Adhesive Anchor, Hilti, Inc.

   c. Power-Fast, Powers Fasteners, Inc.

2.3 FABRICATION

Fabricate concrete reinforcing in accordance with ACI SP-66. Obtain written approval from the Engineer prior to welding reinforcing steel. Weld reinforcement in accordance with ANSI/AWS D1.4.

PART 3 EXECUTION

3.1 PLACEMENT

Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports, and as herein specified. Avoiding cutting or puncturing vapor barrier during reinforcement placement and concreting operations.

Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal/plastic chairs, runners, bolsters, spacers, and hangers, as required.

Install reinforcing bars with clearance indicated on the Plans. Provide laps as shown and stagger locations to minimize the concentration of multiple reinforcing at joints. Unless noted otherwise on the Plans, provide two #5 minimum trim bars around all openings and penetrations. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with tie wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

***** END OF SECTION *****

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes schedules, notes, and details for the construction of cast-in-place concrete structures, landings, equipment piers, housekeeping pads and slabs on grade.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
01310	Project Meetings
01400	Quality Control
03200	Concrete Reinforcement

1.3 REFERENCES

This Section references the latest revisions of the following documents:

Reference	Title
ACI 117	Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 212.3	Chemical Admixtures for Concrete
ACI 301	Specifications for Structural Concrete
ACI 304	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 309	Guide for Consolidation of Concrete
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 350	Code Requirements for Environmental Engineering Concrete Structures and Commentary
ACI 347	Guide to Formwork for Concrete
ACI 350.1	Tightness Testing of Reinforced Engineering Concrete Structures and Commentary
ASTM C31	Making and Curing Concrete Test Specimens in the Field
ASTM C33	Concrete Aggregates

ASTM C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C94	Ready-Mixed Concrete
ASTM C131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C143	Slump of Hydraulic Cement Concrete
ASTM C150	Portland Cement
ASTM C172	Sampling Freshly Mixed Concrete
ASTM C173	Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Chemical Admixtures for Concrete
ASTM C535	Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete

1.4 SUBMITTALS

Submittals shall be in accordance with Section 01300.

A. GENERAL

The submittal for each included concrete mix shall include, as a complete package, the following as defined below:

1. Concrete Mix Design

2. Certified Test Results

3. Sieve Analysis

4. Product Data

An incomplete concrete mix submittal package may render a rejection of the mix or could delay the review process.

B. CONCRETE MIX DESIGN

Submit mix design for the proposed mix to be used on the Project, indicating components, and proportions by weight, including any admixtures. Mix design shall state chloride content. Mix designs to be provided are:

1. Unspecified Concrete

2. Lean Concrete

3. Cement Grout

C. CERTIFIED TEST RESULTS

Submit laboratory test results indicating compressive strength of concrete in compliance with requirements specified herein and in accordance with ACI 301.

D. SIEVE ANALYSIS

Submit sieve analysis for proposed coarse and fine aggregates indicating components, source, gradation, and WSDOT aggregate source approval report, including WSDOT Aggregate Source ID.

E. PRODUCT DATA

Provide product data on all proposed admixtures, accessories, and embedded items to be used on the Project, including, but not limited to:

1. Cement; source and type

2. Air Entraining Agent

3. Water Reducing Admixtures

4. Pozzolans

5. Bonding Agents

6. Curing Compounds/Floor Hardeners

7. Non-Shrink Grout; Non-metallic and Metallic

8. Waterstops

9. Plastic Joint Formers

10. Vapor Barriers

11. Stair Nosings

For admixtures other than those proposed for air entrainment, submit a letter from the manufacturer describing the benefits of its use for the project and effect of its use on the properties of the concrete. Product data shall expressly state admixtures are chloride free, or the manufacturer shall submit a letter certification stating the same.

F. MATERIAL DELIVERY TICKETS

Provide copies of all concrete and grout material delivery tickets for the Project to the Engineer.

1.5 QUALITY ASSURANCE

Perform work in accordance with ACI 301. Acquire cement and aggregates from same source for all work performed on the Project. Conform to ACI 305 when concreting during hot weather. Conform to ACI 306 when concreting during cold weather. Provide or coordinate field and laboratory testing as described later in this Section and under provisions of Section 01400.

1.6 COORDINATION

Coordinate work in accordance with provisions of Section 01310. Coordinate the placement of embedded items with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. FORMS FOR EXPOSED FINISH CONCRETE

Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on the Plans.

B. FORMS FOR UNEXPOSED FINISH CONCRETE

Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. FORMS FOR CYLINDRICAL COLUMNS AND SUPPORTS

Metal, fiberglass reinforced plastic, or paper or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.

D. FORM COATINGS

Provide commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

E. FORM TIES

Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units, which will leave no metal closer than 1-1/2 inches to surface. Unless noted otherwise on Plans, provide ties with plastic cone devices which, when removed, will leave holes not larger than 1-inch diameter in concrete surface.

2.2 CONCRETE MATERIALS

A. CEMENT

ASTM C150, Type II – Moderate or Type I - II. Use one brand of cement throughout the project, unless otherwise approved by the Engineer. Provide low alkali cement where Alkali-Silica Reaction (ASR) mitigation measures are required by WSDOT Aggregate Source Approval.

B. FINE AND COARSE AGGREGATES

Comply with ASTM C33. Provide aggregates from a single source. Coarse aggregate shall be size designation 467 (Nominal size 1-1/2 inch to No. 4 sieve) for all liquid containing structures, and size designation 67 (Nominal size 3/4-inch to No. 4 sieve) for all other concrete. Aggregates shall show a loss of weight not exceeding 35 percent after 500 revolutions

in a Los Angeles wear machine, when tested in accordance with ASTM C131 or ASTM C535. Aggregates shall be from a WSDOT approved source.

C. WATER

Clean, potable, and not detrimental to concrete, in compliance with ASTM C94.

2.3 ADMIXTURES

Except for air entrainment, use of all other admixtures used shall be subject to approval of the Engineer and at no additional cost to the Owner. Only admixtures expressly stated by the manufacturer as being chloride-free shall be used. Subject to compliance with requirements, products, which may be incorporated into the work include, but are not limited to, the following:

A. AIR ENTRAINMENT

ASTM C260 certified by manufacturer to be compatible with other proposed admixtures.

Master Builders MB AE 90 or MICRO-AIR
Sika AER
W.R. Grace Daravair or Darex Series

B. WATER REDUCING ADMIXTURE

ASTM C494 Type A.

Master Builders PolyHeed
Sika Plastocrete 161
W.R. Grace WRDA Series

C. ACCELERATING ADMIXTURE

ASTM C494 Type C.

Master Builders Pozzolith NC534
Sika Plastocrete 161 FL
W.R. Grace Polarset or DCI

D. WATER REDUCING, RETARDING ADMIXTURE

ASTM C494, Type D.

Master Builders Pozzolith 100XR
Sika Plastiment
W.R. Grace Daratard Series

E. WATER REDUCING, ACCELERATING ADMIXTURE

ASTM C494, Type E.

Euclid Chemical Co. Accelguard 80
Master Builders Pozzutec 20
W.R. Grace Daraccel

F. HIGH RANGE WATER REDUCER (HRWR)

ASTM C494, Type F.

Master Builders Rheobuild 1000/3000 FC
Sika Sikament 10 ESL
W.R. Grace ADVA 100

G. HIGH RANGE WATER REDUCER AND RETARDER

ASTM C494, Type G.

Master Builders Pozzolith 440N
W.R. Grace Daracem-100

H. POZZOLAN

ASTM C618 - CLASS F, with a CaO maximum content of 10 percent.

2.4 ACCESSORIES

A. BONDING AGENT

ASTM C881, Type I and II, Grade 2, Class C, Epoxy Resin. Subject to Contract requirements, provide one of the following or equal:

Sika Armatec 110
Conspec SpecBond 100
W.R. Meadows Sealtight Rezi Weld 1000

B. CURING COMPOUND/CHEMICAL FLOOR HARDENER

ASTM C309, Type I, Class A and B. Subject to Contract requirements, provide one of the following or equal:

W.R. Meadows Sealtight 1100-Clear
Conspec RX cure
Chemrex, Inc. Masterkure
Burke Spartan-Cote WB

Note: For potable water facilities, do not use curing compounds unless they are NSF approved [on structure surfaces containing water].

C. GENERAL PURPOSE NON-SHRINK NON-METALLIC GROUT

Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi (17 Mpa) in 48 hours and 7,000 psi (48 Mpa) in 28 days. Subject to Contract requirements, provide one of the following or equal:

Sika SikaGrout 212
Conspec 100 Non Metallic
Chemrex, Inc. Masterflow 928 Grout
W.R. Meadows Sealtight 588

D. WATERSTOPS

Provide waterstop of type and size at construction joints and other joints as indicated on the Plans.

1. PVC (Polyvinyl Chloride)

Serrated (ribbed), 3/8 of an inch minimum thickness for 6 inches and larger and 3/16 of an inch minimum thickness for 4 inches. Comply with Corps of Engineers CRD-C-572. No reclaimed PVC will be allowed in waterstop.

Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include, but are not limited to, the following:

Greenstreak
Vinylex Corporation
W.R. Meadows

2. Cold Joint Waterstop

Install where shown on the Plans or at locations approved by the Engineer. Cold joint waterstop shall be certified by the manufacturer to be compatible for use in wastewater (sewage) containment structures.

Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include, but are not limited to, the following:

Hydrotite, Greenstreak
Waterstop-RX, Colloid Environmental Technologies, Co.

E. PLASTIC JOINT FORMER

Provide and install, per manufacturer's recommendations, where shown on the Plans or at locations approved by the Engineer. Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include, but are not limited to, the following:

Greenstreak
Vinylex Corporation
W.R. Meadows

2.5 CONCRETE MIX

A. GENERAL

Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as that used for field quality control testing.

The maximum water soluble chloride ion content, expressed as a percent of the cement, contributed from all ingredients of the concrete mix, including water, aggregates, cementitious materials, and admixtures, shall not exceed 0.10 percent. Pozzolans may be counted as part of the total cementitious material in the concrete mix design. The cementitious material is the "minimum cement content" specified in the mix design for each type of concrete. When pozzolans are used as part of this "cement content," the minimum content shall be 15 percent by weight of the total cementitious materials (Portland cement and pozzolans) and not more than 20 percent.

Where ASR mitigation measures are required by WSDOT, provide a minimum of 15 percent pozzolan included in the cementitious material in the design mix.

B. MIX DESIGNS

Provide normal weight concrete with the following properties, unless noted otherwise on the Plans.

1. Unspecified Concrete

Structural concrete of general use in structures, sidewalks, and where no specific class of concrete is designated.

Minimum compressive strength @ 28 days:	3,500 psi
Minimum cement content:	5.5 sacks per cubic yard
Maximum water cement ratio by weight:	0.45
Nominal coarse aggregate size:	3/4" to No. 4 (size designation 67)

2. Lean Concrete

Concrete for pipe thrust blocks or for use as noted as "Concrete Fill" on the Plans.

Minimum compressive strength @ 28 days:	2,500 psi
Minimum cement content:	5 sacks per cubic yard

3. Cement Grout

Material for filling guard posts, grouting of clarifier bottoms or for other uses as shown on the Plans. Cement grout shall be sand and cement only and shall not contain coarse aggregate.

Minimum compressive strength @ 28 days:	2,500 psi
Minimum cement content:	6.5 sacks per cubic yard
Maximum water cement ratio by weight:	0.54

C. ADMIXTURES

1. Air Entrainment

Use air-entraining admixture in all exterior exposed concrete. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement in accordance with ASTM C173 or C231 having total air content with a tolerance of plus or minus 1 percent within the following limits:

5.5 percent for 1.5 inch max. coarse aggregate size
6.0 percent for 1.0 inch max. coarse aggregate size
7.0 percent 0.50 inch or less max. coarse aggregate size

2. Other Admixtures

Use of all other admixtures shall be subject to the approval of the Engineer, and shall be in accordance with ACI 212.3 and Manufacturer's recommendations. Only admixtures stated by the manufacturer to be chloride free shall be used.

D. SLUMP LIMITS

Proportion and design mixes to result in concrete slump (1 inch ± of the maximum) at the point of placement in accordance with ASTM C143 as follows:

Ramps, slabs, and sloping surfaces: 3 inches.

Reinforced foundation systems: 3 inches.

Other concrete: 4 inches.

Concrete containing HRWR admixture (super-plasticizer): Not more than 8 inches after addition of HRWR to site-verified 2- to 3-inch slump concrete.

E. CONCRETE MIXING

Comply with requirements of ASTM C94, and as herein specified.

During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than that specified in ASTM C94 may be required.

PART 3 EXECUTION

3.1 GENERAL

Coordinate the installation of joint materials and vapor barriers with placement of forms and reinforcing steel.

3.2 FORMS

Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the work. Use selected materials to obtain required finishes. Solidly butt joints and provide back up at all joints to prevent leakage of cement paste.

Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast-in-place concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Provide Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

Chamfer all exposed corners and edges and other areas shown on the Plans, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

3.3 JOINTS AND WATERSTOPS

A. CONSTRUCTION JOINTS

Locate and install construction joints where indicated, or locate so as not to impair strength and appearance of the structure, as acceptable to the Engineer. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise shown on the Plans.

B. WATERSTOPS

Provide waterstops in construction joints of all water containment structures and where shown on the Plans. Install waterstops to form continuous diaphragm in each joint in accordance with manufacturer's recommendations. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions and recommendations. All waterstops shall be tied into place using hog rings and/or tie wire to keep the waterstop from moving during placement of concrete. Provide manufacturer's written warranty for all waterstop installations.

C. ISOLATION JOINTS IN SLABS-ON-GRADE

Unless otherwise noted, construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as shown on the Plans.

Joint filler and sealant materials are specified in Division 7.

D. SLAB (CONTROL) JOINTS

Construct joints in slabs-on-grade as shown on the Plans. Use saw cuts 1/8 of an inch wide x 1/4 of the slab depth or inserts 1/4-inch wide x 1/4 of the slab depth.

E. PREMOLDED (CONTROL) JOINTS

Insert premolded plastic, hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

F. EDGE FORMS AND SCREED STRIPS FOR SLABS

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.4 INSTALLATION OF EMBEDDED ITEMS:

A. GENERAL

Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use installation drawings, diagrams, instructions, and directions provided by suppliers of items to be embedded.

B. CLEANING AND TIGHTENING

Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

C. REGLETS

Install reglets to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashing as shown at lintels, relieving angles, and other conditions.

3.5 PLACING REINFORCEMENT

See Section 03200.

3.6 PREPARATION OF FORM SURFACES

Clean reused forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

Thin form coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.7 PREPARATION OF EXISTING CONCRETE SURFACES

The Contractor shall bush hammer all existing concrete surfaces that are to have new concrete cast against them. Apply epoxy bonding agent prior to placing concrete.

3.8 CONCRETE PLACEMENT

A. GENERAL

Comply with ACI 304 and as herein specified.

Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Apply temporary protective covering to lower 2 feet of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during concrete placement.

B. PLACING CONCRETE IN FORMS

Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

C. PLACING CONCRETE SLABS

Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations. Maintain reinforcing in proper position during concrete placement operations.

D. COLD WEATHER PLACING

Protect concrete work from physical damage or reduced strength, which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

When air temperature has fallen to or is expected to fall below 40 degrees F (4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C), and not more than 80 degrees F (27 degrees C) at point of placement.

Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

E. HOT WEATHER PLACING

When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F (32 degrees C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is at Contractor's option.

Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed. Upon approval, water-reducing retarding admixture (Type D) may be used when required by high temperatures, low humidity, or other adverse placing conditions.

3.9 FINISH OF FORMED SURFACES

Provide smooth form finish for all formed concrete surfaces exposed-to-view including all surfaces exposed to water or wastewater, or that are to be covered with a coating material applied directly to the concrete, or a covering material applied directly to concrete, such as veneer plaster, painting, or other similar type of system.

Provide smooth form finish for surfaces to be waterproofed or dampproofed. Surfaces must comply with recommendations of the manufacturer of the product being utilized.

Provide rough form finish for formed concrete surfaces not exposed-to-view in the finished work or by other construction, unless otherwise indicated.

A. SMOOTH FORM FINISH

This is to be the as-cast concrete surface obtained utilizing selected form facing material, arranged orderly and symmetrically with a minimum of seams, and as specified herein.

Repair and patch tie holes and defective areas, with all fins or other projections completely removed and smoothed, by one of the following methods:

1. Provide smooth rubbed finish to concrete surfaces after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

2. Provide grout "sacked" cleaned finish. The sacking grout shall be one part Portland cement to 1-1/2 parts fine sand by volume, and mixed with water to consistency of thick paint. Proprietary additives such as epoxy bonding agents or adhesives may be used at Contractor's option. Blend standard Portland cement and white Portland cement, amounts to be determined by trial patches, so that final color of dry grout matches adjacent surfaces. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep sacked surfaces damp by fog spray or other acceptable method so surfaces do not dry out.

B. ROUGH FORM FINISH

This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/8 of an inch in height rubbed down or chipped off. All "bug holes" exceeding 1/2 inch in diameter and exceeding 1/4-inch depth shall be repaired or filled in.

C. RELATED UNFORMED SURFACES

At tops of walls, horizontal offsets, and similar unformed surfaces occurring at adjacent formed surfaces, continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

D. TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:

a.	In the lines and surfaces of columns, pier, walls and in arises	In any 10 feet of length – 1/4 inch. Maximum for entire length – 1 inch

	b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 20 feet of length – 1/4 inch. Maximum for entire length – 1/2 inch
2.	Variations from level or from the grades indicated on the Plans:	
	a. In slab soffits, ceilings, beam soffits, and in arises, measured before removal of supporting shores	In any 10 feet of length – 1/4 inch. In any bay or opening, or in any 20 feet of length – 3/8 of an inch. Maximum for entire length – 3/4 inch
	b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or opening, or in any 20 feet of length – 1/4 inch. Maximum for entire length – 1/2 inch
3.	Variations in the linear building lines from the established position in plan view	In 20 feet of length – 1/2 inch. Maximum for entire length – 1 inch
4.	Variations in distance between walls, columns and partitions	In any 10 feet of distance – 1/4 inch. In any bay or opening – 1/2 inch. Maximum total variation – 1-inch.
5.	Variations in the sizes and locations of sleeves, floor openings and wall openings	Minus – 1/4 inch Plus – 1/2 inch
6.	Variations in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus – 1/4 inch Plus – 1/2 inch

7. Variations in footings:

a.	Variation from dimensions on Plans when formed or plus 3-inches when placed against unformed excavations	Minus – 1/2 inch Plus – 2 inches
b.	Misplacement of eccentricity	2 percent of the footing width in the direction of the misplacement, but not more than 2 inches
c.	Reduction in thickness of specified thickness	Minus – 5 percent

8. Variations in steps:

a.	In a flight of stairs	Riser – 1/8 of an inch Tread – 1/4 inch
b.	In consecutive steps	Riser – 1/16 of an inch Tread – 1/8 of an inch

3.10 MONOLITHIC SLAB FINISHES:

A. SCRATCH FINISH

Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping, including grout finishes where indicated on plans, or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated. Slope surfaces uniformly to floor drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.

B. FLOAT FINISH

Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. TROWEL FINISH

Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks and uniform in texture and appearance. Grind smooth surface defects that would telegraph up through applied floor covering system.

D. TROWEL AND FINE BROOM FINISH

Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

E. NON-SLIP BROOM FINISH

Apply non-slip broom finish to exterior concrete platforms, landings, steps, and ramps, sidewalks and elsewhere as indicated. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner before application.

F. CHEMICAL-HARDENER FINISH

Apply chemical-hardener finish to interior exposed concrete floors and steps, unless noted otherwise. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Evenly apply each coat, and allow 24 hours for drying between coats. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

G. TOLERANCES FOR MONOLITHIC SLAB FINISHES

The flatness of the concrete shall be carefully controlled and the tolerances shall be measured by the straight edge system as specified in paragraph 4.5.7 of ACI 117, using a 10-foot straight edge, within 72 hours after floor slab installation and before shores and/or forms are removed. The listed tolerances shall be met at any and every location at which the straight edge can be placed.

Bullfloated	1/2 inch
Float Finish	3/16 inch
Trowel Finish	1/8 inch
Straightedges	5/16 inch

3.11 CONCRETE CURING AND PROTECTION

A. GENERAL

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep concrete continuously wet for not less than 7 days. Begin final curing procedures immediately following initial curing and before concrete has dried out. Continue final curing for at least 7 days in accordance with ACI 301 curing methods. Avoid rapid drying of concrete at the end of final curing period.

B. CURING METHODS

Perform curing of concrete by use of curing and sealing compound, by moist curing, by moisture-retaining cover curing, or by combinations thereof, as herein specified.

Provide moisture curing by the following methods. Keep concrete surface continuously wet by covering with water, or provide continuous water-fog spray.

Covering concrete surface with absorptive cover, thoroughly saturating cover with water and keeping continuously thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.

Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in wide as practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walls, sidewalks, and curbs, as follows:

Apply curing and sealing compound to concrete slabs and walls as soon as initial curing operations are complete or immediately after the forms have been stripped (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Completely cover the concrete surfaces with curing and sealing compound. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair any damage during curing period.

Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to the Engineer.

C. CURING FORMED SURFACES

Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period and until forms are removed. When forms are removed, continue curing by methods specified above, as applicable.

D. CURING UNFORMED SURFACES

Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of an appropriate curing method.

Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture retaining cover.

3.12 SHORES AND SUPPORTS

A. GENERAL

Comply with ACI 347 for shoring, and as herein specified. Extend shoring from ground to roof for structures four stories or less, unless otherwise permitted. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support work without excessive stress or deflection.

Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until all concrete has attained its required 28 day strength and heavy loads due to construction operations have been removed.

B. REMOVAL OF FORMS

Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F (10 degrees C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

Formwork supporting weight of concrete, such as beam soffits, joints, suspended slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained 70 percent of the design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens, representative of concrete location or members.

Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.13 REUSE OF FORMS

Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Provide new form facing material. Apply new form coating compound as specified for new formwork prior to reuse of forms.

When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and

secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, unless approved by the Engineer and acceptable to the Owner.

3.14 MISCELLANEOUS CONCRETE ITEMS

A. FILLING-IN

Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work. Fill-in all form tie holes and other forming system holes with non-shrink grout.

B. CURBS

Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. BASE PLATE, EQUIPMENT BASES AND FOUNDATIONS

Provide machine and equipment bases (housekeeping pad/pier) and foundations, as shown on the Plans. Set anchor bolts for machines and equipment with template at correct elevations, complying with certified diagrams or templates of manufacturers furnishing machines and equipment.

Provide 4-inch-high, square or rectangular concrete pad around all conduits and small diameter pipes that penetrate through floor slabs.

Provide leveling grout under base plates and equipment frames using non-metallic, non-shrink grout. Minimum thickness for leveling grout shall be 1/2 inches unless noted otherwise on the Plans or specified by equipment manufacturer.

D. STAIR NOSINGS

Provide stair nosings at all exterior cast-in-place concrete stairs or steps. The stair nosings shall be installed in accordance with the manufacturer's written instructions.

3.15 CONCRETE SURFACE REPAIRS

A. PATCHING DEFECTIVE AREAS

Repair and patch defective areas immediately after removal of forms. Cut out honeycomb, rock pockets, voids or bugholes over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. For water and wastewater containment structures, utilize an epoxy resin bonding agent. Place patching mortar after bonding compound has dried.

For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. REPAIR OF FORMED SURFACES

Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, bug holes, honeycomb, rock pockets; fins and other discolorations that cannot be removed by cleaning. Flush out form tie holes and form bolt holes, fill with non-shrink grout, or precast concrete cone plugs or rubber plugs secured in place with bonding agent or epoxy adhesive.

Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. All repairs shall be approved by the Engineer. If defects cannot be repaired, the Contractor shall remove and replace the concrete.

C. REPAIR OF UNFORMED SURFACES

Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.

Repair finished unformed surfaces that contain defects, which affect durability of concrete. Surface defects, as such, include crazing, cracks in

excess of 0.01 inches wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.

Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3 inches of clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

Repair isolated random cracks and single holes not over 1 inch in diameter by dry-pack method. Groove top of cracks and cutout holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

Perform structural repairs with prior approval of the Engineer for method and procedure, using specified epoxy adhesive and mortar. Repair methods not specified above may be used, subject to approval of the Engineer. If acceptable repairs cannot be made, the Contractor shall remove and replace the concrete at no cost to the Owner.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. GENERAL

Sampling and testing for quality control during placement of concrete shall include the following:

1. Sampling Fresh Concrete

   ASTM C172, except modified for slump to comply with ASTM C94.

2. Slump

   ASTM C143: one test at point of discharge for each day's placement of each type of concrete; additional tests when concrete consistency seems to have changed.

3. Air Content

   ASTM C173, volumetric method for lightweight or normal weight concrete; ASTM C231 pressure method for normal weight concrete; one for each day's placement of each type of air-entrained concrete.

4. Concrete Temperature

   Test hourly when air temperature is 40 degrees F (4 degrees C) and below, and when 80 degrees F (27 degrees C) and above; and each time a set of compression test specimens is made.

5. Compression Test Specimen

   ASTM C31; one set of four standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

6. Compressive Strength Tests

   ASTM C39; one set for each day's placement exceeding 5 cubic yards plus additional sets for each 50 cubic yards over and above the first 25 cubic yards of each concrete class placed in any 1 day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

   When total quantity of a given class of concrete is less than 50 cubic yards, Engineer may waive strength test if, in his judgment, adequate evidence of satisfactory strength is provided.

When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

Test results will be reported in writing to Engineer and Contractor within 24 hours after testing. FAX of test results is acceptable; however, mailing hard copies of test results is also required. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7 day tests and 28-day tests.

7. Nondestructive Testing

Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection of concrete.

8. Additional Tests

The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in a structure, as directed by the Owner. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for cost of such tests when unacceptable concrete is verified.

3.17 WATERTIGHTNESS

All water and wastewater holding tanks, basins and structures listed on the Structural Plans shall be tested for watertightness. Each tank, structure or basin shall be tested independently.

Watertightness tests shall be made after the concrete has obtained at least 90 percent of its required 28-day compressive strength, but in no case sooner than 20

days after placement. Watertightness shall conform to the requirements of ACI 350.1.

Leakage testing shall not be conducted during periods of time with measurable precipitation. Evaporation correction shall be made on the basis of an evaporation pan. Suitable evaporation pan shall be approved by Owner and shall be provided by Contractor.

Watertightness testing may follow backfill of the structure, at the Contractor's option. However, if the structure does not pass the test, re-excavation to locate leaks shall be required. All costs associated with location (re-excavation and backfilling) and repair of leaks shall be borne by the Contractor.

***** END OF SECTION *****

SECTION 03350

CONTROLLED DENSITY FILL (CDF)

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section provides all materials, labor, and equipment for installation of Controlled Density Fill (CDF) as shown on Plans and/or in lieu of imported backfill material and compacted structural fill where approved by the Owner.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
03300	Cast-in-Place Concrete

1.3 REFERENCES

This Section references the latest revisions of the following documents:

Reference	**Title**
ASTM C94	Specification for Ready-Mixed Concrete
WSDOT	Standard Specifications for Road, Bridge, and Municipal Construction
ASTM C33	Concrete Aggregate
ASTM C150	Portland Cement
ASTM C618	Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

1.4 SUBMITTALS

Comply with provisions of Section 01300.

A. CERTIFICATE OF COMPLIANCE

Certificate shall verify that the delivered material is in compliance with mix design and shall include: Project Contract No., Date, Truck No., and Batched Weights of each ingredient. The certification shall be signed by a representative of the CDF producer, and shall be someone other than the truck driver.

B. DELIVERY TICKETS

Provide copies of delivery tickets to the Owner.

1.5 DELIVERY AND HANDLING

Comply with requirements of ASTM C94.

PART 2 PRODUCTS

2.1 MATERIALS

A. PORTLAND CEMENT

Type I, II, or III comply with ASTM C150 or State of Washington, Standard Specifications for Road, Bridge, and Municipal Construction Article 9-01, Current Edition.

B. FLY ASH (POZZOLAN)

ASTM C618, Class F or Class C.

C. AGGREGATES

ASTM C33 or State of Washington, Standard Specifications for Road, Bridge and Municipal Construction, Current Edition, Articles 9-03.1 or 9-03.14.

D. WATER

Clean, potable and free from oil or other contaminants.

E. ADMIXTURES

State of Washington, Standard Specifications for Road, Bridge and Municipal Construction, Current Edition, Article 9-23.6.

2.2 CDF MIX DESIGN AND PROPORTIONING

Controlled Density Fill (CDF) shall be a mixture of Portland cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating self-consolidating, free-flowing and excavatable material which will result in a hardened, dense non-settling fill.

Unconfined compressive strength:	100 psi minimum 300 psi maximum
Gallons of water per cubic yard:	35 gallons
Pounds of cement per cubic yard:	50 lbs.
Pounds of fly ash per cubic yard:	250 lbs.
Pounds of aggregate per cubic yard:	3,200 lbs.

Flowability	Slump
Low	6 inches or less
Normal	6 to 8 inches
High	8 inches +

Total water and aggregate quantities may be adjusted for yield if air entraining or water-reducing admixtures are used for flowability. Use 3/8 inch minus aggregates or sand for flowable or excavatable CDF materials.

PART 3 EXECUTION

Verify site and excavations for conditions acceptable to receive CDF. Ensure all inspections and approvals for substrate surfaces and utilities have been made and are complete before CDF placement. Trench sections to be filled with CDF shall be contained at either end of the trench section by use of a bulkhead or earth fill prior to CDF placement.

CDF placement may be started if weather conditions are favorable, and when the temperature is at least 34 degrees F and rising. At the time of placement, the CDF shall have a temperature of at least 40 degrees F. Mixing and placing shall stop when the temperature is 38 degrees F or less, and falling. CDF shall not be placed on frozen ground. Each filling stage shall be as continuous of an operation as is practicable.

Remove displaced groundwater by either dewatering or pumping. Provide for proper disposal of displaced or dewatered groundwater in compliance with local regulations. Provide steel plates to span utility trenches and prevent traffic contact with CDF for at least 24 hours after placement or until CDF has compacted or hardened enough to prevent rutting by construction equipment or traffic.

***** END OF SECTION *****

DIVISION 6

WOOD AND PLASTICS

SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section shows the extent of rough carpentry work on the Plans, including, but not limited to, the following: wood framing, timber posts and beams, rooftop equipment bases and support curbs, wood nailers and blocking, wood furring, fascia, soffits, and sheathing.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals

1.3 REFERENCES

This Section references the latest revisions of the following documents:

Reference	Title
ALSC PS 20	American Lumber Standards Committee (ALSC): American Softwood Lumber Standard
APA PRP-108	American Plywood Association (APA): Performance Standards and Qualification Policy for Structural-Use Panels
APA PS 1	American Plywood Association (APA): Product Standard for Construction and Industrial Plywood
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM D226	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
AWC NDS	American Wood Council (AWC): National Design Specification for Wood Construction
AWC WFCM	American Wood Council (AWC): Wood Frame Construction Manual for one- and two-family dwellings
AWPA U1	American Wood-Preservers' Association (AWPA) Standard
WCLIB 17	West Coast Lumber Inspection Bureau (WCLIB): Standard Grading and Dressing Rules for Douglas Fir, Western Hemlock, Western Red Cedar, White Fir, Sitka Spruce Lumber

1.4 SUBMITTALS

Comply with provisions of Section 01300.

Submit a certificate of compliance from the supplier certifying that the materials provided meet or exceed specified requirements. Certificate shall itemize materials provided on the Project and refer to pertinent specifications.

1.5 DELIVERY, STORAGE AND HANDLING

Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and underneath temporary coverings including polyethylene and similar materials. For lumber and plywood that is pressure treated with waterborne chemicals, provide a sticker between each course to provide air circulation.

PART 2 PRODUCTS

2.1 GENERAL

Lumber shall comply with ALSC PS 20 and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

Each piece of lumber shall be factory marked with Grade Stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill that produced the product.

Nominal sizes are indicated on the Drawings, except as shown by detailed dimensions. Provide actual sizes as required by ALSC PS 20, with moisture content specified for each use.

Provide dressed lumber, S4S, unless otherwise indicated. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

2.2 FRAMING LUMBER

Unless noted otherwise, provide Douglas Fir - Larch No. 2 or better, or Hem-Fir No. 1 or better.

2.3 FASCIA BOARDS AND TRIM

Unless noted otherwise, provide No. 2 Common Boards or better complying with WWPA rules. Where boards are exposed to finish work, provide 19 percent maximum moisture content. Exterior boards and trim shall be cedar, No. 1 or better.

2.4 MISCELLANEOUS LUMBER

Provide wood for support or attachment of other work including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, wood trim, stripping and similar members. Provide lumber of sizes indicated, worked into shapes shown or required. Provide Standard Grade Hem-Fir or better. Provide 19 percent maximum moisture content for lumber items not specified to receive wood preservative treatment.

2.5 PLYWOOD OTHER THAN SHEATHING

A. BACKING PANELS

For Plywood Backing Panels (or Boards) used for mounting electrical, telephone or communications system equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D PLUGGED INT with exterior glue, in thickness indicated on the Drawings. If not otherwise indicated, provide minimum thickness of 15/32 of an inch.

B. MARINE

APA, A-A exterior thickness as indicated on the Plans. HDO (High Density Overlay) faces are acceptable.

2.6 MISCELLANEOUS MATERIALS

A. FASTENERS AND ANCHORAGES

Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable federal specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended fasteners.

Where rough carpentry work is exposed to the weather, in ground contact, or in an area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating per ASTM A153.

B. BUILDING PAPER

ASTM D226, Type I; asphalt saturated felt, non-perforated, 30-lb. type.

C. SILL SEALER GASKETS

Glass fiber resilient insulation fabricated in strip form for use as a sill sealer; 1-inch nominal thickness compressible to 1/32 of an inch; selected from manufacturer's standard width to suit width of sill members.

2.7 WOOD TREATMENT BY PRESSURE PROCESS

Where lumber or plywood is indicated as "P.T." or "Treated," or is specified herein to be treated, comply with applicable requirements of American Wood Preserver's Association (AWPA) Standard U1.

Pressure-treat above-ground items with waterborne preservatives to comply with AWPA Standard U1. After treatment, kiln dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Pressure treat items indicated on the Plans and all of the following: wood cants, nailer, curbs, top plates, equipment support bases, equipment curbs, plywood, blocking, stripping, and similar members utilized in connection with roofing, flashing, vapor barriers and waterproofing. All wood items including plywood used for or around roof penetrations shall be pressure treated.

PART 3 EXECUTION

3.1 GENERAL

Discard units of material with defects that could impair the quality of the work or with units too small to use in fabricating work with minimum joints or optimum joint arrangement. Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, and similar supports to allow attachment of other work.

Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.

Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight

connections between members. Install fasteners without splitting of wood; predrill as required.

3.2 WOOD NAILERS AND BLOCKING

Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD FRAMING, GENERAL

Provide framing members of sizes and on spacings shown, and frame openings as shown, or if not shown, comply with recommendations of the AWC WFCM. Do not splice structural members between supports. Anchor and nail as shown, and to comply with the AWC NDS.

Firestop concealed spaces of wood framed walls and partitions at each floor level and at the ceiling line of the top story. Where firestops are not automatically provided by the framing system used, use closely fitted wood blocks of nominal 2—inch-thick lumber of the same width as framing members.

3.4 STUD FRAMING

Provide stud framing of size and spacing indicated or, if not otherwise indicated, of the following sizes and spacings. Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using 2-inch-thick members with widths equaling that of studs. Nail or anchor plates to supporting construction.

Unless noted otherwise, provide the following minimum framing:

1. For exterior walls provide 2" x 6" wood studs spaced 24-inches on center.

2. For interior partitions and walls provide 2" x 4" wood studs spaced 16-inches on center.

Construct corners and intersections with not less than three studs. Provide miscellaneous blocking and framing as shown and as required for support of facing materials, fixtures, specialty items and trim.

Provide continuous horizontal blocking row at mid-height of walls and partitions 8 feet high and greater, using 2-inch-thick members of same width of wall or partitions.

Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.

For non-bearing partitions, provide double-jamb studs and headers not less than 4-inches deep for openings 3 feet or smaller in width, and not less than 6-inches deep for wider openings.

For load-bearing partitions, provide double-jamb studs for openings 6 feet or smaller in width, and triple-jamb studs for wider openings. Provide headers of depth shown.

Provide diagonal bracing in stud framing of exterior walls, except as otherwise indicated. Brace both walls at each external corner, full story height, at a 45-degree angle, using either a let-in 1" x 4" or 2" x 4" blocking or metal diagonal bracing. Omit bracing where plywood sheathing, siding and/or gypsum wallboard are indicated to be provided.

3.5 TIMBER FRAMING

Provide wood beams and girders of the size and spacing shown. Install with crown edge up and provide not less than 4-inch bearing on supports. Provide continuous members unless shown; tie together over supports if not continuous.

Where beams or girders are framed into pockets of exterior concrete or masonry walls, provide 1/2-inch air space between sides and ends of wood members and supporting wall. Five-quarter cut members built into masonry construction.

Where built-up beams or girders of nominal 2-inch dimension lumber on edge are shown, fasten together with two rows of 16d nails spaced not less than 16-inches on center. Locate one row near top edge and other near bottom edge. Locate end joints in members over supports; for continuous members, stagger ends at quarter points between supports.

Provide wood posts of the sizes shown. Provide metal anchoring and attachment devices as shown.

3.6 INSTALLATION OF SHEATHING

A. GENERAL

Comply with applicable recommendations contained in the APA "Engineered Wood Construction Guide," for types of construction panels and applications indicated.

B. FASTENING METHODS

Fasten panels as indicated on the Plans. Include metal H clips between sheathing panels.

C. PLYWOOD BACKING PANELS

Nail to supports with minimum 10d at 6-inches on center edge nailing and 12-inches on center at intermediate framing.

***** END OF SECTION *****

DIVISION 7

THERMAL AND MOISTURE PROTECTION

SECTION 07210

BATT AND RIGID INSULATION

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes all labor and material to install batt and rigid insulation as indicated on the Plans, and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

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Section	Item
01300	Submittals

1.3 REFERENCES

This Section references the latest revisions of the following document:

Reference	Title
FS HH-I-521	Insulation Blankets, Thermal, (Mineral Fiber for Ambient Temperatures)

1.4 PERFORMANCE REQUIREMENTS

Materials of this Section shall provide continuity of thermal and vapor and air barriers at building enclosure elements.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

Owens Corning or approved equal product.

2.2 MATERIALS

A. BATT INSULATION

ASTM C665; preformed glass fiber batt or roll; kraft-faced and face stapled, to the thickness needed to meet the R-values shown on the Plans and as required by code.

B. RIGID INSULATION

Provide rigid insulation with thickness and R-values shown on the Plans. Rigid insulation to be closed cell, expanded polystyrene beads molded into boards; Owens Corning or equal.

C. STAPLES

Steel wire; galvanized; type and size to suit application.

D. TAPE

Polyester self-adhering type, mesh reinforced, 2 inches wide.

E. INSULATION FASTENERS

Steel impale spindle and clip on flat metal base, self adhering backing, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place; approved by manufacturer of insulation.

F. BUILDING WRAP

A woven plastic fabric engineered as an air infiltration and moisture protection barrier for use in sidewalk construction. Owens Corning, or equal.

G. INSULATION BAFFLE

Insulation baffle shall be Owens-Corning "Raft-R-Mate," or equal.

PART 3 EXECUTION

3.1 EXAMINATION

Verify site conditions before beginning installation. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

The Contractor shall install insulation in accordance with insulation manufacturer's instructions. Install in exterior walls and ceiling spaces without gaps or voids. Trim insulation neatly to fit spaces. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane insulation. Leave no gaps or voids.

Install with factory applied membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members. Retain materials in place with spindle fasteners. Tape seal butt ends, lapped flanges, and tears or cuts in membranes.

Metal Framing: Place vapor and air barrier joints over member face. Extend vapor and air barrier tight to full perimeter of adjacent window and doorframes and other items interrupting the plane of membrane. Tape seal in place. Provide airspace for ventilation as recommended by manufacturer.

***** END OF SECTION *****

SECTION 07900

CAULKING AND SEALANTS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section applies to the furnishing of all labor, materials, tools, and equipment required to install caulking and sealants as called for on the Plans and as specified herein.

All exterior wall joints and interior and exterior joints between all differing or dissimilar materials and at windows, doors, roof penetrations, louvers and similar types of openings shall receive sealants to make the joint air and watertight. This includes concrete to CMU, concrete to wood, CMU to wood, concrete to sheet metal, CMU to sheet metal, etc.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals

PART 2 PRODUCTS

2.1 POLYURETHANE SEALANT

Provide two-component urethane elastomeric compound with 100 percent solids content and the following performance characteristics: 150 psi tensile strength, when tested in accordance with ASTM D412; not more than 45 Shore "A" Hardness; 400 percent ultimate elongation; no apparent change and no increase in hardness, when exposed for a minimum of 3,000 hours in twin arc weatherometer with ultraviolet and water cycles. Provide at expansion, construction, and control joints in exterior and interior concrete slabs or other horizontal or vertical surfaces where indicated on the Plans, and as specified. Provide Sika Flex 1A, or equal.

2.2 TAPE SEALANT

Conform to the performance requirements of the American Architectural Manufacturer's Association Specifications AAMA 804 and AMMA 807, in accordance with ASTM D898.

2.3 ACRYLIC LATEX CAULK

Provide for non-working interior joints at surfaces to be painted (interior use only). Provide DAP Acrylic Latex Caulk, or approved equal. Material shall be a smooth extruding single-component latex based caulk suitable to receive paint.

2.4 SILICONE SEALANT

Provide silicone single-component non-sag sealant. Silicone shall only be used for interior applications. Provide Dow Corning 790 Building Sealant, or equal.

2.5 PRIMERS

Provide primer materials made by or recommended by the various Sealant or Caulking Manufacturers, for the conditions of the application, including the materials to be sealed at the joints, and the type of sealant or caulking material to be used.

2.6 JOINT BACKING MATERIALS

A. FILLER FOR EXPANSION JOINTS IN EXTERIOR SLABS

Provide preformed non-absorbent resilient material conforming to ASTM D1752, Type I; 1/2-inch width X depth required to bring the top surface to within 1/2 inch of the slab surface, or as indicated on the Plans.

B. FILLER FOR EXTERIOR JOINTS

Provide Sandell Manufacturing Company, “Polytite-B,” or equal. Provide backing material as required for sealants at exterior joints.

C. ROPE YARN

Provide raveled strands of non-staining fiber or cotton wicking, in continuous lengths and in sizes as required to fill joints completely.

2.7 WALL JOINTS (HORIZONTAL AND VERTICAL)

Backer rod or backing material shall be closed cell PVC foam or expanded urethane; “Sonofoam” by Sonneborn; “Expandofoam” by Williams, or equal.

Sealant primers, where required, shall be obtained from the same manufacturer. (See requirements for primer compatibility with concrete curing compound in Part 3 below.)

Provide polyurethane sealant at all wall and slab joints.

PART 3 EXECUTION

3.1 GENERAL

Contractor shall confirm that these sealant and primer materials are compatible with the concrete curing compound used, or Contractor shall lightly sandblast and thoroughly clean concrete prior to application of caulking and sealant materials. Exterior priming or sealant work shall not be done when it is raining or snowing, or when moisture therefrom, or dew, is present on surfaces. All exterior dissimilar materials shall be sealed with elastomeric sealants at the joints between the different materials.

3.2 APPLICATION OF SEALANTS

A. PREPARATION OF JOINTS

Inspect surfaces of joints prior to application. Joint sealants shall be installed before other surface finishes are applied. All joints must be solvent cleaned, free of dust, oils and grease before receiving backing materials and sealant. Floor joints must be wire brushed, free of laitance or other residues. Joints shall be completely dry before sealant work is done. Aluminum or other metal surfaces to be in contact with sealants shall be wiped clean with xylol or an MEK solvent to remove any coatings or contamination.

With two component sealants, mask both sides of joints with masking tape to prevent soiling floor, slab, or wall beyond limits of the joint.

B. BACKINGS

Install filler and backer materials in as long of lengths as practicable. Stretch and force into joints with tool designed for that purpose, to a uniform depth, as indicated on the Plans, allowing for installation of sealant and caulking. Provide filler material in slab shapes for joints 1/2 inch or more in depth, and in 3/4 inch or more wide joints to receive sealing material. Provide extruded rod backer material in all other joints to receive sealant. Provide rope yarn in joints to receive caulking compound. Install foil or other suitable bond breaker between backing materials and sealant.

C. MIXING

Where sealing materials require mixing, carefully mix components in strict accordance with the manufacturer's recommendations.

D. PRIMING

Apply primer to all surfaces of joints in contact with sealant materials. Apply full strength and undiluted in a uniform coating of surface. Allow to set or cure prior to proceeding. Do not prime surfaces at back of joint.

E. APPLICATION

Sealant shall be gun applied, giving the joint a full bead of sealant. Skin beads are not acceptable. Tool the bead immediately after application to ensure a firm and full contact with the inner faces of the joint. Do not apply sealants to wet or damp surfaces nor in temperatures below 50 degrees F. Strike off excess sealant with tooling stick or a knife so that finished bead is slightly below surface. Remove excess sealant as work progresses. Sealants in masonry wall joints are to be a maximum of 1/2-inch deep and not less than 1/4 inch in each dimension. Any joints over 1/2-inch wide shall be reported to the Owner and instructions for correcting the applications will be given.

3.3 FINISHING OF JOINTS

Before applying any sealing materials, verify that all contact surfaces have been uniformly coated with primer. Replace any maskings that have been torn or damaged. Apply in continuous beads over backing, using only tools and equipment designed for application of the materials. Fill all joints solid, with no voids. Superficial pointing with skim bead shall not be acceptable. Joints in sills and other wash surfaces shall be filled slightly convex to obtain a flush joint when dry. Entire perimeter of openings in concrete surfaces shall be sealed. Finish by tooling, as necessary for watertight, clean, neat, uniform joints. When applying sealant, do not permit thickness of sealant to exceed 1/2 of the width of the joint.

3.4 CLEANUP

Upon completion, the Contractor shall remove and dispose of masking materials. Remove any excess materials and clean adjacent surfaces free from any soil or stain resulting from sealing and caulking operations.

***** END OF SECTION *****

DIVISION 8

DOORS AND WINDOWS

SECTION 08110

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section covers furnishing and installing hollow metal doors, frames, and glazing as indicated on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
08700	Finish Hardware

1.3 REFERENCES

This Section references the latest revisions of the following documents:

Reference	Title
NFPA 80	Fire Doors and Windows
SDI-100	Standard Steel Doors and Frames
SDI-105	Recommended Erection Instructions for Steel Frames
UL 10B	Fire Tests of Door Assemblies

1.4 QUALITY ASSURANCE

Hollow metal doors and frames shall conform to applicable requirements of SDI-100.

Fire rated door and frame construction shall conform with ASTM E152, NFPA 252, and UL 10B.

Installed frame and door assembly shall conform to NFPA 80 for fire rated class indicated in the Door Schedule on the Plans.

1.5 SUBMITTALS

Submit shop drawings and product data under provisions of Section 01300.

Indicate frame configuration, anchor types and spacing, location of cutouts for hardware, reinforcement, and finish.

Indicate door elevations and internal reinforcement.

1.6 REGULATORY REQUIREMENTS

Conform to applicable Building Code for fire rated frame and door requirements.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

The hollow metal doors and frames shall be as manufactured by Curries, Ceco, Amweld, Republic, Steelcraft, or any other SDI member.

2.2 DOORS AND FRAMES

Location	Material
Exterior Doors	SDI-100 Grade II
Exterior Frames	16-gauge-thick material, to suit grade and model of door.

Provide door and frame types and sizes as shown on the Plans.

2.3 DOOR CONSTRUCTION

Exterior doors shall be polyurethane. Minimum STC rating of 26.

2.4 ACCESSORIES

Rubber silencers shall be resilient rubber.

Glazing stops shall be rolled steel channel shape with mitered corners; prepared for countersink style tamperproof screw.

2.5 PROTECTIVE COATINGS

Coating	Material
Door Frame	See painting section, dissimilar metals system.
Primer	See painting section, metal doors, frames, and trim system.

2.6 FABRICATION

Provide fully welded frames for all new construction. Provide fabricated frames of knock down field assembly type for retrofit applications or for existing door openings.

Mullions for double doors shall be removable type. Provide metal T shaped astragals for double doors.

Fabricate frames and doors with hardware reinforcement plates welded in place. Provide mortar guard boxes.

Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

Prepare frame for silencers. Provide three single rubber silencers for single doors and mullions of double doors on strike side, and two single silencers on frame head at double doors without mullions.

Attach fire rated label to each frame and door unit, if required.

Close top edge of exterior doors flush with inverted steel channel closure. Seal weld all door joints watertight. Caulking of door seams is not acceptable.

2.7 FINISH

Both interior and exterior doors and frames shall be made from galvanealed zinc coating per ASTM A653 or A60 material, with a minimum application rate of 0.60 oz/ft^2. Finish painting shall be in accordance with Section 09900 of these Specifications.

The inside of the metal frame profile shall be coated per Section 09900 of these Specifications. Provide dissimilar metals system. Coating may be shop or field applied.

2.8 GLAZING

Doors with glass relites shall be furnished with formed steel glazing strip frame with attachment screws allowed only on the non-secure side. Glazing for insulated doors shall consist of insulated glass units preassembled with two glass panels separated by a dehydrated interspace with a nominal 1/2-inch overall thickness. Insulated glass panels shall be manufactured in accordance with ASTM E773 and ASTM E774. Glazing for non-insulated doors shall be nominally 1/4-inch thick. All glazing shall be fully-tempered in accordance with ASTM C1048 and shall meet the requirements of ANSI 297.1.

PART 3 EXECUTION

3.1 INSTALLATION

Frames shall be installed in accordance with SDI-105. Doors shall be installed in accordance with SDI-105, and DHI A115-1G.

Coordinate with masonry and metal stud wall construction for proper anchor placement and with installation of glazing. All door frames installed in masonry construction shall be completely filled with the masonry mortar utilized to install the masonry units or be fully grouted with non-shrink grout after installation of the frame. All door frames installed in cast-in-place concrete structures shall be fully grouted with non-shrink grout.

Install roll formed steel reinforcement channels between two abutting frames. Anchor frames to structure and floor.

Contractor shall protect doors and frames as necessary during construction of the Project.

3.2 TOLERANCES

Maximum diagonal distortion shall be 1/8 of an inch, measured with straight edge, from corner to corner.

3.3 ADJUSTING DOORS

Adjust hardware for smooth and balanced door movement.

***** END OF SECTION *****

SECTION 08310

METAL ACCESS HATCHES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of the Contractor furnishing and installing aluminum access hatches and accessories as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
02530	Utility Structures

1.3 QUALITY ASSURANCE

Access hatches shall be guaranteed against defects in material and/or workmanship for a period of 5 years by the manufacturer.

1.4 EQUIPMENT LIST

The metal access hatches to be installed are as follows:

Location	Clear Opening	Type
Flow Meter Vault Weigardt Well No. 1	36" x 36"	Type 2
Flow Meter Vault Weigardt Well No. 2	36" x 36"	Type 2
Flow Meter Vault Weigardt Well No. 3	36" x 36"	Type 2

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

Metal access hatches shall be as manufactured by Halliday Products, Inc., Bilco, L. W. Hatch, or equal.

2.2 ACCESS HATCH TYPE 2

Type 2 access hatches shall be Halliday H1W series, or equal. The hatches shall have a 1/4-inch-thick one-piece mill finish, extruded aluminum channel frame, incorporating a continuous concrete anchor. A 1-1/2-inch drainage coupling shall be located in the front left corner of the channel frame, unless shown otherwise on

the Plans. A bituminous coating shall be applied to the frame exterior where it comes in contact with concrete. The door panel shall be 1/4-inch aluminum diamond plate reinforced to withstand a live load of the H-20 designation. The door shall open to 90 degrees and automatically lock with a stainless steel hold-open arm shall incorporate an enclosed stainless steel compression spring assist. The door shall close flush with the frame and rest on a built-in neoprene cushion/gasket. Hinges and all fastening hardware shall be stainless steel. The unit shall lock with a stainless steel slam lock with removable key and have a non-corrosive handle. The unit shall be guaranteed against defects in material and/or workmanship for a period of 5 years.

PART 3 EXECUTION

Units shall be installed as specified herein and as shown on the Plans. The units shall be connected with drain piping as shown on the Plans, and shall be installed according to the manufacturer's recommendations for safe and proper storage.

***** END OF SECTION *****

SECTION 08700

FINISH HARDWARE

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section specifies that the Contractor shall provide complete finish hardware and suitable fastenings for the project. Quantities listed in any instance are for supplier convenience only and are not guaranteed.

Finish hardware includes items known commercially as "builders' hardware" required, for swinging doors. Hardware specified in the same section as the door and/or doorframe will be furnished by the supplier of that Section.

All hardware furnished in this Section shall comply with the requirements of all applicable codes. All items specified in this Section shall be furnished by a factory-authorized distributor maintaining parts, stocks, and services for standard specified items.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
08110	Hollow Metal Doors and Frames

1.3 REFERENCES

This Section references the latest revisions of the following documents:

Reference	Title
ANSI/NFPA 80	Fire Doors and Windows
ANSI/NFPA 101	Code for Safety to Life from Fire in Buildings and Structures
UL	Building Materials List

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURER'S

Finish hardware shall be as manufactured by the suppliers listed in the following sections.

2.2 FINISHES

Finishes for hardware items specified shall be as follows:

Hardware	Finish
Butts	US26D/US32D
Locksets	US32D (630)
Closers	689
O.H. Stops	US26D
Thresholds	As listed
Misc.	US26D/US32D

2.3 BUTTS

Butts shall be 4-1/2" x 4-1/2" for 3'-0" and under and 5" x 4-1/2" for over 3'-0", except as required for 180-degree swing and shall be of the type listed. Doors up to and including 90 inches in height shall have 1-1/2 pair and doors over 90 inches in height shall have two pair. For unusual size or weight doors, furnish type, size, and quantity recommended by the butt manufacturer. All exterior-outswinging doors shall have non-removable pins. Butts shall be as manufactured by Stanley, or equal.

2.4 LOCKSETS

Locksets shall be of an LWA design with 2-3/4-inch backsets and shall be as manufactured by Corbin Russwin, or equal. All locksets and latchsets shall be the product of one manufacturer. All locksets and latchsets shall be heavy-duty mortise type UL approved for use on fire doors and 3/4-inch antifriction latch bolt. Functions as indicated in the hardware groups. Provide curved lip strikes. Deadbolt functions shall be 1-inch projection.

Locksets and latchsets shall be furnished with sufficient strike lip to protect trim. (note: 3/4-inch latch bolts require 3/4-inch minimum clearance for trim, otherwise extended lip strikes must be furnished).

All locks shall have wrought box strikes.

2.5 MANUAL FLUSH BOLTS

Manual flush bolts shall be as manufactured by Ives, or equal. Refer to hardware groups for sizes and types.

2.6 DOOR CLOSERS, SURFACE

Door closers shall be as manufactured by Norton, Corbin Russwin, or equal. Drop plates shall be furnished where required. Hex nuts and bolts shall be furnished for all doors.

Closers shall be provided as specified in hardware groups and shall have a 10-year guarantee.

2.7 STOPS

All doors are to have a wall stop WC9X series or floor stop F8061X series unless otherwise specified. Where wall stops are specified but cannot be used, substitute a floor stop. If wall stop or floor stop cannot be used, advise the Owner of the specific door during submittal process. Provide proper height floor stops to suit conditions. Contractor to provide solid backing for all wall mounted stops. Stops shall be as manufactured by Trimco, or equal.

2.8 GASKET, THRESHOLD AND RAIN DRIPS

Gaskets and thresholds shall be as specified in the hardware groups and shall be as manufactured by Pemko, or equal.

Provide rain drips at header of all exterior doors. Rain drips shall be extruded aluminum not less than 0.07 in thick, clear anodized or painted to match door frame color. Rain drips shall be approximately 1-1/2 high by 2-1/2 inches projection and shall extend 2 inches on either side of the door opening width.

2.9 DOOR SILENCERS

Door silencers shall be Glynn Johnson Type 64 or 65, or equal. The Contractor shall furnish three door silencers for each single doorframe, and four door silencers for each pair of doorframes.

2.10 KEYING

All cylinder items shall be furnished with visual key control with key code stamped on the face of the keys and marked on the back or side of the cylinders. All standard cylinder items shall be furnished with construction-keyed cylinders.

The Contractor shall coordinate the keying for door locks with the Owner.

2.11 KEY QUANTITIES

Keys shall be furnished in the following quantities:

Type	Quantity
MKs	6 each
Construction Keys	6 each
Change keys per keyed cylinder	2 each
Control keys	2 each

2.12 HARDWARE GROUPS

A. MANUFACTURER'S LIST

Manufacturer	Abbreviation
Stanley	ST
Corbin Russwin	CO
Norton	NO
Pemko	PE
Glynn Johnson	GJ
Richards Wilcox	RW
Ives	IV
Rixson	RX
Trimco	TR

B. Refer to door schedule and related information concerning the following hardware groups:

HW2 (exterior double door)

	Butts CB1961	ST
1 ea.	Lockset ML2051 M26 LC	CO
1 ea.	Cylinder 1000-118-A01-6-XX 626	CO
1 ea.	Flush bolts 458B (bottom inactive)	IV
1 ea.	Dustproof strike 489B	IV
2 ea.	Wall Stop WC9X	TR
1 ea.	Threshold 171 MS & ES	PE
2 ea.	Door Bottom 315N	PE
1 set	Gasket 305R	PE
	Astragal by door manufacturer.	

PART 3 EXECUTION

3.1 INSTALLATION

Refer to A.S.A.H.C., B.H.M.A., and S.D.I. for mounting heights.

Unless a conflict arises, the following are standard mounting heights on some products. If a question or conflict should arise, the hardware supplier, if requested, shall assist the Contractor and Owner in determining mounting heights. All measurements are from finish floor except top butt.

A. BUTTS

Top 11-3/4-inch center of butt to top of door. Intermediate equal distance between top and bottom butts. Bottom 13-inch center of butt.

B. KNOB LOCKS

40-5/16 inch to center of strike DEADLOCKS: 60 inch to center of strike.

C. EXIT DEVICES

40-5/16 inch to center of strike PUSH PLATES: 45 inch to center.

D. PULL PLATES

42 inch to center DOOR CLOSERS: as per manufacturer's instructions.

E. RAIN DRIPS

Align rain drips with bottom edge of doorframe rabbet. Drips shall be set in sealant and fastened with stainless steel screws.

3.2 ADJUSTING

Hardware shall be adjusted for correct operation.

After installation of hardware and before the building is accepted, Contractor shall inspect the installation and certify that the hardware is correctly installed in accordance with the manufacturer's recommendations. Hardware installer shall make any necessary adjustments.

***** END OF SECTION *****

DIVISION 9

FINISHES

SECTION 09250

GYPSUM WALLBOARD

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of all labor, materials, and equipment for all gypsum wallboard, zinc-coated trim, taping, spackling, and texturing necessary to complete all the work indicated on the Plans and as specified. The work shall include installation of gypsum board, exterior and interior grounds, corner beads, taping, spackling, sanding, and texturing of all joints and nail or screw heads to obtain finished walls ready for painting.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
06100	Rough Carpentry

1.3 REFERENCES

This Section references the latest revisions of the following documents:

Reference	Title
ASTM C36	Specification for Gypsum Wallboard
ASTM C79	Test Method for Gypsum Wallboard
ASTM C514	Specification for Nails for the Application of Gypsum Wallboard
ASTM C630	Specification for Water-Resistant Gypsum Backing Board
ASTM C840	Specification for Application and Finishing of Gypsum Wallboard
ASTM C1002	Specification for Steel Drill Screws for the Application of Gypsum Wallboard
ASTM C1047	Specification for Accessories for Gypsum Wallboard

1.4 QUALITY ASSURANCE

All gypsum wallboard products and joint treatment products shall be obtained from a single manufacturer.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

Gypsum wallboard products and joint treatment products shall be as manufactured by Gold Bond Building Products Div., National Gypsum Co., United States Gypsum Co., or approved equal.

2.2 GYPSUM WALLBOARD

Gypsum wallboard shall conform to ASTM C36. Moisture-Resistant Gypsum Wallboard shall conform to ASTM C1396, Type X. Provide in locations as shown on the Plans.

Exterior Soffit Board: A gypsum core soffit panel with additives to enhance the sag and moisture resistance of the core; surfaced with water repellent paper on front, back, and along edges. Materials shall comply with ASTM C931. Provide minimum thickness of 5/8 of an inch. Provide in locations as shown on the Plans.

2.3 TRIM ACCESSORIES

Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for nailing and beaded for concealment of flanges in joint compound. Provide corner beads, L-type edge trim-beads, U-type edge trim-beads, and one-piece control joint beads. Unless specifically noted as "exposed," all trim accessories shall be beaded type to be concealed with joint compound.

2.4 JOINT TREATMENT MATERIALS

Provide materials complying with ASTM C475, ASTM C840 and recommendations from the Manufacturer for the applications indicated. Provide 2-1/2-inches wide, perforated tape for joints. Provide two separate grades of ready-mixed, vinyl-type joint compound. One type shall be for bedding tapes and filling depressions. The second type shall be for taping and sanding.

2.5 FASTENERS

Screws shall conform to ASTM C1002 with heads, threads, points, and finish as recommended by the manufacturer. Nails shall conform to ASTM C514 with heads, threads, configurations, and finish as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

All workmanship and materials shall be of the best quality and any defective work shall be removed and replaced by the Contractor at no additional expense to the Owner. Keep the premises free of accumulations of debris and dust connected with this work and protect adjacent finished surfaces from damage by this work. The Contractor shall establish and maintain application and finishing environment in accordance with ASTM C840. For non-adhesive attachment of gypsum wallboard to framing, maintain not less than 40 degrees F.

3.2 INSTALLATION

All drywall sheets shall be set with staggered joints and screws and/or nails set deep enough to receive a cover of spackle, spaced in accordance with Wallboard Manufacturer's standard specifications. Install approved zinc-coated corner molds at openings and terminations of wallboards. Cut all wallboard close to and around wall penetrations and electrical outlets. Provide a complete, covered installation in all areas where gypsum wallboard is to be installed.

3.3 FINISHING

After the wallboard has been installed, it shall be finished. Apply joint compound or bedding compound and embed tape leaving uniform thickness of materials underneath tape. Cover nail or screw heads smooth with finished surface of board after each application of joint material. After initial application has been complete, it shall be allowed to dry and then sanded smooth. Additional coats of joint compound shall be applied and finish sanded until a finish comparable to the paper surface of the gypsum board has been achieved. All wallboard not covered by other finishes shall be lightly textured (orange peel or similar) and left in condition to receive paint. Obtain Owner's approval prior to applying paint.

3.4 ESCUTCHEONS

Provide escutcheons around all pipe, conduit, and similar types of penetrations through gypsum wallboard walls and ceiling.

***** END OF SECTION *****

SECTION 09900

PAINTING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section covers the furnishing and installation of protective coatings, complete-in-place. Special shop coatings and/or factory-applied finishes on manufactured or fabricated items may be specified elsewhere. Regardless of the number of paint coats previously applied, at least two field coats of paint shall be applied to all surfaces unless otherwise specified herein. Field painting is not required for factory prefinished equipment items such as pumps, blowers, motors, etc. Touchup of the factory applied coatings may be required.

The word "paint" as used herein shall be taken to include all protective coatings and incidental materials as required with the exception that anodized aluminum or zinc galvanized coatings shall not be considered as paint.

Unless specifically noted otherwise in these Specifications or on the Plans, all work performed under this Contract (both new work and modifications to existing facilities) shall be painted. If an existing wall or ceiling (or similar surface) is modified in someway, the entire wall or ceiling surface is to be painted.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
03300	Concrete
07900	Caulking and Sealant
08100	Hollow Metal Doors and Frames
Division 11	Equipment
Division 13	Special Construction
Division 15	Mechanical
Division 16	Electrical

1.3 REFERENCED STANDARDS

The following standards are referenced and shall be considered a part of these Specifications:

American National Standards Institute (ANSI):
A159.1, Surface Preparation Specifications;
Z53.1, Safety Color Code for Marking Physical Hazards

American Society for Testing and Materials (ASTM):
D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
E84, Standard Test Method for Surface Burning Characteristics of Building Materials

National Fire Protection Association (NFPA):
101, Life Safety Code

Steel Structures Painting Council (SSPC):
SP-1, Solvent Cleaning
SP-2, Hand Tool Cleaning
SP-3, Power Tool Cleaning
SP-5, White Metal Blast Clearing
SP-6, Commercial Blast Cleaning
SP-7, Brush-off Blast Cleaning
SP-10, Near-White Blast Cleaning
SP-11, Power Tool Cleaning
SP-13 Surface Preparation for Concrete Surfaces
VIS-89, Visual Standard

1.4 DEFINITIONS

A. PAINT

Includes fillers, primers, sealers, emulsions, oils, alkyds, latex, enamels, thinners, stains, epoxies, vinyls, urethanes, shellacs, varnishes and any other applied coating specified within these Specifications or shown on the Plans.

B. FINISHED ROOM OR SPACE

One that has a finish called for on Room Finish Schedule, or is indicated on the Plans, or is specified herein, to be painted.

C. PAINTING COVERAGE RATE

Coverage's expressed in SF/GAL/coat are the manufacturer's published theoretical coverage's in square feet per gallon per coat.

1.5 SUBMITTALS

In addition to the general submittal requirements listed in Section 01300, the following shall be submitted:

1. Written acknowledgment and certification that products submitted meet requirements of standards referenced in this Section.

2. Manufacturer's application instructions for primer and finish coats.

3. Manufacturer's surface preparation instructions.

4. Manufacturer's full line of color samples for color selection by Owner.

5. If products being used are manufactured by a company other than the specified reference standard, the Contractor must provide a complete comparison of the proposed products with the specified rerefence products per Part 2.1 requirments, including application procedure, coverage rates, and verification that product is designed for intended use. Information must be provided that demonstrates that manufacturer's products are equal to the performance standards of products manufactured by the Tnemec Company, which is the reference standard.

6. Manufacturer's approval of protective coating systems applicator.

7. List of Applicator's experience and qualifications. A minimum of 5-years of experience in the painting of wastewater treatment plant facilities required.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

The following is an approved coating systems manufacturers list subject to compliance with the Specifications contained herein:

1. Ameron Protective Coatings Division.

2. Sherwin Williams.

3. Tnemec Company.

4. Or equal.

The specified coating shall be understood as establishing the type and quality of coating desired. Other manufacturers' products will be accepted provided sufficient information is submitted to allow the Engineer to determine that the coatings proposed are equivalent to those named. Proposed coatings shall be submitted for review in accordance with these Specifications. Requests for review of equivalency will not be accepted from anyone except the Contractor, and such requests shall not be considered until after the Contract has been awarded.

No substitutions shall be allowed that change the number of coats, thickness or generic type of paint required. All materials shall be brought to the jobsite in the original sealed and labeled containers of the paint manufacturer and shall be subject to inspection by the Engineer.

No coating materials other than those specified shall be brought to the jobsite. Thinners, driers and oils brought to the jobsite shall be only those recommended and approved by the paint manufacturer.

All paint shall conform to the applicable air quality regulations at the point of application. Any paint material which cannot be guaranteed by the manufacturer to comply, whether specified by product designation or not, shall not be used.

It shall be the responsibility of the Contractor to ensure the compatibility of the field painting products which will be in contact with each other or which will be applied over shop painted or previously painted surfaces. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to the underlying paint.

All paint used for intermediate and finish coats shall be guaranteed by the paint manufacturer to be fumeproof and suitable for water treatment plant atmospheres. Any paint that cannot be so guaranteed shall not be used. Paint shall be lead-free and mercury-free if available.

All paint products in contact with potable water shall be NSF61 approved.

Tnemec Company products are the reference standard and Tnemec designations for product type are used herein. Requirements for an approved equal product are listed below:

1. For approval of an equal manufacturer. The Contractor shall provide to the Owner in writing a detailed side-by-side comparison of the proposed equal Products Characteristics, Performance Characteristics, and Application Conditions for each Tnemec coating specified in this specification. For consideration for approval this written comparison shall be certified and notarized by an officer of the proposed manufacturer as true and correct.

2. For Products Characteristics this detailed side-by-side comparison shall include for example, but not limited to, Volume Solids, Weight Solids, VOC, Mix Ratio, Zinc Content in Dry Film (by Weight), Spreading Rate per coat, Drying Schedule, Shelf Life and Flash Point.

3. For Performance Characteristics this detailed side-by-side comparison shall include for example, but not limited to, Abrasion Resistance, Corrosion Weathering, Direct Impact Resistance, Dry Heat Resistance, Flexibility, Moisture Condensation Resistance, Pencil Hardness, Salt Fog Resistance, Slip Coefficient and Wet Heat Resistance

4. In addition to the detailed side-by-side comparison for approval of an equal manufacturer, The Contractor shall provide to the Owner in writing five similar installations that have had the proposed or equal coating system and date coating system was put into service. In addition the installations names, locations, and owner's name with contact person and telephone number shall be provided.

5. For consideration for approval as an equal coating system the detailed side-by-side comparison shall be submit, with successful bidder's Shop Drawing at the time of the Preconstruction Conference, along with any proposed monetary adjustments to the contract price. As with all shop drawings, final approval rests with the Owner.

6. As a minimum standard any equal coating system shall have a 5-year service history on its coating system.

2.2 PAINT SYSTEMS

A. SUBMERGED METAL

1. Scope

This Section shall apply to all metal, other than bituminous coated pipe and materials, which are to be continuously or intermittently submerged water unless specified otherwise.

2. Surface Preparation

Near-white blast cleaning, SSPC-SP-10.

3. Coatings

Shop Primer System:

Coat One

Product:	Tnemec Series 91 High Zinc Urethane
MDFT:	2.5 to 3.5 mils

Field Finish System:

Coat One

Product:	Potable Water Epoxy Tnemec Series 140
MDFT:	4 to 6 mils

Coat Two

Product:	Potable Water Epoxy Tnemec Series 140
MDFT:	4 to 6 mils

Total MDFT: 8.0 mils (Finish System Only)

B. NON-SUBMERGED METAL - MILD CONDITIONS

1. Scope

This Section shall apply to all metal which is not submerged but is located indoors which is not subject to splashing from sewage, water, sludge, oil and grease or other corrosive materials unless specified otherwise.

2. Surface Preparation

Commercial blast cleaning, SSPC-SP-6.

3. Coatings

Shop Primer System:

Coat One
Product: Omnithane Series 1
MDFT: 2.5 to 3.5 mils

Field Finish System:

Coat One
Product: Hi-Build Epoxoline Tnemec Series N69
MDFT: 4 to 6 mils

Coat Two
Product: Hi-Build Epoxoline Tnemec Series N69
MDFT: 4 to 6 mils

Total MDFT: 11.0 mils

C. NON-SUBMERGED METAL - SEVERE CONDITIONS

1. Scope

This Section shall apply to all metal which is not submerged but is located outdoors or is subject to splashing from sewage, water, sludge, oil and grease or other corrosive materials unless specified otherwise.

2. Surface Preparation

Near-white blast cleaning, SSPC-SP-10.

3. Coatings

Shop Primer System:

Coat One
Product: Omnithane Series 1
MDFT: 2.5 to 3.5 mils

Field Finish System:

Coat One
Product: Hi-Build Epoxoline Tnemec Series N69
MDFT: 4 to 6 mils

Coat Two
Product: Endura-Shield III Tnemec Series 73
MDFT: 3 to 5 mils

Total MDFT: 10.0 mils

D. COATING OF FACTORY NON-APPROVED FINISHES

1. Scope

This Section shall apply to all interior and exterior steel windows and frames and other similar type of items which have a factory finish which is not an approved corrosion resistant finish.

2. Surface Preparation

Factory coating is to remain. Provide clean surfaces, lightly sand 100 percent of the surfaces, then provide solvent cleaning, SSPC-SP-1.

3. Coatings

Primer System:
Coat One
Product: Typoxy Tnemec Series N27
MDFT: 2 to 3 mils

Finish System:
Coat One
Product: Endura-Shield III Tnemec Series 73
MDFT: 3 to 5 mils

Total MDFT: 5.0 mils

E. EXTERIOR PVC SURFACES

1. Scope

This Section shall apply to all PVC pipe and fittings and similar materials that are located outside of buildings and vaults and are exposed to sunlight. Any and all PVC surfaces that are exposed to UV light are to be painted. Interior PVC items do not paint unless otherwise specified. Interior PVC pipe must be labeled and banded as specified.

2. Surface Preparation

Provide clean surfaces, lightly sand 100 percent of the PVC surfaces, then provide solvent cleaning, SSPC-SP-1.

3. Coatings

Finish System:

Provide One Coat of the following:

Product:	Endura-Shield III, Tnemec Series 73
MDFT:	3 to 5 mils

F. STRUCTURAL STEEL - MILD CONDITIONS

1. Scope

This Section shall apply to all interior structural steel. Items which are interior but may be exposed to splashing of liquids or corrosives shall be coated for severe conditions.

2. Surface Preparation

Commercial blast cleaning, SSPC-SP-6.

3. Coatings

Shop Primer System:

Coat One

Product:	Omnithane Series 1
MDFT:	2.5 to 3.5 mils

Field Finish System:

Coat One

Product:	Hi-Build Epoxoline Tnemec Series N69
MDFT:	4 to 6 mils

Coat Two

Product:	Hi-Build Epoxoline Tnemec Series N69
MDFT:	4 to 6 mils

Total Field applied MDFT: 11.0 mils

G. STRUCTURAL STEEL - SEVERE CONDITIONS

1. Scope

This Section shall apply to all exterior structural steel components and structural steel items which are interior but may be exposed to splashing of liquids or corrosives.

2. Surface Preparation

Near-white blast cleaning, SSPC-SP-10.

3. Coatings

Primer System:

Coat One	
Product:	Series 1 Omnithane
MDFT:	2.5 to 3.5 mils

Finish System:

Coat One	
Product:	Hi-Build Epoxoline Tnemec Series N69
MDFT:	4 to 6 mils
Coat Two	
Product:	Endura-Shield III Tnemec Series 73
MDFT:	3 to 5 mils

Total MDFT: 10.0 mils

H. DUCTILE IRON PIPE AND FITTING MATERIALS (IMMERSION)

1. Scope

This Section shall apply to exposed ductile iron pipe, fittings and materials that are continuously or intermittently submerged or exposed to splash or spill of liquids or corrosive atmospheres. This includes all ductile iron materials installed in a wet well, sump, manhole, vault, pullhole, or similar type of structure. Non-immersion service is covered elsewhere in this Specification.

2. Surface Preparation

Near-white blast cleaning, SSPC-SP-10

3. Coatings

Primer System:

Coat One

Product:	Potable Water Epoxy Tnemec Series 20
MDFT:	3 to 5 mils

Finish System:

Coat One

Product:	Potable Water Epoxy Tnemec Series 140
MDFT:	4 to 6 mils

Coat Two

Product:	Potable Water Epoxy Tnemec Series 140
MDFT:	4 to 6 mils

Total field applied MDFT: 11.0 mils

I. DUCTILE IRON PIPE AND FITTING MATERIALS (NON-IMMERSION)

1. Scope

This Section shall apply to exposed ductile iron pipe, fittings and materials that are not continuously or intermittently submerged. Continuously or intermittently submerged items are covered elsewhere in this Specification.

2. Surface Preparation

Provide surface profile in accordance with ASTM D 4417, Method C

3. Coatings

Primer System:

Coat One

Product:	Omnithane Series 1
MDFT:	2.5 to 3.5 mils

Finish System:

Coat One

Product:	Hi-Build Epoxoline Tnemec Series N69
MDFT:	4 to 6 mils

Coat Two

Product:	Endura-Shield III Tnemec Series 73
MDFT:	3 to 5 mils

Total MDFT: 10.0 mils

J. GALVANIZED SURFACE TOUCHUP

1. Scope

This Section shall apply to all galvanized surfaces, which have received minor damage to the galvanized surface during construction.

2. Surface Preparation

Power tool cleaning, SSPC-SP-3.

3. Coatings

Paint System:

Product:	Tnemec-Zinc Tnemec Series 90-97
MDFT:	3 to 5 mils

Total MDFT: 3.5 mils

K. ALUMINUM BURIED IN CONCRETE - DISSIMILAR METALS

1. Scope

This Section shall apply to all surfaces, which are conducive to corrosion due to interactions between dissimilar metals, or to chemical reactions, to include embedments in cast-in-place or precast concrete or masonry grout. This Section applies to aluminum, hot-dipped galvanized steel, and any other metals that have a dissimilar metals or chemical reaction concern when installed or embedded in concrete, or against concrete, mortar or grout.

2. Surface Preparation

Lightly sand with 150 grit sandpaper to degloss and roughen surfaces. Solvent cleaning, SSPC-SP-1.

3. Coatings

Finish Coat

Product:	Hi-Build Epoxoline Tnemec Series N69
MDFT:	4 to 6 mils

Total MDFT: 4.0 mils

L. GYPSUM WALLBOARD AND EXTERIOR SODFFIT BOARD (ESB)

1. Scope

This Section shall apply to all exposed gypsum wallboard and ESB surfaces.

2. Surface Preparation

Sandpaper smooth, dust and contaminant free.

3. Coatings

Primer System:

Coat One

Product:	Sealer Tnemec Series 151-1051
MDFT:	1.5 to 2.5 mils

Finish System:

Coat One

Product:	H. B. Tnemec-Tufcoat Tnemec Series 1029 EndurTone
MDFT:	2 to 4 mils

Coat Two

Product:	H.B. Tnemec-Tufcoat Tnemec Series 1029 EnduraTone
MDFT:	2 to 4 mils

Total MDFT: 5.5 mils

M. METAL DOORS AND WINDOWS, FRAMES AND TRIM

1. Scope

This Section shall apply to all interior and exterior hollow metal doors and windows, frames and trim.

2. Surface Preparation

All hollow metal doors, windows and frames shall be bonderized, pickled or phosphatized, which will serve as the primer for and shall be compatible with the finish coats to be applied in the field. Prior to field coat application, the surface shall be solvent cleaned SSPC-SP-1, and shall be clean, dry and free of all dirt, oil, grease and any other contaminants.

3. Coatings

Primer System:

Coat One	
Product:	Tnemec Series 27 Typoxy
MDFT:	3 to 5 mils

Finish System:

Coat One	
Product:	Tnemec Series 73 Endurashield
MDFT:	3 to 5 mils

Total MDFT: 6.0 mils

N. PAINTED WOOD AND WOOD TRIM

1. Scope

This Section shall apply to all exposed to view interior and exterior wood and wood trim for buildings and structures. Color shall be selected by the Owner.

2. Surface Preparation

Wood surfaces shall be clean and dry. Sand wood as required.

3. Coatings

Primer System:

Product:	Electrogrip, Tnemec Series 151
MDFT:	1.5 to 2 mils

Finish System:

Coat One:

Product:	Envirocrete, Tnemec Series 156
MDFT:	3 to 4 mils

Coat Two:

Product:	Envirocrete, Tnemec Series 156
MDFT:	3 to 4 mils

Total MDFT: 9 mils

2.3 COLORS

A. GENERAL

Paint colors used for the finish coatings on process equipment, piping and building surfaces shall conform to the following schedules. All finishes shall be glossy unless otherwise specified. Finish coatings, which are applied in the shop by the manufacturer, shall conform with this color schedule wherever possible. Factory coatings which are damaged during shipment or installation, or which are not of suitable color, as determined by the Engineer, shall be recoated in the field in accordance with these Specifications. Color samples shall be submitted to the Engineer for approval prior to application of any field coatings.

B. PROCESS EQUIPMENT COLOR SCHEDULE

Process equipment to include shall be painted in accordance with the following color schedule:

	Process Unit	Color
(A)	Carbon Filters	Light Blue
(B)	Contact Tank	Light Blue

Other equipment items and process materials shall be painted with finish colors selected by the Engineer.

C. PIPING COLOR SCHEDULE

Piping Identification: Exposed piping and piping in accessible chases shall be identified with lettering or tags designating the service of each piping system, shall have flow directional arrows, and shall be color coded as scheduled below.

Piping scheduled to be color coded shall be completely painted with the indicated colors, except surfaces specified to be unpainted shall have segments painted with the specified coding color long enough to accommodate the required lettering and arrows. All other piping specified to be painted shall match adjacent surfaces, unless otherwise approved by the Engineer.

Location: Lettering and flow direction arrows shall be provided near equipment served, adjacent to valves, on both sides of walls and floors where pipe passes through, at each branch or tee, and at intervals of not more than 50 feet in straight runs of pipe. If, in the opinion of the Engineer, the foregoing requirements will result in an excessive number of labels or arrows on a run of pipe, the number required can be reduced.

Metal Tags: Where the outside diameter of pipe or pipe covering is 5/8 inch or smaller, metal tags shall be provided instead of lettering. Tags shall have the specified identifying lettering stamped in, and shall be fastened to the pipe with suitable chains. Metal tags and chains shall be aluminum or stainless steel. Where tags are used, pipe shall be color coded as specified.

Lettering: Lettering on piping shall be painted, stenciled, or snap-on markers. Snap-on markers shall be plastic sleeves as manufactured by Brady "Brady snap-on B-915," Seton "Setmark," or equal. Letter sizes shall be as follows:

Outside Diameter of Pipe or Covering	Minimum Height of Letters
5/8 inch and smaller	Metal tags - 1/4 inch
3/4 inch through 4 inch	3/4 inch
5 inch and larger	2 inches

Color Coding and Lettering Schedule: All piping for the following services shall be color coded and identified using the process names given below. Where scheduled, bands shall be 6-inches-wide spaced along the pipe at 5-foot intervals.

Process	Abbreviation	Color of Pipe	Color of Letters
Backwash Supply	BS	Dark Blue	White
Backwash	BW	Light Brown	Black
Drain	D	Dark Gray	White
Filter to Waste	FTW	Light Blue	Black
Finished Water	FW	Dark Blue	White
Potable Water	W	Dark Blue	White
Raw Water	RW	Olive Green	Black
Sample	S	Same Color as Process	
Potassium Permanganate	PG	Violet	Black
Ferric Chloride	FC	Orange	Black

All exposed piping shall be color coded and lettered. Pipes not tabulated above shall be color coded and lettered as determined by the Engineer.

Electrical conduit shall be painted to match adjacent ceiling or wall surfaces as approved by the Engineer. Vent lines shall be painted to match surfaces they adjoin, otherwise gray.

All valves shall be identified with a valve identification number. Contractor shall provide a computer file (Excel spreadsheet) with this information to the Engineer.

PART 3 EXECUTION

3.1 GENERAL

It is the intent of these Specifications that materials and workmanship be provided such that the highest quality job is obtained. The completed work, prior to acceptance, must be free from runs, skips, mars and any other disfiguring mark due to faulty workmanship or care of the completed work.

It is the responsibility of the Contractor to ensure that all surfaces are prepared in accordance with the written recommendations and directions of the paint manufacturer whose paint is applied.

Approval of conditions shall be obtained from the Engineer prior to applying any or all coats of paint; however, such approval shall not relieve the Contractor of his responsibility of conformance with these Specifications and conformance with the manufacturer's recommendations.

It shall be the responsibility of the Contractor to prevent settling of dust or the occurrence of other conditions detrimental to the finished quality of the job and to repair any damaged paint at no additional cost to the Owner.

Materials or equipment delivered with prime coats shall be touched up as required prior to the application of additional coating(s).

The Contractor shall apply each coating at the rate and in the manner specified by the paint manufacturer. If material has thickened or must be diluted for application by spray gun, the coating shall be built-up to the same thickness achieved with undiluted material. Deficiencies in film thickness shall be corrected by the application of an additional coat(s) of paint. Film thickness shall be determined when dry by the Engineer with a magnetic dry film thickness gauge. The thickness gauge shall be calibrated with test shims.

Where thinning is necessary, only the products of the manufacturer furnishing the paint and for the particular purpose shall be allowed. All thinning shall be done strictly in accordance with the manufacturer's instructions as well as with the full knowledge and approval of the Engineer.

No paint shall be applied when the surrounding air temperature, as measured in the shade, is below 40 degrees F. No paint shall be applied when the temperature of the surface to be painted is below 35 degrees F. Paint shall not be applied to wet or damp surfaces and shall not be applied in rain, snow, fog or mist or when the relative humidity exceeds 85 percent. No paint shall be applied when it is expected that the relative humidity will exceed 85 percent or that the air temperature will drop below 40 degrees F within 18 hours after the application of the paint. Dew or moisture condensation should be anticipated and if such conditions are prevalent, painting shall be delayed until conditions improve to be certain that the surfaces are dry prior to application of paint. No paint shall be applied when the ambient temperature is less than 5 percent F. above the dewpoint. Further, the day's painting shall be completed well within advance of the probable time of day when condensation will occur, in order to permit the paint film an appreciable drying time prior to the formation of moisture.

Manufacturer's recommended drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, longer drying times shall be necessary. The manufacturer's recommendations for recoating time intervals shall be strictly adhered to.

Adequate ventilation, which will effectively remove solvents, shall be provided for proper drying of paints on interior surfaces. A <u>minimum</u> of 7-consecutive calendar days at 70 degrees F following the application of the final coat on

submerged surfaces shall be required before submergence. Longer periods shall be allowed prior to submergence if recommended by the paint manufacturer or if weather conditions require a longer curing time.

3.2 MIXING AND THINNING

Paint shall be thoroughly mixed each time any is withdrawn from the container. Paint containers shall be kept tightly closed except while paint is being withdrawn.

Paint shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. Only thinners approved by the paint manufacturer shall be used. In no case shall the wet film thickness of applied paint be reduced, by addition of paint thinner or otherwise, below the thickness recommended by the paint manufacturer.

3.3 SURFACE PREPARATION

A. GENERAL

Surfaces shall be dry and thoroughly cleaned of foreign materials with all defects filled or removed. All trades employed shall leave the surfaces of their work in such a condition that only minor cleaning, sanding and filling is required of the painting trade for surface preparation.

Hardware, switchplates, machined surfaces, nameplates, lighting fixtures and all other surfaces not to be painted shall be removed or otherwise protected. Drop cloths shall be provided, where necessary, to avoid spotting of surfaces adjacent to the item being painted. Working parts of electrical equipment shall be protected from damage during surface preparation and painting operations.

Ferrous metal cleaning shall be in accordance with Steel Structures Painting Council Specifications (SSPC).

Description	SSPC
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Near-White Blast Cleaning	SP-10
Preparation of Concrete	SP-13

The words “blast cleaning” or equivalent phrases of equal intent shall be taken to refer to the applicable SSPC specification when used in the paint manufacturer’s recommendations or these Specifications.

Hand tool cleaning shall be used when power tool cleaning is not possible. Hand and power tool cleaning shall be in accordance with SSPC Specifications SP-2, SP-3 or SP-11, respectively.

The blast cleaning profile depth shall be not less than 1 mil or greater than 2 mils. In the case of equipment to which the manufacturer applies a primer coating in the shop after fabrication, the blast profile depth needs to be as noted above.

B. WOOD

The Contractor shall sandpaper smooth, then remove dust. After prime coat has dried, seal all knots, pitch and resinous sapwood. The Contractor shall putty nail holes and minor defects prior to painting.

C. FERROUS METAL, GALVANIZED METAL AND HOLLOW METAL SURFACES

The Contractor shall assure that fabrication, welding or burning is completed prior to the sandblasting operation. The Contractor shall chip or grind off flux, splatter, slag or other laminations left from welding. The Contractor shall remove all mill scale. The Contractor shall grind smooth rough welds and other sharp projections.

The Contractor shall near-white blast clean, in accordance with SSPC SP-10, submerged surfaces and surfaces to 12 inches above highest liquid level, and areas subject to splash or spillage.

The Contractor shall commercial blast clean, in accordance with SSPC SP-6, all interior and exterior structural steel surfaces, surfaces located 12 inches above submerged areas, and surfaces located in areas not subject to splash or spillage where exposed to open bodies of liquids.

The Engineer reserves the right to accept preparation of these surfaces in accordance with SSPC SP-3 for areas not practical or possible to sandblast to SSPC SP-6 requirements.

The Contractor shall near-white blast clean, in accordance with SSPC SP-10 surfaces, subject to heat in excess of 600 degrees F. The Contractor shall power tool or hand clean in accordance with SSPC SP-2 or SSPC

SP-3. The Contractor shall apply prime coat on cleaned surfaces within 2 hours of cleaning. The Contractor shall solvent clean galvanized surfaces in accordance with SSPC SP-1.

D. EQUIPMENT

The Contractor shall sandblast the following equipment items or surfaces in accordance with applicable SSPC standards whether prime coated or not:

Shop primed surfaces, which have 2 percent or more of the primed surface damaged.

If catalyzed epoxy prime coat has been exposed to sunlight for longer than 60 days.

E. GYPSUM WALLBOARD

The Contractor shall repair minor irregularities left by finishers, avoid raising the nap of the paper and verify that the moisture content is less than 8 percent before painting. Contractor shall install sealant as required at edges of wallboard where it abuts different materials prior to painting.

F. PREPARATION BY SANDBLASTING

The Contractor shall not sandblast surfaces that will be wet after blasting and before painting. The Contractor shall apply primer to sandblasted surfaces the same day that the surface is blasted and before rusting occurs. The Contractor shall reblast surfaces allowed to set overnight prior to priming or surfaces that show rust bloom.

The sand shall be clean, water washed, with controlled particle size and high silica content. The sand shall have sharp, angular surfaces and contain no clay particles or other extraneous matter.

The profile depth of sandblasted surfaces shall be not less than 1 mil or greater than 2 mils, unless required otherwise by the coating manufacturer.

Compressed air for blasting shall be free of water and oil. The Contractor shall provide accessible separators and traps, shall confine sandblast sand to the area being blasted, shall provide shields of polyethylene sheeting or other such barriers to confine sand and shall plug pipes, holes or openings before sandblasting and keep them plugged until the sandblasting operation is complete and the sand is removed.

The Contractor shall protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from sandblasting. The Contractor shall reblast surfaces not meeting the requirements of these Specifications.

3.4 APPLICATION

A. GENERAL

The Contractor shall mix and apply coatings by brush, roller or spray in accordance with the manufacturer's installation instructions. Spraying equipment shall be inspected and approved in writing by the coating manufacturer. The Contractor shall provide complete coverage's to the mil thickness specified. The thickness specified shall be dry film mil thickness. All paint systems are "to cover." In situations of discrepancy between the manufacturer's square footage coverage rates and mil thickness, mil thickness requirements govern. When color or undercoats show through, the Contractor shall apply additional coats until paint film is of uniform finish and color. The Contractor shall not apply consecutive coats until the Engineer has had an opportunity to observe and approve previous coats.

The Contractor shall apply materials under adequate illumination, shall evenly spread and flow on to provide full, smooth coverage, shall work each application of material into corners, crevices, joints and other difficult to work areas, shall avoid degradation and contamination of blasted surfaces and avoid intercoat contamination, shall clean contaminated surfaces before applying next coat and shall immediately smooth out runs or sags, or remove and recoat entire surfaces. The Contractor shall assure that preceding coats are dry before recoating, shall recoat within the time limits specified by the coating manufacturer and shall allow coated surfaces to cure prior to allowing traffic or other work to proceed.

The Contractor shall coat all aluminum surfaces in contact with dissimilar materials. All fabricated and structural steel shall have prime coat(s) applied in the shop and finish coat(s) applied in the field.

During application of either prime or finish coats, brush coat all weld seams, edges, angles, fasteners and other irregular surfaces to insure a monolithic film, pinhole free surface. Finish coats of paint shall be uniform in color and sheen without streaks, laps, runs, drips, sags or missed areas.

All submerged or intermittently submerged materials shall have surface preparation and coatings applied prior to installation unless otherwise approved by the Engineer. All pipe, pipe supports, and pipe hangers that will be painted shall have surface preparation and coatings applied prior to installation.

B. PRIME COAT INSTALLATION

The Contractor shall prime all surfaces indicated to be painted, shall touch-up damaged primer coats prior to finish coats and shall assure field-applied coatings are compatible with factory-applied coatings. If coatings are not compatible, and if approved in writing by the Engineer, the Contractor shall apply a 2-mil-thick universal barrier coat recommended by the paint manufacturer prior to applying field coats or completely remove factory coatings and reprime.

The Contractor shall prime ferrous metals bedded in concrete to a minimum of 1 inch below exposed surfaces. The Contractor shall backroll all primer coats applied to existing or new CMU block. The Contractor shall assure sandblasting operations do not result in the embedment of sand particles in paint film. The Contractor shall brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over the entire surface being coated. The Contractor shall backroll concrete, masonry, gypsum board and plaster surfaces with a roller if the primer has been spray applied.

C. FINISH SCHEDULE

All work performed under this Contract (both new work and modifications to existing facilities) shall be painted. If the finish schedule requires wall surfaces to be painted in a particular space, the Contractor shall paint all appurtenant surfaces unless specifically noted not to be painted on the Plans. These items to be painted shall include:

1. Pipe supports, and equipment supports.

2. Insulated or wrapped piping, valves, fittings, hydrants and appurtenances except where covered by lagging.

3. Insulated or wrapped ductwork and appurtenances.

4. Conduit and appurtenances.

5. Ferrous metals.

6. Exposed woodwork.

7. Copper and brass surfaces.

8. Inside and/or outside of ferrous metal tankage.

9. New machinery and equipment except:

    a. Electrical panels;

    b. Switchboards;

    c. Switchgear;

    d. Safety switches;

    e. Motor starter equipment;

    f. Busways;

    g. Raceways.

The Contractor shall paint the following surfaces in areas not considered as finished areas:

1. Insulated or wrapped piping, valves, fittings, yard or fire hydrants and appurtenances.

2. Insulated or wrapped ductwork and appurtenances.

3. Exposed wood.

4. New machinery and equipment.

5. Machinery and equipment in sumps, pits, boxes, channels, wetwells and structures.

The Contractor shall paint all exposed interior and exterior surfaces including:

1. Soffits.

2. Insulated or wrapped piping, valves, fittings, yard or fire hydrants and appurtenances except when covered by lagging.

3. Insulated or wrapped ductwork and appurtenances except when covered by lagging.

4. Conduit and appurtenances.

5. Exterior and interior surfaces of ferrous metal tankage.

6. Ferrous metals.

7. Exposed wood.

8. Plaster surfaces.

9. Concrete block to be sealed, paint interior surfaces only.

The Contractor shall not paint the following elements unless specifically noted on the Plans to be painted:

1. Stainless steel surfaces except as required to identify piping.

2. Exposed to view aluminum surfaces.

3. Galvanized metal surfaces.

4. Fiberglass surfaces except fiberglass piping and piping appurtenances.

5. FRP ductwork unless gel coat color is not acceptable to the Owner.

6. Interior of pipe, ductwork, and conduits.

7. Moving parts of mechanical and electrical units.

8. Code labels and equipment identification and rating plates.

9. Piping, ductwork, or pipe conduit when enclosed between suspended ceiling and overhead slabs or located in pipe chases or surfaces to be lagged.

10. Factory-finished furniture, laboratory casework, metal toilet partitions, kitchen units, lockers, shop and storage equipment or miscellaneous items that have preapproved factory applied finishes.

11. Prefaced masonry, burnished masonry units, or glass masonry.

12. Structural steel or steel deck required to be fireproofed.

13. Contact surfaces of friction-type connections.

14. Pipe and/or duct lagging.

3.5 FIELD QUALITY CONTROL

The Contractor shall be responsible for performing, testing and assuring conformance with all requirements of these Specifications.

The Contractor shall maintain daily records showing:

- Start date of work in each area.
- Date of application for each following coat.
- Moisture content and surface temperature of substrate. Also record weather conditions, ambient air temperature and dew point.
- Provisions utilized to maintain temperature and humidity of work area within paint manufacturer's recommended ranges.

The Contractor shall measure the surface temperature of items to be painted with surface temperature gauges specifically designed for such use. The Contractor shall measure substrate humidity with humidity gauges specifically designed for such use. The Contractor shall measure wet paint with wet film thickness gauges. The Contractor shall measure paint dry film thickness with a Mikrotest gauge calibrated against the National Bureau of Standards "Certified Coating Thickness Calibration Standards." The Engineer may direct measurement of paint thickness at any time during the project to ensure conformance with these Specifications. A sufficient number of dry film thickness measurements shall be made so that there is approximately one measurement for each 100 square feet of surface area painted.

Where a wall or ceiling or other type of surface is disturbed and patched, the Contractor shall repaint entire wall or ceiling. The Contractor shall provide wet paint signs as necessary. The Contractor shall touch up damaged finish coats using the same material as specified for the finish coat.

At the conclusion of all painting activities, Contractor shall submit a painting field test report to the Engineer showing the above information plus results of wet film and dry film thickness tests. Provide four copies of final test report.

3.6 PAINTING SITE

Either shop painting or field painting and surface preparation shall be acceptable when painting work is performed in conformance with this Section, unless the painting is activity specified elsewhere in these Specifications.

3.7 PAINT THICKNESS

All paint thicknesses specified herein are minimum dry film thickness (MDFT). The thickness of paint over metallic surfaces shall be measured with a magnetic thickness gauge; paint thickness over wood or masonry shall vary in accordance with surface texture, but in no case shall the manufacturer's recommended coverage rate be exceeded. The minimum thicknesses given are total coating thickness for the coating specified, including multiple coats of the same material, where applicable.

***** END OF SECTION *****

DIVISION 10

SPECIALTIES

SECTION 10300

SAFETY EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

The Contractor shall furnish and install safety equipment items including fire extinguishers, chemical protection equipment, NFPA sign and emergency shower.

One fire extinguisher shall be furnished and installed in each of the following locations.

A. South Wellfield Treatment Building – Piping Room.

B. South Wellfield Treatment Building – Chemical Room.

C. North Wellfield Treatment Building – Filter Room.

Two sets of chemical protection equipment shall be furnished and installed in each of the following locations:

A. South Wellfield Treatment Building - Piping Room

One NFPA sign shall be furnished and installed in each of the following locations:

A. South Wellfield Treatment Building - Chemical Room

One emergency shower and eye wash unit shall be installed in each of the following locations.

B. South Wellfield Treatment Building - Piping Room

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
11241	Ferric Chloride Feed System

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS

The fire extinguishers shall be 5-pound monoammonium phosphate, dry chemical, nitrogen pressurized, Underwriter's Laboratories listed. The chemical shall be suitable for Class A, B, and C fires. Fire extinguishers shall have metal valve pressure gauges and corrosion resistant handles and wall hooks.

2.2 CHEMICAL PROTECTION EQUIPMENT

The following chemical protection equipment shall be provided:

Item	Quantity
Pair of extra large arm length, flock lined, neoprene rubber gloves	2
Full length heavyweight cotton apron with SBR rubber coating	2
Safety goggles	2
Clear plastic face shield	2

2.3 NFPA 700 DIAMOND SIGNS

The NFPA 700 diamond sign shall be 12″ x 12″ high intensity reflective aluminum. The sign shall be rigid and mounted with stainless steel screws. The sign shall be installed on the exterior door of the chemical room. The NFPA sign rating shall be 2/0/0.

2.4 EMERGENCY SHOWER/EYE WASH STATION

The emergency shower shall be vertically mounted with green epoxy coated galvanized piping and brass valves and shall be located as shown on the Plans. It shall be equipped with a green ABS plastic shower head, stainless steel pull activator and stay-open ball valve with foot-treadle and push-flag operation. It shall be capable of maintaining a flow rate of 30 gpm at 30 psi, and comply with ANSI Z358.1-1990. The emergency shower shall be equipped with a thermostatic mixing valve (Haws Model 9201E, or equal) to supply tempered water to both the emergency shower and eyewash fixtures. The emergency shower shall be Haws Model 8300CRP, or equal

PART 3 EXECUTION

Safety equipment shall be installed in the general areas specified.

Specific locations shall be determined by a Safety Inspector with the Washington State Department of Labor and Industries. The Safety Inspector's visit shall be

arranged by the Contractor. Any costs associated with the Safety Inspector's site visit shall be included in the Contractor's cost for the project.

***** END OF SECTION *****

DIVISION 11

EQUIPMENT

SECTION 11000

EQUIPMENT GENERAL PROVISIONS

PART 1 GENERAL

1.1 SCOPE

The provisions of this Section apply to all Sections of Divisions 11, 13, 14, 15, and 16, unless specifically revised therein.

The Contractor shall direct the attention of all subcontractors and suppliers of equipment and related appurtenances for the work to the applicable provisions in the Contract Provisions wherever they may occur.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
01600	Materials and Equipment
01800	Testing, Commissioning and Training
03300	Cast-in-Place Concrete
09900	Painting
11010	Vibration and Critical Speed Limitations
Division 11	Equipment
Division 13	Special Construction
Division 14	Conveying Systems
Division 15	Mechanical
Division 16	Electrical

1.3 STANDARDS FOR THE WORK

Pipe, fittings, wiring and supports shall be provided to produce complete, operable systems with all elements properly interconnected as shown in schematic diagrams or to provide specified operations. If a specific dimensioned location is not shown for interconnections or smaller system elements, the Contractor shall select appropriate locations and show them on Shop Drawing submittals for review.

Equipment and material shall be new and without imperfections and shall be erected in a neat and workmanlike manner; aligned, leveled, cleaned and adjusted for satisfactory operation; installed in accordance with the recommendations of the manufacturers and the best standard practices for this type of work so that connecting and disconnecting of piping and accessories can be readily made and

so that all parts are easily accessible for inspection, operation, maintenance and repair. Oil and lubrication fittings shall be located clear of and away from guards, base, and equipment and within reach from the operating floor. In order to meet these requirements with equipment as furnished, minor deviation from the Plans may be made as authorized by the Engineer. All such minor deviations from the Plans that may include extending oil and lubrication fittings for accessibility and safety shall be executed at no additional cost to the Owner.

1.4 MANUFACTURER'S INSTRUCTIONS

The recommendations and instructions of the manufacturers of products used in the work are hereby made part of these Specifications, except as they may be superseded by other requirements of these Specifications.

1.5 SUBMITTALS

A. GENERAL

Product Submittals shall be provided to the Engineer for all equipment specified in Divisions 11, 13, 14, 15, and 16, in accordance with Specification 01300, this Section and the respective equipment specification section. Submittals shall be dated and signed as certified for use in construction of this project.

B. MANUFACTURER'S LITERATURE

Manufacturer's literature shall be submitted for equipment, including, as applicable, performance characteristics, fan curves and pump curves, motor data sheets and methods of assembly.

The following minimum requirements shall accompany all manufacturers' literature submittals:

1. Description of materials.

2. Rating data - Mechanical and Electrical as applicable.

3. Motor Data including bearing and enclosure information.

4. List of any special tools and/or spare parts required and to be furnished, if any.

5. Exceptions taken to the specification and detailed explanation why the exception is being taken.

6. Additional specific information that is specified in the equipment sections.

7. For motor driven equipment served by variable frequency drives (VFDs), provide vibration and critical speed requirements of the equipment, minimum speed requirements of motor and driven machinery, acceleration and deceleration requirements of the equipment, and torque and speed information as per Part 1.6 of this Section.

C. SHOP DRAWINGS

Shop Drawings shall be submitted showing sizes and arrangement of equipment, foundations and anchor bolts required, control diagrams, wiring diagrams, pipe hanging details, ductwork layouts and connections to other work. The arrangement of mechanical equipment and appurtenant piping shown on the Plans may be varied as necessary to fit the certified manufacturer's installation drawings. However, the manufacturer's drawings shall not deviate from the Plans and Specifications as to location, size, type and design of equipment.

The following minimum requirements shall accompany all shop drawing submittals:

1. Overall dimensions.

2. Mounting arrangement and dimensions.

3. Connection sizes and orientation.

4. Capacity and location of lifting eyes.

5. Motor arrangement showing location of electrical connections.

6. Detail electrical wiring diagrams, showing component designation and rating, and the connection points and associated terminals and cable identification for connection to the process control system.

7. The Contractor shall ascertain the location of all electrical (power and control) connections in order to properly orient electrical conduits.

D. DESIGN CALCULATIONS

Seismic design calculations shall be submitted for equipment and for supports and anchorage for equipment.

E. FACTORY TEST REPORTS

Factory tests shall be performed for each piece of equipment where specifically called for in the Section specifying that equipment. Note that factory tests are inherent in many reference standards. The requirement for a factory test in a referenced standard shall make that requirement a part of these Specifications. Conduct factory tests at the same speeds at which the equipment will operate in the field except as noted.

Where specifically noted, the Engineer may witness performance test. The Contractor shall inform the Engineer in sufficient time to allow arrangements to be made for witness of such tests. When non-witnessed tests are performed, certified results shall be supplied by the Contractor to the Engineer.

Factory testing of pumps shall be done in accordance with the requirements and standards of the Hydraulic Institute. Tests of other equipment shall conform to the requirements set forth in these Specifications.

F. IDENTIFICATION OF DELIVERED EQUIPMENT

Each piece of equipment delivered to the project site shall be accompanied by a completed form which will contain at least the following information:

1. Owner's name and location of project.

2. Contractor's name and subcontractor if applicable.

3. Name of item being submitted.

4. Specification reference by section, paragraph and page.

5. Data on item (manufacturer, general descriptive data, dimensions, size of connections, speeds, performance curves, serial number).

6. Motor data, type, voltage, frequency, phase, full load amperes, starting method, frame size, enclosure, insulation type, NEMA Code letter, dimensions, service factor, serial number.

7. Date and signature of person certifying performance.

G. MANUFACTURER'S AFFIDAVITS

Equipment manufacturers, or their authorized representatives, shall each submit a notarized written report with respect to his equipment certifying the following:

1. The equipment has been properly installed and lubricated

2. The equipment is in accurate alignment

3. The manufacturer was present when the equipment was placed into operation

4. The manufacturer has checked, inspected, and adjusted the equipment as necessary

5. The equipment is free from any undue stress imposed by connecting piping or anchor bolts

6. The equipment is not imposing any undue stress on any connecting members

7. The equipment has been operated satisfactorily under full load conditions

8. The manufacturer has inspected his equipment during the operational demonstrations and system validation tests to the extent specified

9. The equipment is fully covered under the terms of the guarantee

PART 2 PRODUCTS

2.1 DESIGN

All equipment shall be designed for the service intended, of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection and during continuous or intermittent operation, shall be adequately stayed, braced and anchored, and shall be installed in a neat and workmanlike manner. Appearance, safety, and utility shall be given consideration in the design of equipment. Materials of construction shall be cathodically compatible.

2.2 STANDARD REQUIREMENTS

A. MATERIALS

Design, fabricate and assemble equipment and systems with new materials and in accordance with acceptable engineering and shop practices. Manufacture individual parts to standard sizes and gauges so repair parts can be installed in the field. Make like parts of duplicate units interchangeable. Do not place equipment in service at any time prior to delivery except as required for factory or shop tests.

Any portions of equipment in contact with potable water shall be NSF61 approved.

B. UNIFORMITY

Unless otherwise specified, equipment or material of the same type or classification used for the same purpose shall be the product of the same manufacturer and shall be the same model.

C. SEISMIC REQUIREMENTS

Supports and anchorage of equipment(s) shall comply with the requirements of the 2012 *International Building Code* (IBC) and ASCE 7-10 *Minimum Design Loads for Buildings and Other Structures*, Chapter 13 Seismic Design for Nonstructural Components, as referenced and amended by the IBC. For the following design parameters:

- Building Occupancy Category III
- Site Class D
- The component Importance Factor: $I_p = 1.25$
- Design response acceleration coefficients:

  $S_{DS} = 0.930g$
  $S_{D1} = 0.707g$

- Seismic Design Category D

D. STANDARDS

Provide equipment and materials suitable for service conditions and meeting standard requirements of ANSI, ASME, AWWA, ASTM, NEMA, UBC, NPC, UL and OSHA.

2.3 LUBRICATION

Provide lubricants of types recommended by equipment manufacturers, in quantities sufficient for a minimum of 1-year's consumption prior to completion, testing and final acceptance.

2.4 EQUIPMENT BASES AND BEDPLATES

Mount equipment assemblies on a single heavy cast iron or welded steel bedplate on a grout or concrete base unless otherwise shown or specified. Provide bases and bedplates with machined support pads, vibration pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Corners shall be rounded or chamfered and ground smooth. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide leveling screws in equipment bases and bedplates to aid in leveling prior to grouting.

2.5 ANCHORS AND FASTENERS

Each equipment manufacturer shall furnish the required anchor bolts, nuts and washers of adequate design for securing bases and bedplates to concrete bases. Provide anchor bolts of length to allow for 1-1/2 inch of grout under baseplates and adequate anchorage into structural concrete unless otherwise shown or specified. The manufacturer shall submit to the Engineer design calculations regarding recommended sizing and type of anchor bolts, nuts, and washers for securing the equipment, in accordance with the project seismic requirements.

Anchor and assembly bolts and nuts shall be of ample size and strength for the purpose intended. All nuts, bolts and washers shall be Type 316 stainless steel. All leveling nuts shall be Type 316 stainless steel.

All motor-driven equipment shall be furnished with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive. Do not provide expansion type anchors for motor-driven equipment, or equipment or piping subject to vibration.

Expansion type anchors are not to be used for any submerged applications unless specifically noted on the Plans.

Anchor all non-motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive except that, where specifically allowed by note on the Plans, expansion type anchors may be used.

2.6 SAFETY GUARDS

Cover belt or chain drives, fan blades, couplings, exposed shafts and other moving or rotating parts on all sides with safety guards conforming to all applicable Federal, State, and local codes and regulations; conform to the most restrictive requirement. Design guards for easy installation and removal, complete with necessary supports, accessories, and fasteners, all hot-dip galvanized. Design guards in outdoor locations to prevent entrance of rain and dripping water. Provide tachometer test opening in line with ends of shafts. Typically, guards shall be expanded metal on a structural steel frame except that outdoor guards may be of solid material. Provide spring loaded hinged doors with latch for service and lubrication access.

All pipes, manifolds, heaters, and other surfaces, which have a surface temperature sufficient to burn human tissue, shall be covered with a thermal insulating material or otherwise guarded against contact.

Guards shall comply with the requirements of these Specifications, WISHA Standards, and "The Principles and Techniques of Mechanical Guarding" (OSHA 2057, 1973), whichever is more stringent.

2.7 LIFTING EYES

All equipment weighing over 100 pounds shall be supplied with lifting eyes. Parts of equipment assemblies, which are normally serviced separately, such as motors, shall have individual lifting eyes.

2.8 ELECTRICAL COMPONENTS

Equipment shall be manufactured, fabricated and installed in a manner which permits conduit connection to electrical power and control equipment from below the connection point, terminal box, or connection box without offsets or bends such that the conduit will drain away from the equipment.

Electric motors, control panels, accessories, etc., shall conform to the requirements of Divisions 11, 12, 13, 14, 15 (Equipment items) and Division 16, Electrical.

If any motor fails during the warranty period, the Contractor shall replace the motor with a new motor. Rewinding a failed motor shall not be acceptable.

All electrical components shall be recognized or labeled and listed by a recognized electrical testing laboratory for the application, or approved by the Washington State Department of Labor and Industries for installation on the Project.

2.9 MOTOR PROTECTIVE DEVICE COORDINATION AND DOCUMENTATION

The Contractor shall maintain a spreadsheet or database list of the motor characteristics that are necessary to size, select, and/or set the various motor protective devices, such as thermal overloads, breaker trip devices, motor protection relays, etc. This list shall also include any additional information needed to set-up, program or adjust the variable frequency drive which serves motor driven equipment such as minimum speed, acceleration, etc. The list shall be sent with each equipment submittal for motor driven equipment and shall be updated to reflect the motor information for the submitted equipment

The Contractor shall record the size and/or settings of each motor protective device at the time of startup and after any subsequent adjustments on the motor characteristics list described in the preceding paragraph.

In addition, the Contractor shall take a digital photo of each motor nameplate when the motor arrives at the jobsite. Each digital photo shall be emailed to the Engineer, noting any discrepancy between the motor nameplate data and the submitted motor data.

2.10 NAMEPLATES/DATA PLATES/IDENTIFICATION

Each piece of equipment and its driver shall be furnished with a stainless steel metal nameplate fastened to the item in an accessible position. This nameplate shall contain the manufacturer's name, equipment rating, capacity, size, model, serial number and speed. Data for motors shall be NEMA standard. All information written or printed shall be in English. Each item of equipment shall bear a different serial number. Measurement units shall be given for ratings and capacity.

Nameplates for tanks and pressure vessels shall give working pressure, test pressure, vessel plate thickness and ASME Code data.

Each piece of rotating equipment shall have a direction of rotation arrow.

Each piece of equipment shall be labeled using a plastic laminate label with the functional name and number of the equipment shown on the Plans or provided by the Engineer. Name and number shall correspond to those used on Motor Control Centers and Panels.

Labels shall be fastened to the equipment base or other acceptable location. The letters shall be at least 1/2-inch high with a border trim on all sides not less than 1/4-inch. Color shall be green background with white letters. Fasteners shall be

brass or stainless steel screwed into inserts, anchor shields or tapped holes in equipment or base.

Units of measure shall be shown on the indicating and totalizing dials of all meters, gauges and other measuring devices.

2.11 PROTECTION AGAINST ELECTROLYSIS

Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, non-metallic separators or washers. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings or bushings.

2.12 PAINTING

Painting of all equipment shall be in accordance with Section 09900 of these Specifications.

2.13 NOISE

Mechanical and electrical equipment shall not create sound levels that are in excess of that permitted by WISHA for 8 hours per day worker exposure unless otherwise noted for the specific piece of equipment involved.

2.14 VIBRATION AND CRITICAL SPEED LIMITATIONS

Mechanical and electrical equipment shall meet the vibration and critical speed limitation requirements described in Section 11010.

2.15 PRESSURE GAUGE CONNECTIONS

Provide tapped and plugged suction and discharge gauge connections on the pump nozzles or flanges. Where this is not possible, provide gauge connections on the piping immediately adjacent to the pump.

2.16 PUMP SEAL WATER

The Plans show a seal water system applicable to some pump installations. The Contractor shall review each pump installation with the pump manufacturer and shall provide seal water installations in strict accordance with the manufacturer's recommendations at no additional cost to the Owner.

PART 3 EXECUTION

3.1 INSPECTION

Inspect each item of equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for new equipment installation.

3.2 PREPARATION

Prior to installing equipment, ensure that the areas are clean and that concrete or masonry operations are completed. Maintain the areas in a broom-clean condition during installation operations. Clean, condition, and service the equipment in accordance with the Operation and Maintenance Instruction Manuals and specific requirements included in applicable Sections of these Specifications.

3.3 SPARE AND LOOSE PARTS

Prior to equipment startup provide an inventory of spare and loose parts supplied under the project. Turn over inventory and parts to the Owner. The Owner's written acknowledgment of receipt is required for project completion. Loose parts are defined as items such as special tools, keys, safety equipment, and portable equipment.

3.4 INSTALLATION

A. EQUIPMENT

Equipment shall conform to the approved submittals and Operation and Maintenance Instruction Manuals. Employ skilled craftsmen experienced in installation of the types of equipment specified. Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce acceptable installations free of vibration or other defects.

B. ANCHOR BOLTS

Deliver bolts with templates or setting drawings and verify that bolts are correctly located before structural concrete is placed. Prior to assembly, the Contractor shall coat all stainless steel bolts and nut threads with anti-seizing compound.

C. BASE AND BEDPLATE GROUTING

Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Bevel exposed grout at 45-degree angle, except around exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth, dense finish and damp cure with burlap for 3 days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform corrective work as required to conform to the tolerances given in the applicable Operation and Maintenance Instruction Manual.

The Contractor shall make an allowance of at least 1-1/2 inches for grout under the equipment bases, whether or not shown on the Plans. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the complete work. Unless otherwise authorized, all grout shall be a non-shrink, non-metallic grout as stated in Section 03300.

Where practicable, the grout shall be placed through the grout holes in the equipment base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

D. PRESSURE GAUGES

Pressure gauges shall be installed on all pump discharge piping at a location where the gauges can be easily read. The gauges shall be located upstream of the isolation valves, if possible. Gauges shall be installed on other equipment items as specified. The gauges are specified in Division 13 and shall be installed as detailed on the Plans.

3.5 EQUIPMENT STARTUP AND ADJUSTMENT

The Contractor, at his/her own expense, shall arrange for an authorized factory-trained representative of the company or companies supplying the various items of equipment to:

- Supervise the equipment installation in accordance with the Operation and Maintenance Instruction Manual.
- Be present when the equipment is first put into operation.

- Inspect, check, adjust as necessary, and approve the installation.

- Repeat the inspection, check and adjust until all trouble or defects are corrected and the equipment installation and operation are acceptable.

- Witness and supervise operational demonstrations and system validation tests to the extent specified.

- Prepare and submit the specified Manufacturer's Affidavit.

The representative shall be experienced and knowledgeable regarding the equipment being tested.

The Contractor shall give initial lubrication to all equipment in accordance with the manufacturer's recommendations.

The manufacturer shall provide a formal test procedure and report forms for recording data. The Contractor shall submit the report forms to the Engineer prior to operational testing.

All equipment shall be field tested and demonstrated to the Engineer that proper operation and capacity have been fully complied with. For pumps, this shall include measurement of suction and discharge pressure at the pump and measurement of pumping rate by volumetric means, or through a suitably calibrated meter for two points on the performance curve. Current draw and voltage on the motor for each phase shall be measured for each pumping rate measurement. For two-speed pumps, such tests shall be conducted at both speeds. For variable speed pumps, blowers or fans, these tests shall be conducted at minimum and maximum speeds and at the specified duty point.

The Contractor shall furnish and test equipment or measuring devices (including portable flow meters) required that are not part of the permanent installation. Tests for variable speed pumps, blowers, and other equipment shall be performed at 60 Hz and at the initial anticipated flow or capacity levels.

The field test shall demonstrate under all conditions of operation that the equipment:

- Has not been damaged by transportation or installation.

- Has been properly installed.

- Has no mechanical defects.

- Is in proper alignment.
- Has been properly connected.
- Is free of overheating of any parts.
- Is free of vibration in excess of the limits in Section 11010.
- Is free of excessive noise.
- Is free of overloading of any parts.
- Shall operate as specified with the specified control system.
- Is free of critical speeds as specified in Section 11010.

In addition, the entire facilities shall be demonstrated to be in full operating order prior to the acceptance of the work. Should any equipment or part thereof fail to operate as intended, it shall be immediately removed and replaced, all at the Contractor's expense.

Equipment start-up and adjustment shall take place before instruction of the Owner's personnel is performed.

3.6 INSTRUCTION OF OWNER'S PERSONNEL

Conduct an instruction program for up to six operations personnel designated by the Owner in accordance with Specification Section 01800. Furnish the services of qualified instructors from the various equipment manufacturers for the duration specified in each specific Section. Include instruction covering basic system operation theory, routine maintenance and repair, and "hands on" operation of equipment.

Provide the instruction program at the Owner's convenience before contract closeout. The Contractor shall audio- and video-record all training sessions, and also provide the Owner with any audio-visual training materials the manufacturer utilizes (i.e., DVDs, PowerPoint presentations, videocassettes etc.). Cost of instruction and audio-visual training materials shall be included in the bid price for the equipment.

3.7 SOUND LEVEL TESTING

Measure the sound level developed by all mechanical and electrical equipment provided under the Contract Provisions. Perform testing in all rooms and spaces

containing such equipment during the final operation test program with all equipment operating. Use OSHA approved instruments and record the highest sound levels developed when measured according to OSHA standards in each room and space. Deliver a certified copy of records to the Engineer.

***** END OF SECTION *****

SECTION 11010

VIBRATION AND CRITICAL SPEED LIMITATIONS

PART 1 GENERAL

1.1 SCOPE

This Section specifies vibration and critical speed limitations for rotating mechanical equipment. Individual equipment specification sections may specify more stringent requirements, which shall then govern. Field-testing and vibration measurements shall be taken on all rotating mechanical equipment.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
11000	Equipment General Provisions

1.3 SUBMITTALS

Manufacturer's certified calculations and data showing location of critical speeds in relation to operating speeds shall be provided in accordance with Section 01300, when specified in the individual equipment specification sections.

Where equipment is driven with a motor powered with a variable-frequency drive, the Contractor shall provide information on the limits and ranges of the vibration, torsion, mechanical, thermal, and similar characteristics of the driven equipment, where such limits or ranges impact the speed, time, or ramp settings of the variable-frequency drive. These points and ranges shall be included as part of the submittal information for the driven item of equipment. The purpose of this requirement is to allow coordination of the variable-frequency drive configuration with the limitations of the driven equipment.

1.4 VIBRATION LIMITATIONS

Vibration frequencies shall span the range from 5.0 to 5,000 Hz. Where specified, measurements shall be obtained while the installed equipment is operating within the specified speed range. These measurements shall be recorded and provided to the Engineer along with the Manufacturer's Affidavits.

A. CENTRIFUGAL

1. Machines with Sleeve Bearings: Unless otherwise specified, centrifugal machines with sleeve bearing shafts shall not exhibit unfiltered Root Mean Square (RMS) readings for vibration displacement in excess of the following:

Shaft speed range, rpm	Displacement, peak to peak, mils
Up to 900	3.5
901 - 1800	3.0
1801 - 3000	2.5
3001 - 4500	2.0
Above 4500	1.6

Displacement measurements shall be taken radially on the shaft at two points at each bearing. Measuring points shall be 90 degrees apart.

2. Machines with Antifriction Bearings: Unless otherwise specified, centrifugal machines with antifriction bearing shafts shall not exhibit unfiltered RMS readings for vibration velocity in excess of 0.12 inches per second. Velocity measurements shall be taken on one point of each bearing housing.

B. POSITIVE DISPLACEMENT MACHINES

Unless otherwise specified, positive displacement machines of the rotary, reciprocating and controlled volume types shall operate without any lateral or torsional vibration characteristics that may accelerate wear of the equipment. The Contractor shall provide manufacturer's certification that the manufacturer has inspected the machine under operating conditions and found it to comply with the requirements of this paragraph.

1.5 CRITICAL SPEED REQUIREMENTS

Unless otherwise specified, rotating mechanical equipment shall not exhibit critical speeds within the specified range of operating speeds. Critical speeds for equipment with rigid rotor systems shall be at least 20 percent greater than maximum operating speed or impeller blade pass frequency, whichever is greater. Critical speeds for equipment with flexible shaft-rotor systems shall be at least 15 percent below minimum operating speed and 20 percent above maximum operating speed or impeller blade pass frequency, whichever is greater.

***** END OF SECTION *****

SECTION 11211

SUBMERSIBLE WELL PUMPS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes furnishing, installing, and testing submersible well pumps and accessories at Wiegardt Well No. 1, Wiegardt Well No. 2, and Wiegardt Well No. 3.

The Contractor and pump manufacturer's representative shall coordinate all aspects of supplying, delivering, installing, and testing the pumps to comply with the requirements of these Specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
01800	Testing, Commissioning, and Training
11000	Equipment General Provisions
15050	Piping Systems
15100	Valves
Division 16	Electrical

1.3 EQUIPMENT LIST

The following equipment shall be provided:

Item	Equipment Number
Wiegardt Well No. 1 Pump	01 WP 01
Wiegardt Well No. 2 Pump	02 WP 01
Wiegardt Well No. 3 Pump	03 WP 01

1.4 DESIGN CONDITIONS

The submersible pump covered by these Specifications shall have the motor mounted below the pump sections as herein described and further indicated on the Drawings.

The submersible pump assembly shall be comprised of a submersible motor combined with a vertical turbine pump assembly of multi-stage configuration. The pump assembly shall be driven by the motor shaft through a coupling, with

power being supplied to the motor through a submersible type cable. The cable shall be supported on the riser column.

The submersible pumps/motors shall be capable of meeting the following performance requirements.

Well Designation	**Wiegardt Well No. 1**
Maximum Pump and Motor Speed	3,450 rpm
Motor Horsepower	15 hp
Rated Capacity (Primary Design Point)	168 gpm
Total Dynamic Head	206 feet
Minimum Efficiency at Design Point (Pump Only)	71.9%
Maximum Pump Diameter	5-5/8-inch
Maximum Motor Diameter	5-5/8-inch
Pump Intake Setting Depth	95 feet
NPSH Required at Rated Capacity	19.4 feet
Shutoff head, Maximum	330 feet
Pump Discharge Pipe Size	3-inch
Pump Column Size	3-inch

Well Designation	**Wiegardt Well No. 2**
Maximum Pump and Motor Speed	3,450 rpm
Motor Horsepower	15 hp
Rated Capacity (Primary Design Point)	168 gpm
Total Dynamic Head	205 feet
Minimum Efficiency at Design Point (Pump Only)	71.9%
Maximum Pump Diameter	5-5/8-inch
Maximum Motor Diameter	5-3/8-inch
Pump Intake Setting Depth	95 feet
NPSH Required at Rated Capacity	19.4 feet
Shutoff head, Maximum	330 feet
Pump Discharge Pipe Size	3-inch
Pump Column Size	3-inch

Well Designation	**Wiegardt Well No. 3**
Maximum Pump and Motor Speed	3,450 rpm
Motor Horsepower	15 hp
Rated Capacity	168 gpm
Total Dynamic Head (Secondary Design Point)	204 feet
Minimum Efficiency at Design Point (Pump Only)	71.9%
Maximum Pump Diameter	5-5/8-inch
Maximum Motor Diameter	5-5/8-inch
Pump Intake Setting Depth	95 feet
NPSH Required at Rated Capacity	19.4 feet
Shutoff head, Maximum	330 feet

1.5 SUBMITTALS

Submit shop drawings for the pump together with sufficient data to show that the equipment conforms to the Specification requirements. Show that the pump and driver supports and anchorage will resist seismic forces per the IBC. Submit information on the moment of inertia of the rotating elements in units of pounds-feet squared including weight and radius of gyration.

1.6 PUMP WARRANTY

In addition to the warranty required in the General Conditions, the equipment manufacturer shall provide an extended warranty covering defects in material and workmanship for 2 years following the date of substantial completion. The warranty shall be in printed form, shall apply to all similar units and shall include parts and labor.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

The pump furnished for Wiegardt Well No. 1 under this Section shall be Grundfos Model 150S150-6, or approved equal.

The pump furnished for Wiegardt Well No. 2 under this Section shall be Grundfos Model 150S150-6, or approved equal.

The pump furnished for Wiegardt Well No. 3 under this Section shall be Grundfos Model 150S150-6, or approved equal.

2.2 FACTORY TESTING

Perform certified factory performance tests in accordance with Hydraulic Institute Standards for each pump.

Tests shall be sufficient to determine the curves for capacity, kilowatt input, water horsepower, and overall efficiencies for heads from shutoff to a point beyond the minimum specified head for the pumping units. Sufficient test data shall be submitted to enable computation and plotting of curves for brake horsepower and pump efficiency for full range operation. A minimum of four points, including shutoff, shall be taken for each test run. One point of the four shall be taken as near as possible to the rated condition of head and discharge. One point shall be taken near the maximum capacity point of the standard curve. Discharge shall be expressed in gallons per minute on the curves.

Six certified copies of the curves showing the results of the factory shop performance and hydrostatic tests, shall be furnished to the Owner for approval. Shipment of the pumping units shall not be made until the Owner has approved the test data curves.

2.3 SUBMERSIBLE WELL PUMPS

The submersible pumps shall have a stainless steel shell with an outer diameter no greater than shown in Part 1.4. Impellers shall be constructed of stainless steel. Suction caps shall be polycarbonate with stainless steel inserts. The unit shall also have a positive drive 7/16-inch hexagonal stainless steel shaft. The intake and intake screen shall be stainless steel, along with the cable guard, which will have tapered ends to prevent the pump from catching on the well. All screws, washers and nuts shall be stainless steel. All above references to stainless steel indicate series 300 stainless steel shall be used. The pump shall have an internal spring loaded check valve. A strainer shall serve to exclude particles which are too large to pass through the pump. Pump and motor half couplings shall be stainless steel with drive key, pin, and screw. Thrust must be transmitted through hardened coupling screws.

2.4 MOTOR

The motors for each well pump shall be 15 hp, 3 phase, 460 V, 3600 RPM premium efficiency motor with a 1.15 safety factor.

The pump shall be provided with a NEMA stainless series water filled motor, as manufactured by Franklin Electric. The stator core of the motor shall be formed from non-aging silicon steel laminations and secured in a heavy steel tube. The stator coils shall be placed in semi-closed slots and secured by heat resisting insulating wedges. The squirrel cage rotor shall be stack shrunk on the shaft making a solid indestructible assembly. The rotor and shaft shall be accurately machine and dynamically balanced to insure vibrationless operation. Bronze sleeve bearings shall be provided at each end of the rotor. A pivot or solid shoe thrust bearing shall carry the weight of all rotating parts and the hydraulic thrust of the pump. The motor shall be equipped with a thrust bearing properly sized to for thrust loading across the entire pump curve. Upthrust bumpers shall not be acceptable. The stator and motor casing shall be of steel and the upper bearing bracket of close grained cast iron, containing a small percentage of nickel to increase the density. The motor shaft through the seal and the motor coupling shall be stainless steel. The seal shall have silicon carbide faces.

2.5 POWER CABLE

The power cable from the control panel or junction box to the motor shall be UL approved, submarine type power cable consisting of three-stranded, copper insulated conductors of proper size to carry the full load motor amperes at rated voltage or to keep voltage drop between motor and control panel below 3 percent, whichever is larger. Each conductor shall be enclosed in an insulating watertight synthetic rubber or plastic jacket: the whole to be enclosed in an outer synthetic rubber of plastic jacket which shall be impervious to oil. The power cord shall be sealed, not only by use of a cord grip, but shall have individual conductors sealed into the cord cap assembly with an epoxy sealing compound to insure a watertight cable connection at the surface plate assembly. The power cable shall be supported on the riser column by means of cable clamps at intervals not exceeding 10 feet.

2.6 COLUMN ASSEMBLY

The outer column shall be of 3-inch No. 2 standard weight galvanized steel column pipe with a wall thickness not less than 0.322 inches and interchangeable sections not more than 10 feet in length. The ends of each section shall be faced parallel and machined with eight straight threads per inch permitting ends to butt and ensuring alignment when connected by standard mill steel couplings.

2.7 WATER LEVEL ACCESS PORT

The pump column shall be installed with a pipe conduit to allow measurement of water levels by installation of electronic devices, either permanent or portable. The conduit shall be Schedule 80 PVC quick set drop pipe, flush joint threaded pipe 10-foot long. Pipe shall measure 1.66 inches OD and 1.25 inches ID. The PVC flush joint pipe shall meet ASTM Standard F 480-88A for thermoplastic well casing pipe and couplings.

PVC pipe shall be installed, strapped to the columns with gradual curves to allow passage of a device such as a level transducer or a sensor from a portable depth gauge. Every attempt shall be made during installation to set the pump column within the casing, including turning of the column to locate a position with least resistance to installation, to successfully install the drop pipe without damage by binding, scraping, etc. The PVC pipe is to extend to the column connection at the bowls.

2.8 CHECK VALVES

Check valves shall Flomatic Model 80DIX, or approved equal. The check valve shall be spring loaded with stainless steel fasteners and springs. The seat shall be

elastomer with ductile iron body and poppet. The valve follower shall be equipped with an anti-spin lug to prevent spinning.

2.9 ATTACHMENT ITEMS

Straps to hold PVC piping shall be either stainless steel or manufactured plastic straps, suitable for this particular installation and the possible difficulties that may be encountered upon pump and column installation within the close tolerances to be encountered.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment in strict conformance with the manufacturer's installation instructions. Align pumps and motors after installation. In no event shall the riser column be bent (curved) out of straight alignment upon installation within the well.

The pump installer shall be responsible for the ordering and installation of all approved materials to be used in the pump installation.

The subcontractor installing the pump/column and associated equipment shall be responsible for alignment of all of the installed equipment and setting the lateral adjustments.

The equipment, its installation, and the workmanship shall conform to Washington State standards, particularly "Minimum Standards for Construction and Maintenance of Wells," Chapter 173-160 WAC, as prepared by Washington State Department of Ecology. Included in this standard is the requirements of disinfection of the well itself and the equipment to be installed therein as per WAC 173-160-365. The completed well shall conform in all respects with the above stated document of minimum standards.

3.2 FIELD TESTING

Field test all pumps for conformance with the design conditions in this Section.

After installation within the pump house, the pumping unit shall be subjected to a field running test under actual operating conditions. The field test shall be made by the Contractor and pump supplier as required by Section 01800. The field test shall demonstrate under all conditions of operation that the pump assembly:

1. Has not been damaged by transportation or installation.

2. Has been properly installed.

3. Has no mechanical defects.

4. Is in proper alignment.

5. Has been properly connected.

6. Is free of overheating of any parts.

7. Is free of all objectionable vibration, as specified in Section 11010.

8. Is free of excessive noise.

9. Is free of overloading of any parts.

10. Shall operate as specified with the specified control system.

Any defects in the equipment or failure to meet requirements of the Specification shall be promptly corrected by the Contractor and/or pump supplier.

Disinfection of the well and its equipment is more specifically covered by the AWWA Standard C-654, "Disinfection of Wells." Section 4 thereof and other related Sections apply to chlorination of permanent equipment and material used in wells. The final disinfection test of the well shall be a bacteriological test conforming with the requirements of Section 6 thereof. Well water shall not be pumped into the public water system until the well and water are approved for domestic use as approved by State Department of Health and the Owner.

3.3 MANUFACTURER

The services of a factory trained representative of the submersible pump manufacturer shall be provided. Services shall include two days (two visits) on site for the supervision of equipment startup, testing and instruction of the Owner's personnel in the operation and maintenance of the equipment, and the cost of these services shall be included in the bid price.

***** END OF SECTION *****

SECTION 11222

CARBON FILTER TREATMENT SYSTEM

PART 1 GENERAL

1.1 SCOPE

The Contractor shall furnish and install a carbon filter treatment system complete with tanks, piping, valving, instrumentation, control equipment and accessories to produce a complete functional filtration system as specified herein. The system shall be designed to removed particles from the water and catalytically oxidize and remove hydrogen sulfide from water.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
01800	Testing, Commissioning, and Training
09900	Painting
11000	General Requirements for Equipment
Division 15	Mechanical
Division 16	Electrical

1.3 EQUIPMENT LIST

The following equipment shall be provided with the pyrolusite treatment system:

Item	Equipment Number
Carbon Filter No. 1	04 CF 01
Carbon Filter No. 2	04 CF 02

1.4 SYSTEM DESCRIPTION

Calgon Carbon Corporation will furnish the Model 8 Carbon Filter System described herein (for installation by others). The complete filter system includes the following:

A. Carbon filters with internals for carbon retention

B. Activated carbon

C. Influent, effluent and backwash piping with valves

D. Carbon fill and discharge piping with valves

E. Vent and pressure relief piping

F. Water piping and utility connections

G. Accessories as shown below

H. Manufacturer's services

The vessels, piping, valves, and carbon function as a system and are the end products of a single manufacturer to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

System design criteria are listed below:

Number of Vessels	System Flow Rate GPM (EBCT – minutes)	Pressure Drop – Normal Operation PSI	Pressure Drop Backwash Operation PSI
Two (2)	450 (10)	12 -15	15

1.5 SUPPLIER'S QUALIFICATIONS

Supplier of the adsorption system shall have the following minimum qualifications:

At least 20 years of experience successfully supplying both adsorption systems and GAC to treat water with flow rates greater than 500 gpm average daily flow.

Must own and operate an equipment fabrication facility with capabilities to both fabricate the equipment per applicable ASME code and finish lining and paint in a single facility.

Must own and operate at least two (2) GAC production facilities.

1.6 PERFORMANCE CRITERIA

The carbon filter shall provide removal of hydrogen sulfide to below 0.01 mg/L.

1.7 SUBMITTALS

One submittal package with the following information will be provided for approval by the Owner. Fabrication will begin upon receipt of Owner's approval.

Filter vessel specifications and drawing including design pressure, dimensions, and capacity.

System flow diagram showing all valves, components, instrumentation and utilities.

System general arrangement showing dimensions, weights, and elevations including influent, effluent, backwash, and carbon exchange pipe connection locations.

Pressure drop information across the system.

Specification of the granular activated carbon to be utilized in the system.

Material specifications for pipe, fittings and instrumentation.

Specifications for vessel lining.

Specifications for vessel painting.

The system Operating and Maintenance Manual will be provided upon completion of the project/shipment of the system.

PART 2: PRODUCTS

2.1 APPROVED MANUFACTURERS

The filter treatment system shall be as furnished by Calgon Carbon Corporation or approved equal. The structural, mechanical, and electrical designs for the filter treatment system are specific to the equipment manufactured by Calgon Carbon Corporation. The manufacturer's representative can be reached at (412) 776-0842. If the Contractor chooses to utilize equipment from a different manufacturer, all necessary modifications to accommodate the dimensions, mounting, piping, controls and all other aspects of the treatment system shall be provided by the Contractor at no additional cost to the Owner.

2.2 THE SYSTEM

The proposed system shall be designed to treat approximately 450 gpm. The application rate shall not exceed 4.5 gpm/sf during normal operation and 15 gpm/sf during backwash.

The normal operating pressure of the proposed system will not exceed 150 psig. The treatment system shall consist of two 8 foot diameter filters. All materials used in the manufacture of this system shall conform to the specifications contained herein. Each filter shall contain 72 inches of Calgon Centaur® 20X50 Filter Media.

2.3 CARBON FILTER VESSELLS

The carbon filters shall be Model 8 Carbon Adsorption Vessels, as designed by Calgon Carbon Corporation to meet the following specifications.

The carbon filter vessels shall be fabricated of carbon steel, conforming to ASTM A516 grade 70, 8′-0″ diameter by 8′-0″ straight side height with 2:1 elliptical top and bottom heads. Each vessel will be sized to contain 10,000 pounds of GAC and shall accommodate approximately 30 percent bed expansion within the straight side of the vessel using Calgon Centaur® 20X50 Filter Media.

The structural aspects of the vessel shall be sufficient to meet the Seismic requirements per Section 11000 of the specifications.

Each vessel will be designed with a single PVC piping ring underdrain system that provides uniform distribution of the treated water using a minimum of one (1) septa nozzle for every nominal square foot of vessel cross section, and allows replacement of the septa without the need to remove external piping. The septa will be designed to contain the GAC within the filter and shall be constructed of polypropylene (ppl) material.

All surfaces will be degreased prior to sandblasting. The filter internal surface shall be blasted to a white metal finish (SSPC-SP5) to provide a 3 to 4 mil anchor pattern. The exterior surfaces of the filter shall be prepared by blasting per SSPC-SP7.

The interior surfaces of the vessel shall be lined with a nominal lining thickness of 35 to 45 mil dry film (dft). The lining material shall be a vinyl ester resin combined with a special curing system and inert flake pigment that meets the requirements of the U.S. Federal Register, Food and Drug Regulations Title 21, Paragraphs 175.300 and 177.2420 and the requirements of ANSI 61 when applied and cured per the manufacturer's requirements.

The exterior surface of the filters shall be painted according to the following:

1. Primer: Tnemec Series 94-H2O Hydro-Zinc, applied at 2.5 to 3.5 mils dry film thickness.

2. Stripe Coat: Tnemec Series 73 Endura-Shield at 3 to 5 mils dry film thickness.

3. Intermediate Coat: Tnemec Series 73 Endura-Shield at 3-5 mils dry film thickness.

4. Finish Coat: Tnemec Series 73 Endura-Shield at 3-5 mils dry film thickness.

The total dry film thickness of the coating system shall be a minimum of 11.5 mils.

2.4 VALVES

A. The process and utility piping; excluding GAC fill and discharge piping shall be equipped with butterfly valves for flow control. A total of ten (10) butterfly valves shall be supplied. Eight (8) of the 6″ diameter shall be electrically controlled butterfly valves to accommodate the process and backwash control functions; Two (2) valves are needed for backwash control, two (2) valves are needed for influent isolation, two (2) valves for effluent isolation, and two (2) valves for the vent function.

B. The influent, effluent, and backwash control valves shall be a cast iron wafer type body butterfly valve with aluminum-bronze disc, BUNA-N seats and stainless steel shaft to mate to 150 pound ANSI flanges. The valves shall be rated for 200 psig in closed position at 180°F, and meet or exceed Section 5.0 of AWWA Specification C-504-87.

C. The carbon fill and discharge valves shall be 3″ diameter full port ball valves, 316 stainless steel construction with TFE seats and seals. A total of four (4) valves shall be supplied, two (2) for carbon fill and two (2) for carbon discharge.

D. Utility valves for the compressed air supply shall be bronze or brass or barstock brass body regular port ball valves.

E. Utility valves for the compressed air supply shall be bronze or brass or barstock brass body regular port ball valves.

2.5 VALVE ACTUATORS

Control valve actuators shall be Rotork Q100.

The electric motor valve operators (actuators) shall contain motor, gearing, manual override, limit switches, torque switches, drive coupling and integral motor controls. Actuator shall also include devices for transmitting a position feedback signal proportional to travel with an output via the two wire control system.

The motor shall be specifically designed for actuator service. The motor shall be of the induction type with Class F insulation and protected by means of a thermostat imbedded in the motor windings. Motor enclosure shall be totally enclosed, non-ventilated. Motor shall be capable of operating on 120 volts AC, single phase, 60 Hz power.

Actuator housing shall have a double sealed (NEMA 4) watertight (NEMA6) enclosure meeting the requirements of IEC IP68 (submersion in water to a depth of 7 m for 72 hrs).

The actuator gear case and all housing shall be die cast aluminum to BS 1490. The main gearcase and motor housings shall be to grade 4 with the remainder being LM24.

Output drive shall be machined to suit valve stem to which it is attached. Gearing shall be double reduction worm and wheel with steel worm and aluminum bronze worm wheel. The second stage worm and wheel shall be self-locking to ensure that the output cannot be back driven by valve reaction forces.

All gearing shall be grease or oil lubricated and designed to withstand the full stall torque of the motor.

Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation.

Manual operation shall be available by means of a padlockable hand/auto selection lever. When engaged the handwheel shall drive the second stage wormshaft. Return from manual to electric mode of operation shall be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation. At no time shall the handwheel be driven by the motor.

The actuators shall be suitable for mounting on the valves, which they are to operate. Actuators shall be suitable for operation for ambient

termperatures – 10 degrees F to 110 degrees F. Externally adjustable mechanical stops shall be provided with a setting of 80 degrees to 100 degrees of output movement. Conduit entries shall be two 1-inch ASA NPT.

Actuators shall have integrally mounted open/close and local/stop/remote selectors.

All valve levers shall be installed in the same relative orientation for ease of operation.

Actuators shall be listed and labeled by a recognized electrical testing laboratory or be acceptable to the Washington State Department of Labor and Industries for installation on this project.

2.6 CONTROL PANEL

The motor actuated valves shall be controlled by a control panel provided with the valve assembly as shown on the Plans.

The control panel shall be configured to operate from a 20 amp 120 volt 1-phase circuit. The valve actuators shall be powered from the control panel.

The control panel shall be provided with an Allen Bradley Compact Logix PLC programmed from the factory to backwash the filters from a discrete signal provided via Ethernet from the Master PLC.

Each filter shall be called to start backwash and terminate backwash independently from Master PLC.

2.7 PIPE AND FITTINGS

A. The process and utility piping on the adsorption system shall include influent water to the system, treated water (effluent), backwash water supply and discharge, filter vent lines and granular activated carbon fill and discharge piping.

B. The influent and effluent pipe network shall be configured for parallel filter operation.

C. Process piping (influent, effluent and backwash) shall be 6″ diameter, constructed of schedule 40 carbon steel, ASTM A53 Grade B materials with 125# ASTM A126 Class B cast iron flanged fittings.

D. Vent piping shall be 3″ diameter, constructed of schedule 40 carbon steel, ASTM A53 Grade B materials.

E. Carbon fill piping shall be 3″ diameter, constructed of schedule 40 carbon steel, ASTM A53 Grade B materials.

F. Carbon discharge piping shall be 3″ diameter, constructed of schedule 40 polypropylene lined carbon steel, ASTM 53 Grade B materials with ppl lined flanged fittings.

G. Utility piping shall be constructed of threaded schedule 80 carbon steel, ASTM 53 Grade B materials.

H. All piping surfaces shall be prepared by blasting per SSPC-SP7.

I. The piping network shall be provided with a structural steel support frame for support of the piping module.

J. The piping shall be painted according to the following:

1. Primer: Tnemec Series 94-H2O Hydro-Zinc, applied at 2.5 to 3.5 mils dry film thickness.

2. Stripe Coat: Tnemec Series 73 Endura-Shield at 3 to 5 mils dry film thickness.

3. Intermediate Coat: Tnemec Series 73 Endura-Shield at 3-5 mils dry film thickness.

4. Finish Coat: Tnemec Series 73 Endura-Shield at 3-5 mils dry film thickness.

The total dry film thickness of the coating system shall be a minimum of 11.5 mils.

2.8 SAMPLING AND INSTRUMENTATION

All instrumentation associated with the filters shall be accessible from grade.

The process piping shall be equipped with pressure gauges to indicate the pressure entering and exiting each filter and to provide information on pressure drop across each filter and the system. The pressure gauges shall have 4 ½" face diameter with a stainless steel bourdon tube in a phenolic case housing (1 to 160 psig range). A total of three (3) shall be provided for the system.

Each filter vessel shall be equipped with sample taps to enable sampling of the water entering and exiting each filter. A total of three (3) will be provided for the system.

2.9 FILTER MEDIA

The filter media shall be a Calgon Centaur® 20X50. The filter media shall be NSF Certified to ANSI/NSF Standard 61.

2.10 ACCESSORIES

The carbon fill and discharge shall be fitted with hose connections, such that carbon transfer to and from the filters can be facilitated using carbon transfer hoses. These connectors shall be 4″ Quick Disconnect Adaptors constructed of aluminum as manufactured by Dover Corp. as Kamlock connectors or equal.

Two (2) flush connections shall be provided on each GAC fill line, one upstream and one downstream of the valve. One (1) flush connection shall be provided on each GAC discharge line, downstream of the valve. The connections shall be welded into the steel or stainless steel pipe or screwed into solid propylene "spacers" for the lined pipe. Flush connections shall consist of a short section of 3/4″ pipe, a 3/4″ full port ball valve and a 3/4″ quick disconnect adaptor to match with water hose fittings.

Each vessel shall be provided with one (1) 6″ stainless steel effluent strainer basket mounted in the effluent line from the vessel. The basket strainer shall be constructed of 316 stainless 14 gage plate with 1/8" diameter holes drilled on 3/16" centers, covered with 40 mesh 316 stainless steel screen and topped by a 4 mesh 316 stainless steel support screen.

The influent and effluent pipe for each vessel shall be provided with a molded neoprene reinforced rubber expansion joint which allows 4 way movement and 30° angular misalignment. A total of four (4) shall be provided for the system.

Pressure relief shall be provided by a 3" rupture disk constructed of impervious graphite and designed to relieve pressure at the design pressure of the vessel and at the maximum flow to the system. The rupture disks shall be mounted off the vessel vent line and vent to atmosphere. A total of two (2) will be provided for the system.

2.11 INSTRUCTIONS

Four complete sets of the manufacturer's Installation, Operating and Maintenance Manual shall be included with the treatment system. The O&M manual shall include schematic diagrams of electrical controls.

2.12 FOUNDATION DESIGN AND ANCHORAGE

The filter manufacture shall provide the design for the anchorage and foundation meeting local building earthquake requirements for the filtration system. The design and calculations shall be stamped and signed by an Engineer Registered in the State of Washington.

PART 3: EXECUTION

3.1 GENERAL

The Contractor shall provide and install the carbon filter treatment system as shown on the Plans and as specified herein, and in strict conformance with the manufacturer's recommendations.

3.2 MANUFACTURER

The services of a factory authorized service representative with at least 5-years experience commissioning similar installations shall be made available to supervise, inspect and provide operator training after initial startup as further defined below.

The services of a factory-trained representative of the treatment system manufacturer shall be provided to inspect the installation of all filter system equipment prior to startup in order to verify that the equipment has been properly installed and operates properly individually and as a system. The manufacturer's representative shall calibrate the equipment and make any field adjustments necessary to insure proper operation. After startup and commissioning, the manufacturer's representative shall instruct the Owner's personnel on proper operation and maintenance of the filter system. Manufacturer's services shall include three days at the site. The Contractor shall coordinate site visits with the manufacturer and Owner and be present during the manufacturer's site visits. If it is necessary for the manufacturer's representative to make additional trips due to fault or need of the Contractor, the additional trips shall be at the expense of the Contractor.

3.3 GUARANTEES

The Manufacturer shall guarantee all equipment, coatings, valves, and controls for 3 years against defects in workmanship or materials. Any part proving defective shall be replaced or repaired within this period in accordance with provisions of this contract.

The manufacturer shall guarantee that, under actual operating conditions: (1) the media shall not be washed out of the system during the service run or backwashing period; and, (2) the under drain system, gravel and media shall not become fouled, either with turbidity or by other particles, while operating as specified by the manufacturer.

These guarantees shall apply provided that the owner operates the filter system in accordance with Manufacturer's recommendations.

***** END OF SECTION *****

SECTION 11240

POTASSIUM PERMANGANATE FEED SYSTEM

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section covers furnishing and installing a Potassium Permanganate feed system that shall consist of two diaphragm metering pumps, a saturator tank, and all associated piping, tubing, clamps, valving, and accessories required for a complete and operable Potassium Permanganate feed system as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
01800	Testing, Commissioning, and Training
11000	General Requirements for Equipment
15050	Piping Systems
Division 16	Electrical

1.3 EQUIPMENT LIST

The following equipment shall be provided with the pyrolusite treatment system:

Item	Equipment Number
PG Feed Pump	04 MP 03
PG Feed Pump	05 MP 01
50 PG Saturator Tank	04 ST 02
50 PG Saturator Tank	05 ST 01

1.4 PERFORMANCE REQUIREMENTS

The Potassium Permanganate metering pumps shall be capable of supplying up to 1.98 gph of $KMnO_4$ (5.0 – 7.0 percent) solution at a pressure of 232 psi.

The PG saturator tank shall be capable of automatically producing a saturated solution of Potassium Permanganate ($KMnO_4$) when connected to a potable water source and when filled to within specified limits with granular $KMnO_4$.

All products and/or materials used and in contact with potable water or in contact with chemicals to be injected into potable water must bear the NSF stamp or be listed by the NSF as in compliance with Standard 61.

1.5 WARRANTY

In addition to the warranty required in the General Conditions, the equipment manufacturer shall provide an extended warranty covering defects in material and workmanship for 2 years following the date of substantial completion. The warranty shall be in printed form, shall apply to all similar units, and shall include parts and labor.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

The feed pumps shall be Grundfos Series DDA 7.5-16.

2.2 POTASSIUM PERMANGANATE FEED PUMPS

A. GENERAL

The potassium permanganate metering pumps shall be positive displacement, electronic metering diaphragm type pumps. Diaphragm shall be actuated by a microprocessor controlled stepper motor providing a 3000:1 turndown ratio.

The output volume shall be adjustable from the minimum to the maximum capacity, while the pump is in operation. The pump shall operate at 100 percent stroke length throughout the pumps entire capacity range.

The pumps shall be labeled and listed by a recognized electrical testing laboratory for the application, or approved by the Washington State Department of Labor and Industries for installation on the project.

B. ENCLOSURE

Drive mechanism and microprocessor shall be housed in a corrosion resistant, plastic UV stabilized enclosure.
The pump design shall include provisions for optional positioning of the control interface/display, for right/left side and front mounting.

Pump enclosure rating shall be to NEMA 4X standards.

The pump design shall include a integral removable click stop mounting plate, to allow for flat base or wall mounting.

C. INTERFACE

User interface/display shall be backlit LCD with selectable on-site positioning for either side or front mounting.

The interface shall provide a selection of metered output to be displayed in Gal/hr or l/hr. Pumps displaying percent (%) of output only will not be accepted.

The interface should include a turn and push (click wheel) for easy navigation.

The interface menu shall include 25 language selections and provide easy navigation of all configuration and operational functions.

The interface shall include a lock function to protect against unauthorized changes.

A built in counter shall be included to provide a running total of, accumulated strokes, cumulative hours of operation and dosing flow.

A priming button shall be provided on the interface. The priming button shall initiate a time selectable prime cycle operating at full capacity without need of attenuating the pumps output setpoint.

A system of white, red, orange and green LCD shall indicate pump status and alarm conditions.

D. DRIVE

An integral variable speed stepper motor shall be used to ensure the pump discharge phase extends throughout the full period between suction intervals. Variable frequency drives shall not be accepted. The drive mechanism shall not require regular field service or external lubrication. Drive motors shall be recognized or labeled and listed by a recognized electrical testing laboratory approved by the Washington State Department of Labor and Industries, or the motor shall be specifically approved by the Washington State Department of Labor and Industries for installation on the project.

E. LIQUID END

The process diaphragm shall be Teflon, Teflon faced diaphragms are not acceptable.

Head and valves body material shall be (PVDF) (316 Stainless Steel) (Polypropylene) (PVC), with (Ceramic) (Stainless Steel) ball material.

Wetted gasket material shall be (PTFE)(FKM) (EPDM).

Suction and discharge valve design shall incorporate double ball arrangement. Spring-loaded valves shall be available as an option. Direction of flow shall be clearly marked on each check valve to ensure correct installation.

Head design shall incorporate integral priming valve.

A back-plate with separation chamber shall have a safety lip seal and drain hole.

F. OPERATION

The pump's stroke length will always be 100 percent. No adjustment to the stroke length, to regulate flow, or for other reasons, is acceptable.

Repeatable metering accuracy shall be ±1 percent at constant hydraulic conditions throughout the entire output range.

The pump shall be equipped with a slow mode function for use with high-viscosity liquids. The slow mode function shall reduce the suction speed to either 50 or 25 percent of maximum capacity to ensure optimal priming and pumping reliability.

The pump shall be equipped with a calibration function which when initiated operates the pump for a set number of strokes and displays the anticipated pumped volume. The calibration process allows adjustment of the pump to set the calibration relative to the drawdown volume.

The pump shall be equipped with an analog re-scalable 0/4-20mA signal input. The scaling menu should allow for four point adjustments (two for signal, two for flow) within the signal and flow ranges.

The pump shall be equipped with provisions for selectable mode NO/NC external pump enable/disable interface.

A configurable maximum capacity limit shall be included in the interface menu. The limit value is to be specified as (gal or liters)/ hr.

The pump shall be equipped with input connections for dual level control and alarm outputs for low-level and empty tank warnings.

The pump shall be equipped with a programmable proportional 0/4-20mA signal output.

The pump shall be able to automatically de-aerate the pump head without the need for external devices.

The pump shall be equipped with two potential free selective programmable outputs.

G. OPERATION

The pump shall come equipped with five menu selectable control modes; Manual, analog, pulse, timer or batch. Optionally, the pump shall also be Profibus compatible.

Manual Control

1. Output of pump is displayed in gal or liters per hour. Pump output adjustment is performed with the turn and push knob (click wheel) on the interface.

2. Pumping rate changes are to be achieved through precise speed control with fixed full stroke length.

3. Pump output is to comply with prescribed menu maximum capacity value.

4. Pump should include a start/stop key.

Automatic Control

1. Analog: Pump shall include direct interface provisions for analog control. Both direct and reverse acting 0/4-20ma input configurations are to be acceptable inputs. The menu configuration shall permit pump maximum output multipoint scaling. The pump shall include a local alarm for loss of input signal.

2. Pulse: The pump shall include direct interface provisions for pulse output devices. In pulse control mode, the pump shall be configured to deliver a volume of product per incoming pulse. The pump speed shall attenuate the delivery rate based on the frequency of pulses generated by the external device.

3. Batch: In batch mode the pump shall respond to deliver a menu configurable quantity of liquid after receiving a remotely provided contact input.

4. Timer: The pump shall be equipped with a ten-day internal timer. The configuration menu shall permit the user to prescribe timed sequence start point and the time between each successive timed delivery cycle. The pump should also allow for weekly timed feed.

H. PULSATION DAMPER

Each pump shall be equipped with a pulsation dampener rated for at least 200 psi and constructed of material suitable for contact with potassium permanganate.

I. MULTIFUNCTION VALVE

Each pump shall be equipped with a multifunction valve backpressure and pressure relief valve.

J. CALIBRATION COLUMN

Column shall be Schedule 80, clear CPVC pipe volume size as shown, with a clear, observable length of at least 24 inches, and shall be permanently calibrated in milliliters and fractions thereof, to allow reading of the fluid contents with an accuracy of 1 percent.

2.3 PIPING

A. CHEMICAL SOLUTION PIPING

Chemical solution piping shall be pipe as specified in Section 15050 PIPING SYSTEMS.

B. STRAINER

Y-pattern, PVC with Viton O-rings, socket-weld ends, size as shown, 1/32-inch thick PVC sheet screen, 1/32-inch perforations, open area of

strainer basket at least twice the pipe cross-sectional area, removable cap for screen cleaning, and suitable for potassium permanganate service.

2.4 50-GALLON POTASSIUM PERMANGANATE SATURATOR TANK

The saturator tank shall be a free standing, 50-gallon polyethylene tank. The translucent tank wall shall have graduations every 5 gallons for easy checking of solution levels. The 1/2-inch inlet water pipe shall be manifolded in the tank for optimum water dispersion through the chemical bed. The tank wall shall have 3/4-inch drain, overflow connections, and a 1/2-inch inlet water connection with a solenoid valve. A vacuum breaker, flow meter (Rockwell or equal), and a flow regulator (set to pass 2 gpm, maximum) shall be in the inlet-waterline. The cover shall support a level switch and a metering pump. A floating pump suction connection shall have a strainer, and if required for the pump, a foot valve. The tank shall hold 300 pounds of potassium permanganate that requires refilling (manual) at the 100 pound level.

Water shall be automatically admitted by the float-level switch and solenoid valve. A drop pipe shall carry water to the tank bottom where water shall be discharged through manifold piping. Water shall flow up through the chemical to produce a saturated solution. The pump suction and strainer shall float on this solution. Solution shall be drawn into the pump head and metered to the point of application.

Operation shall be automatic. All wetted parts shall be plastic to provide maximum corrosion resistance. All openings shall be covered to minimize dusting and odor.

2.5 POTASSIUM PERMANGANATE EQUIPMENT PIPING AND VALVING

Piping, valving, fittings, and accessories shall be in accordance with the appropriate sections in Division 15 of these Specifications.

2.6 STATIC MIXER/INJECTOR

Static mixer shall be wafer style with injection port. Static mixer shall be constructed of PVC and shall be suitable for mixing potassium permanganate solution in water. Mixer shall be provided with a 0.8 beta ratio. Mixer shall be Westfall 2800, or approved equal.

2.7 CALIBRATION CYLINDER

Calibration cylinder shall be clear PVC plastic with NPT thread connections at top and bottom, 500 milliliter capacity, and marked in units of milliliters per minute

and gallons per hour. Calibration cylinder shall be as available from USA Bluebook, Stock No. 29376, or equal.

2.8 CHEMICAL

For each system provide 300 lbs of solid granular potassium permanganate certified under the requirements of NSF Standard 60 drinking water treatment chemical. The Contractor shall fill the 50 gallon saturator tank with permanganate solution

PART 3 EXECUTION

3.1 GENERAL

The equipment shall be installed in accordance with the Manufacturer's recommendations and instructions and as shown on the Drawings.

3.2 FIELD TESTS

Functional Test: Prior to startup, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test. Provide certification of test results. Tests and certification shall be as specified in Section 01800, TESTING, COMMISSIONING, AND TRAINING.

Performance Test: The Contractor, assisted by the equipment manufacturer's representative, shall conduct field tests with the equipment in its installed position. Tests shall include a load test in compliance with OSHA requirements and demonstration to the Engineer that under this load condition the equipment will perform satisfactorily throughout the complete range of operation. All safety devices shall be successfully demonstrated. Test and reports shall be as specified in Section 01800, TESTING, COMMISSIONING, AND TRAINING.

3.3 MANUFACTURER'S REPRESENTATIVE

The manufacturer shall include the services of a factory-trained field engineer for the purposes of installation inspection, making field adjustments necessary to ensure proper feed pump operation, equipment start-up, performance testing, and training of plant personnel regarding proper operation and maintenance of the equipment. Manufacturer's services shall include two eight hour days at the site (2 visits) for inspection, certification, and testing.

***** END OF SECTION *****

SECTION 11241

FERRIC CHLORIDE FEED SYSTEM

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section covers furnishing and installing a ferric chloride ($FeCl_3$) feed system as shown on the Plans and specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
01800	Testing, Commissioning, and Training
11000	General Requirements for Equipment
15050	Piping Systems
Division 16	Electrical

1.3 EQUIPMENT LIST

Equipment numbers are as follows:

Item	Quantity	Equipment Number
Ferric Chloride Pump No. 1	1	04 MP 01
Ferric Chloride Pump No. 2	1	04 MP 02
Contact Tank	1	04 CT 01

1.4 PERFORMANCE REQUIREMENTS

Each ferric chloride pump shall be capable of pumping from 0 to 1.98 gph of ferric chloride solution (40 percent) at a pressure of 232 psi.

All products and/or materials used and in contact with potable water or in contact with chemicals to be injected into potable water must bear the NSF stamp or be listed by the NSF as in compliance with Standard 61.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

The feed pumps shall be Grundfos Series DDA 7.5-16.

2.2 FERRIC CHLORIDE FEED PUMPS

A. GENERAL

The ferric chloride metering pumps shall be positive displacement, electronic metering diaphragm type pumps. Diaphragm shall be actuated by a microprocessor controlled stepper motor providing a 3000:1 turndown ratio.

The output volume shall be adjustable from the minimum to the maximum capacity, while the pump is in operation. The pump shall operate at 100 percent stroke length throughout the pumps entire capacity range.

The pumps shall be labeled and listed by a recognized electrical testing laboratory for the application, or approved by the Washington State Department of Labor and Industries for installation on the project.

B. ENCLOSURE

Drive mechanism and microprocessor shall be housed in a corrosion resistant, plastic UV stabilized enclosure.

The pump design shall include provisions for optional positioning of the control interface/display, for right/left side and front mounting.

Pump enclosure rating shall be to NEMA 4X standards.

The pump design shall include a integral removable click stop mounting plate, to allow for flat base or wall mounting.

C. INTERFACE

User interface/display shall be backlit LCD with selectable on-site positioning for either side or front mounting.

The interface shall provide a selection of metered output to be displayed in Gal/hr or l/hr. Pumps displaying percent (%) of output only will not be accepted.

The interface should include a turn and push (click wheel) for easy navigation.

The interface menu shall include 25 language selections and provide easy navigation of all configuration and operational functions.

The interface shall include a lock function to protect against unauthorized changes.

A built in counter shall be included to provide a running total of, accumulated strokes, cumulative hours of operation and dosing flow.

A priming button shall be provided on the interface. The priming button shall initiate a time selectable prime cycle operating at full capacity without need of attenuating the pumps output setpoint.

A system of white, red, orange and green LCD shall indicate pump status and alarm conditions.

D. DRIVE

An integral variable speed stepper motor shall be used to ensure the pump discharge phase extends throughout the full period between suction intervals. Variable frequency drives shall not be accepted. The drive mechanism shall not require regular field service or external lubrication.

Drive motors shall be recognized or labeled and listed by a recognized electrical testing laboratory approved by the Washington State Department of Labor and Industries, or the motor shall be specifically approved by the Washington State Department of Labor and Industries for installation on the project.

E. LIQUID END

The process diaphragm shall be Teflon, Teflon faced diaphragms are not acceptable.

Head and valves body material shall be (PVDF) (316 Stainless Steel) (Polypropylene) (PVC), with (Ceramic) (Stainless Steel) ball material.

Wetted gasket material shall be (PTFE)(FKM) (EPDM).

Suction and discharge valve design shall incorporate double ball arrangement. Spring-loaded valves shall be available as an option. Direction of flow shall be clearly marked on each check valve to ensure correct installation.

Head design shall incorporate integral priming valve.

A back-plate with separation chamber shall have a safety lip seal and drain hole.

F. OPERATION

The pump's stroke length will always be 100 percent. No adjustment to the stroke length, to regulate flow, or for other reasons, is acceptable.

Repeatable metering accuracy shall be ±1 percent at constant hydraulic conditions throughout the entire output range.

The pump shall be equipped with a slow mode function for use with high-viscosity liquids. The slow mode function shall reduce the suction speed to either 50 or 25 percent of maximum capacity to ensure optimal priming and pumping reliability.

The pump shall be equipped with a calibration function which when initiated operates the pump for a set number of strokes and displays the anticipated pumped volume. The calibration process allows adjustment of the pump to set the calibration relative to the drawdown volume.

The pump shall be equipped with an analog re-scalable 0/4-20mA signal input. The scaling menu should allow for four point adjustments (two for signal, two for flow) within the signal and flow ranges.

The pump shall be equipped with provisions for selectable mode NO/NC external pump enable/disable interface.

A configurable maximum capacity limit shall be included in the interface menu. The limit value is to be specified as (gal or liters)/ hr.

The pump shall be equipped with input connections for dual level control and alarm outputs for low-level and empty tank warnings.

The pump shall be equipped with a programmable proportional 0/4-20mA signal output.

The pump shall be able to automatically de-aerate the pump head without the need for external devices.
The pump shall be equipped with two potential free selective programmable outputs.

G. OPERATION

The pump shall come equipped with 5 menu selectable control modes; Manual, analog, pulse, timer or batch. Optionally, the pump shall also be Profibus compatible.

Manual Control

1. Output of pump is displayed in gal or liters per hour. Pump output adjustment is performed with the turn and push knob (click wheel) on the interface.

2. Pumping rate changes are to be achieved through precise speed control with fixed full stroke length.

3. Pump output is to comply with prescribed menu maximum capacity value.

4. Pump should include a start/stop key.

Automatic Control

1. Analog: Pump shall include direct interface provisions for analog control. Both direct and reverse acting 0/4-20ma input configurations are to be acceptable inputs. The menu configuration shall permit pump maximum output multipoint scaling. The pump shall include a local alarm for loss of input signal.

2. Pulse: The pump shall include direct interface provisions for pulse output devices. In pulse control mode, the pump shall be configured to deliver a volume of product per incoming pulse. The pump speed shall attenuate the delivery rate based on the frequency of pulses generated by the external device.

3. Batch: In batch mode the pump shall respond to deliver a menu configurable quantity of liquid after receiving a remotely provided contact input.

4. Timer: The pump shall be equipped with a ten-day internal timer. The configuration menu shall permit the user to prescribe timed sequence start point and the time between each successive timed delivery cycle. The pump should also allow for weekly timed feed.

H. PULSATION DAMPER

Each pump shall be equipped with a pulsation dampener rated for at least 200 psi and constructed of material suitable for contact with ferric chloride.

I. MULTIFUNCTION VALVE

Each pump shall be equipped with a multifunction valve backpressure and pressure relief valve.

J. CALIBRATION COLUMN

Column shall be Schedule 80, clear CPVC pipe volume size as shown, with a clear, observable length of at least 24 inches, and shall be permanently calibrated in milliliters and fractions thereof, to allow reading of the fluid contents with an accuracy of 1 percent.

2.3 PIPING

A. CHEMICAL SOLUTION PIPING

Chemical solution piping shall be pipe as specified in Section 15050 PIPING SYSTEMS.

B. STRAINER

Y-pattern, PVC with Viton O-rings, socket-weld ends, size as shown, 1/32-inch thick PVC sheet screen, 1/32-inch perforations, open area of strainer basket at least twice the pipe cross-sectional area, removable cap for screen cleaning, and suitable for ferric chloride service.

C. QUICK-CONNECT COUPLER

Provide a PVC male or female quick-connect coupler by socket weld PVC end for ferric chloride service. Provide an appropriate polypropylene male plug or female dust cap for coupler. Fittings shall satisfy the dimensions requirements of MIL-C-27487E.

The Contractor shall verify size of Quick-Connect Coupler and type of end (male or female) for chemical coupler with the Owner, prior to ordering any material.

2.4 CONTACT TANK

The contact tank shall have a maximum height of approximately 99 inches, a diameter of 64 inches and a capacity of 900 gallons. The tank shall be constructed from fiberglass and rated for an operating pressure of 150 psi. The tank shall be equipped with vertically oriented 6-inch inlet and outlet flanges located on the top and bottom of the vessel. The tank shall include an integral stand to allow the tank to be freestanding.

The contact vessel shall be part number TS6386C66*T as manufactured by Safe Water Technologies, or approved equal.

2.5 CHEMICAL

Provide two (2) full 275 gallon ferric chloride chemical totes. Ferric Chloride supplied shall meet AWWA Standard B407.

2.6 HAZARDOUS MATERIAL PLACARDING

All chemical storage tanks and entrance doors into chemical storage buildings and/or rooms shall be signed with placards in accordance with Standard 79-3 of the Uniform Fire Code, current edition.

In addition, signs identifying the location of the emergency shutoff valves on the chemical lines shall be installed at the valve location at both tanks and pumps.

Poly Processing or approved equal. The unit shall be constructed of material compatible with the chemical tank contents.

PART 3 EXECUTION

3.1 GENERAL

The equipment shall be installed in accordance with the Manufacturer's recommendations and instructions and as shown on the Drawings.

3.2 FIELD TESTS

Functional Test: Prior to startup, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test. Provide certification of test results. Tests and certification shall be as specified in Section 01800, TESTING, COMMISSIONING, AND TRAINING.

Performance Test: The Contractor, assisted by the equipment manufacturer's representative, shall conduct field tests with the equipment in its installed position. Tests shall include a load test in compliance with OSHA requirements and demonstration to the Engineer that under this load condition the equipment will perform satisfactorily throughout the complete range of operation. All safety devices shall be successfully demonstrated. Test and reports shall be as specified in Section 01800, TESTING, COMMISSIONING, AND TRAINING.

3.3 MANUFACTURER'S REPRESENTATIVE

The manufacturer shall include the services of a factory-trained field engineer for the purposes of installation inspection, making field adjustments necessary to ensure proper feed pump operation, equipment start-up, performance testing, and training of plant personnel regarding proper operation and maintenance of the equipment. Manufacturer's services shall include two eight hour days at the site (2 visits) for inspection, certification, and testing.

***** END OF SECTION *****

SECTION 11242

AIR VENTURI INJECTORS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section covers furnishing and installing one air venturi at the South Wellfield and five at the North Wellfield as shown on the Plans and specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
15050	Piping Systems

1.3 SUBMITTALS

Submit Catalog cuts and shop drawings in accordance with Section 01300 to demonstrate that the valves and appurtenances conform to the Specifications requirements.

The Contractor shall furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for all valves.

1.4 QUALITY ASSURANCE

All materials and equipment furnished under this Section shall be by the manufacturer specified.

PART 2 PRODUCTS

2.1 AIR VENTURI INJECTORS

All air venturi injectors shall be manufactured by Mazzei Injector Company, or equal.

A. SOUTH WELLFIELD

Material:	PVDF
Design Upstream Pressure	60 PSI

Existing Wells	Targeted Air Flow	Pressure Drop Across Venturi	Injector Inlet and Outlet Size	Injector Suction Port Size	Injector Model Number
Wiegardt Wells 1-3	312 SCFH	25 PSI	3-INCH	1-1/2-INCH	3090

B. NORTH WELLFIELD

Material: PVDF
Design Upstream Pressure 60 PSI

Existing Well	Targeted Air Flow	Pressure Drop Across Venturi	Injector Inlet and Outlet Size	Injector Suction Port Size	Injector Model Number
Well 4	105 SCFH	15 PSI	2-INCH	1-1/4-INCH	2081
Well 5	105 SCFH	15 PSI	2-INCH	1-1/4-INCH	2081
Well 6	139 SCFH	25 PSI	2-INCH	1-1/4-INCH	2081
Well 7	53 SCFH	25 PSI	1.5-INCH	½-INCH	1584
Well 8	139 SCFH	25 PSI	2-INCH	1-1/4-INCH	2081

PART 3 EXECUTION

3.1 GENERAL

The equipment shall be installed in accordance with the Manufacturer's recommendations and instructions and as shown on the Plans.

***** END OF SECTION *****

DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13422

PRESSURE INSTRUMENTS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section covers furnishing and installing pressure gauges and transducers and accessories as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
11000	Equipment General Provisions
Division 16	Electrical

1.3 PERFORMANCE REQUIREMENTS

The gauges shall be selected so that under normal operating conditions the pointers will be approximately vertical and at the midpoint of the pressure scales.

1.4 EQUIPMENT LIST

Pressure instrument range and type are as follows:

Location	Range	Number	Type
Wiegardt Well 1 Pressure Gauge	0 to 150 psi		
Wiegardt Well 2 Pressure Gauge	0 to 150 psi		
Wiegardt Well 3 Pressure Gauge	0 to 150 psi		
Filter System Inlet Gauge	0 to 150 psi		
Filter System Outlet Gauge	0 to 150 psi		
Filter System Inlet Pressure Transducer	0-150 psi	02 PT 01	1
Filter System Outlet Pressure Transducer	0-150 psi	02 PT 02	1
Wiegardt Well No. 1 Water Level Transducer	0 to 150 feet	01 LT 01	2
Wiegardt Well No. 2 Water Level Transducer	0 to 150 feet	02 LT 01	2
Wiegardt Well No. 3 Water Level Transducer	0 to 150 feet	03 LT 01	2

1.5 DELIVERY, STORAGE AND HANDLING

All equipment shall be completely factory assembled, skid mounted, crated and delivered to protect against damage during shipment.

All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions.

1.6 WARRANTY

In addition to the warranty required in the General Conditions, the equipment manufacturer shall provide an extended warranty covering defects in material and workmanship for 2 years following the date of substantial completion. The warranty shall be in printed form, shall apply to all similar units, and shall include parts and labor.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

The pressure gauges shall be U.S. Gauge, Ashcroft, or equal. The Type 1 pressure transducer shall be Foxboro IGP-10, ABB-Kent Taylor, or equal. The Type 2 Level Transducer shall be GE Druck Model No. PTX 1730, or equal.

2.2 PRESSURE GAUGE

The pressure gauges shall be glycerine filled type and shall have all internal parts immersed. Pressure gauges shall be minimum 4 1/2-inch dial size, with black metal cases and stainless steel bourdon tubes. The pressure gauge ranges shall be selected based on the anticipated working pressures of the lines to which they will be attached. All pressure gauges shall be fitted with 316 stainless steel pressure snubbers and isolation valves. Gauges shall be ANSI Grade A or better with an accuracy of +/-1 percent over their full range.

2.3 PRESSURE TRANSDUCER TYPE 1

Provide pressure transducers as shown on the Drawings and as specified herein. The pressure sensitive element shall be 316 stainless steel and shall be calibrated for the range specified in the pressure gauge schedule.

The unit shall include fully adjustable span, zero, suppression, and elevation adjustments. The electronic transducer shall be strain gage, capacitance, or mechanical resonance type. The transducer shall be "smart," with configuration

and calibration possible through keys internal to the transducer. No external devices shall be required for these functions.

The transducer shall be capable of deriving operating power from the 4-20 milliamp current loop with no auxiliary power supply (a "two-wire transmitter"). The transducer shall be capable of operating at 20 mA with a minimum of 12.5 VDC at the transmitter and shall be capable of regulating loop current with up to 24 VDC applied. Measurement accuracy shall be ±0.5 percent.

The transducer shall have an integral display of pressure or water level on the face of the unit.

2.4 PRESSURE TRANSDUCER TYPE 2

The pressure transducer shall be 316 Stainless Steel construction designed for long lasting life in hostile environments. The unit shall be furnished with a standard vented polyurethane cable. The unit shall be purchased with sufficient length to set the transmitter at 1 foot above the pump as indicated on the Drawings and extend to the junction box as shown on the Plans, with a spare 10 feet of cable. The pressure shall generate a 4-20 mA output proportional to the calibrated range for the water level measured, when powered by a 9 to 30 volt DC power supply.

The unit shall be GE Druck Model PTX 1730, 0-30 PSI gage pressure, supplied with a sensor termination enclosure with desiccant and waterproof vent, GE Druck Model STE 110, or equal. Sensor and termination enclosure must be from the same manufacturer and intended for use with each other.

The Contractor shall supply weights as necessary to ensure that the pressure transducer will hang straight down the well and not float in the well water column. Weights shall be stainless steel, brass, or other material that will not corrode, and will not contaminate the water supply well. Lead weights are not acceptable.

PART 3 EXECUTION

3.1 GENERAL

The pressure gauges, transducers, and switches shall be installed as shown on the Drawings. Installation shall be in strict accordance with the manufacturer's recommendations and instructions.

3.2 FIELD TESTING

The Contractor shall perform the field testing described in Sections 01800 and 11000.

The field test shall insure that the equipment will operate as desired under field conditions. The manufacturer shall provide a formal test procedure and report forms for recording data. The Contractor shall submit the report forms to the Engineer prior to operational testing.

Any defects in the equipment or failure to meet requirements of the Specification shall be promptly corrected by the Contractor.

3.3 MANUFACTURER'S REPRESENTATIVE

The services of a qualified manufacturer's representative shall be furnished for inspection of the installation, initial adjustments and instruction of the Owner's personnel in operation and maintenance for the pressure sensor installation. Manufacturer's services shall include one 8 hour day at the site and shall be included in the bid price.

***** END OF SECTION *****

SECTION 13426

MAGNETIC FLOW METERS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes furnishing and installing magnetic flow meters as shown on the Plans and as specified herein. The flow meters shall include all necessary accessories and hardware for a complete and workable installation.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
01800	Testing, Commissioning, and Training
11000	Equipment General Provisions
Division 16	Electrical

1.3 EQUIPMENT LIST

Equipment numbers are as follows:

Item	Equipment Number
South Wellfield Wiegardt Well No. 1	01 FE/FIT 01
South Wellfield Wiegardt Well No. 3	02 FE/FIT 02
South Wellfield Wiegardt Well No. 3	03 FE/FIT 01
South Wellfield Finished Water	04 FE/FIT 01
South Wellfield Backwash Supply	04 FE/FIT 02
North Wellfield System Water	07 FE/FIT 01

1.4 PERFORMANCE REQUIREMENTS

The magnetic flow meters shall have an accuracy of ±0.5 percent of the actual flow rate at velocities of 1.5 ft/sec or greater.

The flow meters shall be provided with the following size and flow range for the specified application and location.

Flow Meter	Flange Diameter (inches)	Flow Range (gpm)	Transmitter Location
01 FE/FIT 01	4	0-300	Remote
02 FE/FIT 01	4	0-300	Remote
03 FE/FIT 01	4	0-300	Remote
04 FE/FIT 01	6	0-1,000	Integral
04 FE/FIT 02	8	0-2,000	Integral
07 FE/FIT 01	6	0-2,000	Integral

The liquids to be measured will be potable water.

1.5 DELIVERY, STORAGE AND HANDLING

All equipment shall be completely factory assembled, crated and delivered to protect against damage during shipment.

All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions.

1.6 WARRANTY

In addition to the warranty required in the General Conditions, the equipment manufacturer shall provide an extended warranty covering defects in material and workmanship for 2 years following the date of substantial completion. The warranty shall be in printed form, shall apply to all similar units, and shall include parts and labor.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

The magnetic flow meters and transmitter shall be Siemens SITRANS 5100W/MAG 6000, or equivalent equipment manufactured by ABB, Endress & Hauser, Krohne or Toshiba. No other manufacturers shall be accepted.

2.2 GENERAL

The magnetic flow meters shall be of the low frequency and short form coil design. The field principle of electromagnetic induction shall produce a positive DC pulsed signal directly and linearly proportional to the liquid flow rate. The metering tube shall be constructed of Type 316 stainless steel with Class 150 ANSI flanged end connections. Electrodes can either be protruding (bullet nose) or flush for the meters, but shall be of Type 316 stainless steel, Hastelloy®, or zirconium construction. The material of construction of the liner shall be NBR

hard rubber, Neoprene rubber or chloroprene rubber. The meter shall secure its power from the transmitter. No electronics shall be mounted in the metering tube of the magnetic flow meter.

The transmitters shall be integral to the flow head where specified in Part 1.4. Provisions for remotely mounting the transmitter shall be provided where the transmitter is specified to be remote. Transmitter shall be interchangeable without reprogramming the meters or disconnecting the cables. The transmitters shall convert the output signal from the flow meters and transmit the signal via an isolated analog 4-20 mA signal directly proportional to flow rate. The transmitter shall have automatic zero correction. The transmitters shall be designed to operate from a 120 AC, 60 Hz, single phase, power source. The transmitters shall generate power for the flow tube.

The transmitters shall produce a totalization of flow dry contact output pulse signal or opto-isolated transistor pulse signal, which is directly and linearly proportioned to totalization of flow and which is suitable for use with a 24 VDC discrete input with an input impedance of at least 2 kΩ. The minimum pulse duty cycle shall be adjustable to be at least 250 ms.

The magnetic flow meter tube and transmitter shall be NEMA 4X classified. The units shall be listed and labeled by a electrical testing laboratory recognized by the Washington State Department of Labor and Industries or be acceptable to the Washington State Department of Labor and Industries for installation on this project.

Each meter system shall be wet-calibrated at the manufacturer's facility against the master system. A calibration certificate shall be furnished for each meter.

Provide grounding rings or grounding electrodes with each flow meter as required to maintain the specified accuracy.

The flow meters shall be capable of accidental submergence to 3 feet for a period of 30 minutes.

2.3 ANALOG INSTRUMENTATION

The flow meters shall be of the manufacturer's latest design. The equipment shall have 4 to 20 milliamperes standard DC (direct current) isolated floating outputs and shall conform to ISA 50.1. Each output shall be provided with adjustments for gain and bias. The resultant output shall be 4-20 mA DC into approximately 750 ohms. Accuracy shall be ±0.25 percent of full scale output.

Analog instruments shall operate without loss of loop accuracy due to electromagnetic interference, resistive or inductive losses or similar problems

related to field interconnection of components when connected with shielded 2/conductor #18 gauge copper wire in the manner shown on the Plans.

2.4 SPARE PARTS

The Contractor shall supply one spare transmitter.

All spare parts shall be suitably identified and effectively protected from moisture and corrosion with appropriate wrappings or coatings or a combination thereof. All parts shall be furnished in sturdy labeled boxes.

2.5 FACTORY TESTING

The equipment shall be fully tested at the manufacturer's plant before shipment. Tests shall insure that the equipment will operate as desired under anticipated field conditions. Certified copies of test report(s) shall be submitted to the Engineer prior to shipment.

PART 3 EXECUTION

3.1 INSTALLATION

The flow meters shall be installed as shown on the Plans and in accordance with the Manufacturer's recommendations and instructions. If ground rings are required to maintain the specified accuracy, they shall be installed with the units and bonded to grounding conductor where recommended or required by the Manufacturer.

3.2 FIELD TESTING

The Contractor shall perform the field testing described in Sections 01800 and 11000.

The field test shall insure that the equipment will operate as desired under field conditions. The manufacturer shall provide a formal test procedure and report forms for recording data. The Contractor shall submit the report forms to the Engineer prior to operational testing.

Any defects in the equipment or failure to meet requirements of the Specification shall be promptly corrected by the Contractor.

3.3 MANUFACTURER'S SERVICES

The services of a factory-trained representative of the magnetic flow meter manufacturer shall be provided. Services shall include a minimum of 1 day onsite. Services shall include inspection of the installation, initial configuration,

programming, startup, and adjustments and instruction of the Owner's personnel in operation and maintenance. Instruction and training of the Owner's personnel shall not take place until startup is completed and the magnetic flow meters are fully operational and shall be at a time and location agreed to by the Owner. The cost of these services shall be included in the bid price.

The representative shall provide for two additional service calls during the initial 2 years of equipment operation.

***** END OF SECTION *****

SECTION 13451

PROGRAMMABLE LOGIC CONTROLLER (PLC) PROGRAMMING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes programmable logic controller (PLC) control system(s), including: software, programming, installation, field testing, and training.

1.2 RELATED WORKS SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
13450	Programmable Logic Controller (PLC) Hardware
13452	Human Machine Interface (HMI) Alarm Software and Process Computer
16050	Basic Electrical Materials and Methods

1.3 SYSTEM DESCRIPTION

A. DESIGN REQUIREMENTS

1. The system includes programmed algorithms, which run on the PLC hardware to provide a complete and functional process control system for the facility.

B. PERFORMANCE REQUIREMENTS

1. The installed system performs the functional and operational algorithms required for control of the process.

1.4 DEFINITIONS

A. ANALOG I/O

Analog I/O are PLC input/output electronic signals that are contiguous over time. Analog signals represent a large number of values within a specific range.

B. DIGITAL I/O

A single digital binary bit with one of a possible two states which may be represented as 1's or 0's, ON or OFF, YES or NO, TRUE or FALSE. Digital I/O may also be called "discrete" I/O. Within this specification, both terms are synonymous.

C. HMI

Human Machine Interface – The way a person interacts with a computer or electronic device. It comprises the screen menus and icons, keyboard shortcuts, command language, and help functions. All input devices, such as mouse, keyboard, touch screen, and remote controls are also included. The HMI system is typically located in an office or lab environment.

D. I/O

Inputs/Outputs – Input and output signals into and out of a PLC or RTU.

E. OIM

Operator Interface Module – A programmable operator interface directly associated with, or integral to, an electrical device (such as a VFD or Soft Start drive). This interface displays device setpoints and status with a keypad for data entry.

F. OIU

Operator Interface Unit – A graphical display of industrial plant system variables and status. It may also allow for process control. Navigation of its programming may be via keypad, touch screen, or a combination. An OIU is typically located on a field control panel or control panel in an electrical equipment room.

G. PLC

Programmable Logic Controller – A device used to monitor and control system process. It can be used stand-alone or in conjunction with other systems such as SCADA. It may provide telemetric functions or interface with telemetric equipment.

H. RTU

Remote Telemetry Unit/Remote Terminal Unit – A device that reads the status of process devices and transmits them to another telemetric unit. RTUs may transmit a command from another source but will not alter or interpret the command. RTUs do not control the process.

1.5 SUBMITTALS

A. PRODUCT DATA

1. Manufacturer's information for software components including specific version or release numbers for each program, module, driver, or similar software.

2. Manufacturer's programming manual.

B. SHOP DRAWINGS

1. Annotated copies of PLC software programs with cross reference and I/O and register lists, as described in Paragraph C 2 below.

C. OPERATION AND MAINTENANCE MANUALS

1. See Section 01300 "Submittals."

2. Provide specific information including:

a. Include final annotated electronic copies of system programming, final cross reference, and final I/O and register lists.

i. Annotations include the following:

(1) Description of each rung's function.

(2) Description of each coil, contact, timer, counter, or similar function block component.

(3) Reference to name, control loop or instrumentation tag number(s) of I/O devices for each rung where applicable.

ii. Cross reference includes register addresses indicating where each register, coil, contact, timer, counter, or similar function block, is used.

iii. Schedule of system I/O including internal register address of each I/O point

iv. Listing of auxiliary registers and values such as setpoints, operating parameters, control loop tuning parameters, and similar registers or values used, including the following associated data:

(1) Each value or parameter with its register type, register address, descriptive name, and function in the program or algorithm.

b. Include information for obtaining assistance from the programmer.

1.6 QUALITY ASSURANCE

A. QUALIFICATIONS

1. Programmer has experience successfully programming PLCs for a minimum of two projects of similar size and complexity. Utilize one programmer for the entire project.

1.7 SEQUENCING AND SCHEDULING

A. INSTALLATION AND STARTUP

1. Sequence the installation and startup of the PLC program in coordination with the scheduled startup of portions of the plant. This sequencing may involve startup and operation of portions of the plant under the new control system while other portions remain in operation under the old control system. Provide for operation of the revised portions of the plant under the new control system, while maintaining operation of other parts of the facility under the old system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The PLC software must be the latest version and of the same manufacturer as the PLC of Section 13450, and must be compatible with that PLC hardware.

2.2 COMPONENTS

A. Utilize the manufacturer's complete system programming software package which uses a high level language with preprogrammed software algorithms which may be linked to perform the functions specified and/or required.

1. Software operates on a personal computer using a Microsoft Windows type operating system.

2. Software is capable of downloading and monitoring programs on a PLC processor locally via serial link.

3. Software capabilities include:

a. Full documentation capability.

b. On/off line programming.

c. Offline simulation prior to download.

d. Program over network capability.

e. Two step commands requiring operator verification prior to deletion of any programming.

4. If required by the software manufacturer provide a "runtime" license of the software to the Owner and provide copies of the license agreement to the Owner.

2.3 SOURCE QUALITY CONTROL

A. TESTING

1. Test programming after completion of programming and prior to loading on PLC at the project site.

a. System is operated continuously and checked for correct operation including program operation, loop controls, indications, alarm responses, noise immunity, and on/off sequencing control.

b. Utilize dummy I/Os to verify proper operation of programming.

c. Provide a computer and software during testing to allow viewing of system parameters and entering of parameters simulating operator entries of parameters such as setpoints, and alarm values.

PART 3 EXECUTION

3.1 APPLICATION

A. Create program using manufacturer's software specified in Part 2.

1. Provide programming to accomplish all control and monitoring requirements indicated or specified.

B. PROGRAM ORGANIZATION

1. Organize and format the PLC programs in each processor consistently.

a. The programming and annotation for any given alarm, timer, counter, control loop, function, etc., in any given processor shall be programmed, formatted and organized similarly to other comparable alarm, timer, counter, control loop, function, etc., in any other processor in the system.

2. Create the program to utilize system memory and register space in an efficient and logical manner.

a. Organize code sections logically.

b. Assign or use register and memory space to minimize complexity, scan time, and memory space, but not at the expense of logical order.

3.2 SYSTEM CONNECTIVITY

A. PLC LOCAL AREA NETWORK CONNECTIONS

All hardware, cabling, adaptors, and software, parameter settings, and programming shall be included and integrated to provide a complete functional and reliable communication network between the PLC and the following devices:

1. Power Monitor Unit (PMU) Status

   If network connectivity is specifically called out on the Plans to Power Monitor Units (PMUs), then the following electrical power conditions shall be continually measured by those PMUs and the resulting data network-transmitted to the PLC:

   a. Volts (each phase)

   b. Amps (each phase)

   c. KVAR (each phase)

   d. KW (each phase)

   e. KVA (each phase)

   f. THD (each phase)

2. Full Voltage Non-Reversing (FVNR) Motor Starter Modules

   If network connectivity is specifically called out on the Plans to FVNR motor starters, then those starters shall be monitored and controlled for:

   a. Module Power Valid — Network DI

   b. Bus Power Valid — Network DI

   c. Module Fault (specific fault codes) — Network DI

   d. Module Overload — Network DI

   e. Motor Running — Network DI

f.	Motor Run Command	Network DO
g.	Actual motor amperes	Network AI

3. Soft Start (SS) Motor Drives

   If network connectivity is specifically called out on the Plans to Soft Start motor drives, then those drives shall be monitored and controlled for:

a.	Drive Power Valid	Network DI
b.	Bus Power Valid	Network DI
c.	Drive Fault (specific fault codes)	Network DI
d.	Motor Running	Network DI
e.	Motor at Full Voltage	Network DI
f.	Motor Run Command	Network DO
g.	Actual motor amperes	Network AI

4. Variable Frequency (VFD) Drives

   If network connectivity is specifically called out on the Plans to VFD motor drives, then those drives shall be monitored and controlled for:

a.	Drive Power Valid	Network DI
b.	480 V Valid	Network DI
c.	Drive Fault (specific fault codes)	Network DI
d.	Motor Running	Network DI
e.	Motor Run Command	Network DO
f.	Auto speed input to drive	Network AO
g.	Actual speed (frequency) output from drive	Network AI

h.	Actual speed (frequency) output from drive	Network AI
i.	Actual motor amperes	Network AI
j.	Actual motor voltage	Network AI

B. PLC HARD-WIRED CONNECTIONS

The following connections shall be hard-wire connected to the PLC:

1. Motor Starters General

Regardless of whether motor starters and drives are hardwired or network-connected to the PLC, the following additional status signals shall be hard-wired and monitored for each motor controller:

a. If the motor controller contains an HOA switch, then the switch shall be monitored for “HAND” position and “AUTO” position.

b. If the motor controller contains an ON/OFF switch, then the switch shall be monitored for “ON” position.

c. If the motor controller contains an RESET/OFF/ON switch, then the switch shall be monitored for “RESET” position and “ON” position

d. If the motor controller contains ON and OFF pushbuttons, then both buttons shall be monitored for their pressed position.

e. If a Motor Safety Disconnect Switch (MSDS) can disable the motor controller’s control logic, then sense when the MSDS is closed.

f. Sense if the motor controller power breaker is closed.

g. If the motor controller contains an over-temperature detector, then sense on over temperature.

h. If the motor controller contains a seal leak detector, then sense on seal leak.

i. If the motor controller contains a low water level sensing circuit that can disable the starter, then sense on low water level.

j. If the motor controller contains a high water level sensing circuit that can force the starter, then sense on high water level.

2. Full Voltage Non-Reversing (FVNR) Motor Starter Modules

If network connectivity is not specifically called out on the Plans to FVNR motor starters, then those starters shall be hard-wired for:

a.	Starter Power Valid	PLC DI
b.	Bus Power Valid	PLC DI
c.	Starter Overload	PLC DI
d.	Motor Running	PLC DI
e.	Motor Run Command	PLC DO

Some existing motor starters may not have provision for digital outputs as described above. In those cases, only those digital outputs that are available shall be used.

3. Soft Start (SS) Motor Drives

If network connectivity is not specifically called out on the Plans to Soft Start motor drives, then those drives shall be hard-wired for:

a.	Drive Power Valid	PLC DI
b.	Bus Power Valid	PLC DI
c.	Drive Fault	PLC DI
d.	Motor Running	PLC DI
e.	Motor at Full Voltage	PLC DI
f.	Motor Run Command	PLC DO

4. VFD Drives

If network connectivity is not specifically called out on the Plans to VFD motor drives, then those drives shall be hard-wired for:

a.	Drive Power Valid	PLC DI
b.	480 V Valid	PLC DI
c.	Drive Fault	PLC DI
d.	Motor Running	PLC DI
e.	Motor Run Command	PLC DO
f.	Auto speed input to drive	PLC AO
g.	Actual speed (frequency) output from drive	PLC AI
h.	Actual speed (frequency) output from drive	PLC AI
i.	Actual motor amperes	PLC AI

3.3 PROGRAM CONTROL METHODS

A. MOTOR STARTER PLC-DERIVED STATE CONDITIONS

The following states shall be continually derived within the PLC control logic for each starter:

1. Drive/Starter Disabled

In the "DISABLED" state, the drive/starter cannot be queued to run. The PLC shall set the status of a starter to the "DISABLED" state under the following conditions:

a. The drive's selector switch is in the "OFF" position.

b. The drive is faulted for any of the following reasons:

i. Drive control power is not valid

ii. Drive bus voltage is not valid

iii. Drive fault

iv. Starter overload/overcurrent

v. Drive breaker open

vi. Motor over temp

vii. MSDS open

2. Drive/Starter Ready

In the "READY" state, the drive/starter can be queued to run. The PLC shall set the status of a starter to the "READY" state under the following conditions:

a. The drive's selector switch is in the "AUTO" position.

b. The drive is not disabled

c. The drive is not running

3. Drive/Starter Running

In the "RUNNING" state, the drive/starter is in the running queue either by a successful auto run request or a successful forced manual run. The PLC shall set the status of a starter to the "RUNNING" state under the following conditions:

a. The drive is running ("RUN" status is true)

B. PLC REGISTER MANAGEMENT

1. The following registers shall be provided within the PLC:

a. For each motor, provide an hh.h "MOTOR RUNTIME REGISTER".

b. For each motor, provide a 32-bit integer "MOTOR STARTER COUNTER REGISTER."

c. For each flow meter with a totalizing function, provide a 64-bit integer "ACCUMULATED TOTAL GALLONS REGISTER".

d. For each flow meter with a totalizing function, provide a 32-bit integer "DAILY TOTAL GALLONS REGISTER."

e. For each flow meter with a totalizing function, provide a 32-bit integer "DAY 1 GALLONS REGISTER". This register is one day previous to today (yesterday).

f. For each flow meter with a totalizing function, provide 32-bit integer registers "DAY X GALLONS REGISTER" where X = 7 if a SCADA system is included in the design and X = 31 if a SCADA system is not included in the design.

2. The following registers shall be updated within the PLC. If flow totalizing functions are provided, either by flow pulses received from the flow meter transmitter or derived by software integration, then flow meter totalizing registers shall be updated as follows by a TOTALIZING INCREMENT AMOUNT:

a. Each 1,000 msec, registers "MOTOR RUNTIME REGISTER" are incremented for each motor if the motor starter is in the "RUNNING" state (time-driven).

b. Registers "MOTOR STARTER COUNTER REGISTER" are incremented for each motor on a successful transition of state from its "READY" to its "RUNNING" state (event-driven).

c. For each flow meter totalizing input pulse, or integrated totalizing incremental value, set.

"ACCUMULATED TOTAL GALLONS REGISTER" = "ACCUMULATED TOTAL GALLONS REGISTER" + TOTALIZING INCREMENT AMOUNT.

d. For each flow meter totalizing input pulse, or integrated totalizing incremental value, set.

"ACCUMULATED TOTAL GALLONS REGISTER" = "ACCUMULATED TOTAL GALLONS REGISTER" + TOTALIZING INCREMENT AMOUNT.

e. For each flow meter totalizing input pulse, or integrated totalizing incremental value, set.

"ACCUMULATED TOTAL GALLONS REGISTER" = "ACCUMULATED TOTAL GALLONS REGISTER" + TOTALIZING INCREMENT AMOUNT.

C. PLC STATUS MANAGEMENT

The following conditions shall be established within the PLC:

1. Unless otherwise specified, alarm or fail conditions shall be latched in the PLC and shall require manual resetting via the PLCs OIU or system's HMI before returning to normal operation.

2. Register values for time delays, setpoints, lead-lag order, etc. shall be changeable by the operator at the PLCs OIU or system's HMI.

3.4 PROCESS CONTROL ALGORITHM

A. MASTER PLC [05 PLC 01]

The Master PLC shall provide the functionality described below. All controls and alarms shall be provided with delay capabilities, dead bands, and/or hysteresis to prevent unwanted ratcheting or oscillating control behavior.

1. Inputs and Outputs

Digital and analog inputs are detailed on the Plans. The following is a summary of equipment that provides inputs and outputs to the PLC.

a. Master PLC Digital Inputs

The Master PLC shall monitor digital inputs for motor starters as described in Part 3.2.A/B:

i. Well No. 4 Motor Starter (09 MS 04)
ii. Well No. 5 Motor Starter (09 MS 05)
iii. Well No. 6 Motor Starter (09 MS 06)
iv. Well No. 7 Motor Starter (09 MS 07)
v. Well No. 8 Motor Starter (09 MS 08)
vi. Booster Pump No. 1 Motor Starter (07 MS 01)

vii. Booster Pump No. 2 Motor Starter (07 MS 02)
viii. Booster Pump No. 3 Motor Starter (07 MS 03)
ix. Booster Pump No. 4 Motor Starter (07 MS 04)
x. Booster Pump No. 5 Motor Starter (07 MS 05)

The Master PLC shall also monitor the digital inputs for totalizing pulses for the following flowmeters:

i. Finished Water Flowmeter (05 FE/FIT 01)
ii. System Water Flowmeter (07 FE/FIT 01)

The Master PLC shall also monitor the digital inputs from the South Wellfield PLC (04 PLC 01) via network.

The Master PLC shall send calls to run to equipment based on the algorithms described below. Equipment with run commands include the following:

i. Well No. 4 (09 MS 04)
ii. Well No. 5 (09 MS 05)
iii. Well No. 6 (09 MS 06)
iv. Well No. 7 (09 MS 07)
v. Well No. 8 (09 MS 08)
vi. Booster Pump (07 BP 01)
vii. Booster Pump (07 BP 02)
viii. Booster Pump (07 BP 03)
ix. Booster Pump (07 BP 04)
x. Booster Pump (07 BP 05)

The Master PLC shall send digital outputs to actuated ball valves based on the algorithms described below. Actuated ball valves receiving digital outputs from the PLC include the following:

i. Ball Valve No. 1, Train 1, Filter 1, Raw Water (05 BV 01)
ii. Ball Valve No. 2, Train 1, Filter 1, Backwash (05 BV 02)
iii. Ball Valve No. 1, Train 1, Filter 2, Raw Water (05 BV 03)
iv. Ball Valve No. 2, Train 1, Filter 2, Backwash (05 BV 04)
v. Ball Valve No. 1, Train 1, Filter 3, Raw Water (05 BV 05)

vi. Ball Valve No. 2, Train 1, Filter 3, Backwash (05 BV 06)
vii. Ball Valve No. 1, Train 2, Filter 1, Raw Water (05 BV 07)
viii. Ball Valve No. 2, Train 2, Filter 1, Backwash (05 BV 08)
ix. Ball Valve No. 1, Train 2, Filter 2, Raw Water (05 BV 09)
x. Ball Valve No. 2, Train 2, Filter 2, Backwash (05 BV 10)
xi. Ball Valve No. 1, Train 2, Filter 3, Raw Water (05 BV 11)
xii. Ball Valve No. 2, Train 2, Filter 3, Backwash (05 BV 12)
xiii. Ball Valve No. 1, Train 3, Filter 1, Raw Water (05 BV 13)
xiv. Ball Valve No. 2, Train 3, Filter 1, Backwash (05 BV 14)
xv. Ball Valve No. 1, Train 3, Filter 2, Raw Water (05 BV 15)
xvi. Ball Valve No. 2, Train 3, Filter 2, Backwash (05 BV 16)
xvii. Ball Valve No. 1, Train 3, Filter 3, Raw Water (05 BV 17)
xviii. Ball Valve No. 2, Train 3, Filter 3, Backwash (05 BV 18)
xix. Ball Valve No. 1, Train 4, Filter 1, Raw Water (05 BV 19)
xx. Ball Valve No. 2, Train 4, Filter 1, Backwash (05 BV 20)
xxi. Ball Valve No. 1, Train 4, Filter 2, Raw Water (05 BV 21)
xxii. Ball Valve No. 2, Train 4, Filter 2, Backwash (05 BV 22)
xxiii. Ball Valve No. 1, Train 4, Filter 3, Raw Water (05 BV 23)
xxiv. Ball Valve No. 2, Train 4, Filter 3, Backwash (05 BV 24)

The Master PLC shall send digital outputs to control valves based on the algorithms described below. Each control valve shall receive three separate digital signals. Control valves receiving digital outputs from the PLC include the following:

i. Control Valve, Train 1, Filter 1 (05 CV 01)
ii. Control Valve, Train 1, Filter 2 (05 CV 02)
iii. Control Valve, Train 1, Filter 3 (05 CV 03)
iv. Control Valve, Train 2, Filter 1 (05 CV 04)
v. Control Valve, Train 2, Filter 2 (05 CV 05)
vi. Control Valve, Train 2, Filter 3 (05 CV 06)
vii. Control Valve, Train 3, Filter 1 (05 CV 07)
viii. Control Valve, Train 3, Filter 2 (05 CV 08)
ix. Control Valve, Train 3, Filter 3 (05 CV 09)
x. Control Valve, Train 4, Filter 1 (05 CV 10)
xi. Control Valve, Train 4, Filter 2 (05 CV 11)
xii. Control Valve, Train 4, Filter 3 (05 CV 12)

The Master PLC shall also have a digital output indicating PLC status.

b. Master PLC Analog Inputs

The Master PLC shall monitor analog inputs from the following instruments. The Master PLC shall maintain registers for daily maximum, minimum, and average values for each parameter. The Master PLC shall maintain registers for control and high and low alarm setpoints for each analog input (with the exception of flowmeters and current transducers).

i. North Wellfield Finished Water Flow Meter (05 FE/FIT 01)
ii. North Wellfield Reservoir Level Transducer (08 LT 01)
iii. North Wellfield System Water Flow Meter (07 FE/FIT 01)
iv. North Wellfield System Pressure Transducer (07 PT 01)

c. Master PLC Analog Outputs

The Master PLC shall generate analog outputs to control the speed of the following pieces of equipment:

i. Potassium Permanganate Metering Pump No. 1 (05 MP 01)

2. Well Pump Control

The mode of each well pump will be controlled by an H-O-A switch on the face of each motor starter. In Hand mode, the well pump will run. In Off mode, the well pump will not run. In Auto mode, the well pump will be controlled by the Master PLC. The Master PLC will call the wells to run based upon the level in the north wellfield reservoirs. The Master PLC shall call all wells to run simultaneously.

3. Booster Pump Controls

The booster pumps at the north wellfield will be called to run by the Master PLC. The Master PLC will call the booster pump to run based upon a distribution system pressure setpoint as measured by the pressure transducer located on the booster station discharge manifold [07 PT 01],. Each booster pump shall be assigned an operating position (lead, lag 1, lag 2, lag 3, or lag 4) from the operator interface. The operator shall be able to provide separate pump-on and pump-off pressure setpoints for each booster pump.

4. Flows

Both instantaneous (analog) and total flow (digital) flow signals will be transmitted from flow meters [05 FE/FIT 01] and [07 FE/FIT 01] to the Master PLC. The Master PLC operator interface shall have a screen that displays the instantaneous and total flow for each meter. A reset button shall be provided that allows the operator to reset the running total for each flowmeter. An inventory of screens is detailed in Section 13453 of these specifications.

5. Level Transducers

Analog level signals will be transmitted from the north wellfield reservoir level transducer [08 LT 01] to the Master PLC. The Master PLC operator interface shall have a screen that displays the instantaneous level for the North Wellfield reservoirs. An inventory of screens is detailed in Section 13453 of these Specifications.

6. Filtration System Control

Through the operator interface, the operator will be allowed to select the following backwash control methods (Run Time or Flow) The Master PLC shall maintain a register that tracks total filter run time since the last backwash. In Run Time mode, the Master PLC shall call for backwash when the total run time since the last backwash reaches an operator selectable setpoint (initially set at 12 hours). In Flow mode when the total flow reaches an operator selectable value (initially set at 400,000 gallons), the Master PLC shall call for backwash.

The Master PLC will call each filter to backwash in sequence. For each filter vessel, the call for backwash shall be initiated by three digital signals from the Master PLC. For each filter vessel, backwash shall be initiated by a digital signal to close the raw water ball valve, open the backwash supply ball valve, and switch the filter control valve from normal operation to backwash. For each filter vessel, backwash shall continue for an operator selectable length of time before backwash is terminated by a digital signal generated by the Master PLC to close the backwash supply valve, open the raw water ball valve, and switch the filter control valve from backwash to rapid rinse. The rapid rinse cycle shall proceed for an operator selectable length of time before the Master PLC generates a digital signal to switch the filter control valve back to the normal operating position. Each filter vessel shall proceed through the entire backwash/rapid rinse sequence prior to beginning backwash on the next filter.

Backwash shall begin on the subsequent filter when the rapid rinse cycle is complete on the previous filter. This process shall be repeated until each filter has been backwashed.

The Master PLC shall maintain a register that tracks the total raw water flow since the completion of the last filter backwash. Following backwash, the Master PLC will then reset the counters for run time and total flow since the last backwash.

7. Potassium Permanganate System Control

One potassium permanganate metering pump will be assigned to operate with the North Wellfield Wells. When the wells operate, the Master PLC shall signal potassium permanganate Metering Pump No. 1 (05 MP 01) to run. The speed of the metering pump

will be controlled by the Master PLC based upon the finished water flow rate as measured by [05 FE/FIT 01].

B. SOUTH WELLFIELD PLC SYSTEM [04 PLC 01]

The South Wellfield PLC shall provide the functionality described below. All controls and alarms shall be provided with delay capabilities, dead bands, and/or hysteresis to prevent unwanted ratcheting or oscillating control behavior.

1. Inputs and Outputs

Digital and analog inputs are detailed on the Plans. The following is a summary of equipment that provides inputs and outputs to the South Wellfield PLC.

a. South Wellfield PLC Digital Inputs

The South Wellfield PLC shall monitor digital inputs for motor starters for the following equipment as described in Part 3.2.A/B:

i. Wiegardt Well No. 1 (01 WP 01)
ii. Wiegardt Well No. 2 (02 WP 01)
iii. Wiegardt Well No. 3 (03 WP 01)
iv. Booster Pump (04 BP 01)
v. Booster Pump (04 BP 02)
vi. Booster Pump (04 BP 03)
vii. Booster Pump (04 BP 04)

The South Wellfield PLC shall also monitor digital inputs from the following equipment:

viii. MCC Surge Protector (04 SPD 01)
ix. MCC Main Disconnect Breaker (04 MCB 01)

The South Wellfield PLC shall also monitor the digital inputs for totalizing pulses for the following flowmeters:

i. Wiegardt Well No. 1 Flow Meter (01 FIT 01)
ii. Wiegardt Well No. 2 Flow Meter (02 FIT 01)
iii. Wiegardt Well No. 3 Flow Meter (03 FIT 01)
iv. Finished Water Flowmeter (04 FE/FIT 01)
v. Backwash Supply Flowmeter (04 FE/EIT 02)

The South Wellfield PLC shall also monitor the digital inputs from the following PLC units via network.

vi. Master PLC (05 PLC 01)

b. Digital Outputs

The South Wellfield PLC shall send calls to run to equipment based on the algorithms described below. Equipment with run commands include the following:

i. Wiegardt Well No.1 Pump (01 WP 01)
ii. Wiegardt Well No.2 Pump (02 WP 01)
iii. Wiegardt Well No.3 Pump (03 WP 01)
iv. Booster Pump Station (04 BPS 01)
v. Ferric Chloride Metering Pump No. 1 (04 MP 01)
vi. Ferric Chloride Metering Pump No. 2 (04 MP 02)
vii. Potassium Permanganate Metering Pump No. 1 (04 MP 03)

The South Wellfield PLC shall also send the following digital signals to the Filter System Control Panel:

viii. Call to Backwash

The South Wellfield PLC shall also have a digital output indicating PLC status.

c. South Wellfield PLC Analog Inputs

The South Wellfield PLC shall monitor analog inputs from the following instruments. The South Wellfield PLC shall maintain registers for daily maximum, minimum, and average values for each parameter. The South Wellfield PLC shall maintain registers for control and high and low alarm setpoints for each analog input (with the exception of flowmeters and current transducers).

i. Wiegardt Well No. 1 Level Transducer (01 LT 01)
ii. Wiegardt Well No. 2 Level Transducer (02 LT 01)
iii. Wiegardt Well No. 3 Level Transducer (03 LT 01)
iv. Wiegardt Well No. 1 Flow Meter (01 FIT 01)
v. Wiegardt Well No. 2 Flow Meter (02 FIT 01)
vi. Wiegardt Well No. 3 Flow Meter (03 FIT 01)

vii. SWF Reservoir Level Tranducer (04 LT 01)
viii. Finished Water Flowmeter (04 FE/FIT 01)
ix. Backwash Supply Flowmeter (04 FE/FIT 02)
x. Raw Water Pressure Transducer (04 PT 01)
xi. Finished Water Pressure Transducer (04 PT 02)

d. South Wellfield PLC Analog Outputs

The South Wellfield PLC shall generate analog outputs to control the speed of the following pieces of equipment:

i. Ferric Chloride Metering Pump No. 1 (04 MP 01)
ii. Ferric Chloride Metering Pump No. 2 (04 MP 02)
iii. Potassium Permanganate Metering Pump No. 1 (04 MP 03)

2. Well Pump Control

The mode of each well pump will be controlled by an H-O-A switch on the face of the control panel. In Hand mode, the well pump will run. In Off mode, the well pump will not run. In Auto mode, the well pump will be controlled by the South Wellfield PLC. The South Wellfield PLC will call the well to run based upon the level in the South Wellfield reservoir.

3. Booster Station Control

The booster station will only be allowed to run based upon a signal from the South Wellfield PLC. The South Wellfield PLC will call the booster pump to run based upon a distribution system pressure setpoint as measured by the pressure transducer located on the booster station discharge manifold or the pressure as measured at the north wellfield by [07 PT 01]. All lead/lag sequencing associated with the booster station is integral to the booster station control panel.

4. Flows

Both instantaneous (analog) and total flow (digital) flow signals will be transmitted from each of the flow meters located in Areas 1 through 4 to the South Wellfield PLC. The South Wellfield PLC operator interface shall have a screen that displays the instantaneous and total flow for each meter. A reset button shall be provided that allows the operator to reset the running total for each

flowmeter. An inventory of screens is detailed in Section 13453 of these specifications.

5. Level Transducers

Analog level signals will be transmitted from level transducers to the South Wellfield PLC. The South Wellfield PLC operator interface shall have screens to display the instantaneous level for each transducer. An inventory of screens is detailed in Section 13453 of these specifications.

6. Filtration System Control

The South Wellfield PLC will have the following control and coordination with the Filter System Control Panel (04 CP 02). Through the operator interface, the operator will be allowed to select the following backwash control methods (Run Time, Flow, or Headloss) The South Wellfield PLC shall maintain a register that tracks total filter run time since the last backwash. In Run Time mode, when the total time reaches an operator selectable setpoint (initially set at 15 hours), the South Wellfield PLC shall send a digital signal to the Filter System Control Panel to begin a backwash sequence. The South Wellfield PLC shall lock out the well pumps while the filter is backwashing.

The South Wellfield PLC shall maintain a register that tracks the total raw water flow since the completion of the last filter backwash. In Flow mode when the total finished water flow reaches an operator selectable value (initially set at 400,000 gallons), the South Wellfield PLC shall send a digital signal to the Filter System Control Panel to begin a backwash. The South Wellfield PLC will also monitor the Filter System Inlet Pressure Transducer (04 PT 01) and the Filter System Outlet Pressure Transducer (04 PT 02). In all modes, when the differential between these two values exceeds an operator selected level (initially set at 15 psi), the South Wellfield PLC shall signal the Filter System Control Panel to begin a backwash sequence. Following backwash, the South Wellfield PLC will then reset the counters for run time and total flow since the last backwash.

7. Ferric Chloride System Control

Two ferric chloride metering pumps will be assigned to operate with the Wiegardt Wells. When a well operates, the PLC shall

signal Ferric Chloride Metering Pump No. 1 (04 MP 01) or Ferric Chloride Metering Pump No. 2 (04 MP 02) to run in alternating sequence such that each time a call to run is received the operating metering pump is switched. The speed of each metering pump will be controlled by the South Wellfield PLC based upon the finished water flow rate as measured by [04 FE/FIT 01].

8. Potassium Permanganate System Control

One potassium permanganate metering pump will be assigned to operate with the Wiegardt Wells. When a well operates, the PLC shall signal Potassium Permanganate Metering Pump No. 1 (04 MP 03) to run. The speed of the metering pump will be controlled by the South Wellfield PLC based upon the finished water flow rate as measured by [04 FE/FIT 01].

3.5 FIELD QUALITY CONTROL

A. Test, verify and demonstrate access to and functionality of PLC system.

1. Test, verify and demonstrate access to and functionality of all I/O in the PLC system through the operator interface.

B. Provide for programming personnel to be present on site at startup of the system(s):

1. Conduct startup of program applications and perform operational and functional checks.

2. Coordinate the startup and testing of the software application(s) with the PLC hardware installation (Section 13450).

3. Provide Owner with a written statement that software program application has been properly started up, operates per requirements, and is ready for operation by Owner's personnel.

3.6 DEMONSTRATION

A. Demonstrate the system in accordance with Section 01800 "Testing, Commissioning, and Training."

B. ON-SITE TRAINING

1. Provide the following formal training sessions at the Owner's facility for Owner's operating and maintenance personnel by an instructor familiar with the both the manufacturer's commercially available applications provided, and the specific programmed applications provided for this project, after the system has successfully undergone all field testing and acceptance procedures. Each training session shall be a minimum of 4 hours. Use any time which remains after each training session (up to the 4 hour minimum) to provide minor adjustments to the system per the Owner's request for easier or more convenient operator use of the system.

   a. Initial 2-day training session at the time of startup.

   b. Follow-up 1-day training session 3 months after startup.

   c. Follow-up 1-day training session 6 months after startup.

   d. Follow-up 1-day training session 12 months after startup.

***** END OF SECTION *****

SECTION 13453

OPERATOR INTERFACES

PART 1 GENERAL

1.1 SCOPE

Work Specified in this section includes Operator Interface Units (OIUs) [04 OIU 01] and [05 OIU 01] and hardware, programming software, installation, project specific programming, field-testing, and training.

1.2 RELATED DOCUMENTS

Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
13430	Control Panels
13450	Programmable Logic Controller Hardware
16050	Basic Electrical Materials and Methods

1.4 REFERENCES

Reference	Title
NEMA	National Electrical Manufacturers Association
ICS-1	General Standards for Industrial Control and Systems
ICS-1.1	Safety Guidelines for the Application, Installation and Maintenance of Solid State Control
ICS-4	Terminal Blocks for Industrial Use
ICS-6	Enclosures for Industrial Controls and Systems
Publication NO 250	Enclosures for Electrical Equipment (1000 V maximum)
NFPA	National Fire Protection Association
NEC	National Electric Code

1.5 SYSTEM DESCRIPTION

A. DESIGN REQUIREMENTS

1. The OIU includes a flat panel graphic display (LCD or similar) with touch screen operator input. The operator interface shall include all

components needed to communicate with the PLC provided under Section 13450.

2. The OIU must be compatible with the PLC and be of the same manufacturer. The OIU shall display process variables and constants stored in the PLC registers using graphical interface screens with icons, bitmaps, symbols, and other graphics representing the process equipment. The OIU shall allow the operator to move between screens and enter setpoints, turn discrete data points on and off, or perform similar operations. PanelView Plus, PanelMate Plus, or equal. Provide programming for each operator interface for a minimum of 10 screens, with an average of 6 analog I/O points per screen and 20 discrete I/O points per screen. The Contractor shall provide for up to five additional screens of similar complexity at no additional cost to the Owner.

B. PERFORMANCE REQUIREMENTS

1. The installed system allows the operator to view process information and configure operator adjustable parameters in the PLC from operator interfaces located in [04 CP 01] and [05 CP 01].

1.6 SUBMITTALS

A. PRODUCT DATA

1. Manufacturer's data sheets for hardware components including specific model numbers for each device, dimensions, and power requirements.

2. Manufacturer's installation manual, operation and maintenance manual.

B. SHOP PLANS

1. Plans

a. System diagram showing the arrangement, connection and interconnection of the operator interface to the PLC system.

2. Description of proposed screens including the following data:

a. Description of proposed screen layout.

b. Description of graphic symbols used to represent process equipment.

c. Displayed I/O points.

d. Displayed operator configurable parameters and setpoints.

3. Listing of spare parts provided with the system.

C. OPERATION AND MAINTENANCE MANUALS

1. See Section 01300 “Submittals.”

2. Provide specific information including:

a. Manufacturer’s published operation and maintenance manual, and troubleshooting guide.

b. Information for obtaining assistance and troubleshooting, parts ordering information, and field service personnel requests.

3. Include documentation detailing operator control.

1.7 QUALITY ASSURANCE

A. QUALIFICATIONS

1. Programmer has experience successfully programming OIUs for a minimum of two projects of similar size and complexity.

PART 2 PRODUCTS

2.1 MANUFACTURERS

The operator interface must be of the same manufacturer as the PLC of Section 13450.

2.2 EQUIPMENT

A. OIUs shall have a battery-backed time clock, with the ability to timestamp critical data.

B. OIUs shall have 64MB/64MB standard application memory.

C. OIUs shall have both Ethernet and RS-232 communication ports.

D. OIUs shall be specifically designed for operation in unconditioned audible noise and high vibration areas.

E. OIUs shall include all components needed to communicate directly with the PLC specified under Section 13450.

F. OIUs shall have a 6.5-inch minimum flat panel screen (LCD active matrix TFT or equivalent), 640 x 480 resolution with 18-bit color graphics.

G. OIUs shall have touch screen inputs.

H. OIUs shall retain its programming and configuration in the event of loss of power.

I. Provide communication cable between PLCs and OIUs. If the communication protocol is Ethernet, then connect through an Ethernet switch.

2.3 SOFTWARE

A. Provide one copy of the manufacturer's complete system programming software package which allows configuration of the operator interface screens to the Owner within 2 weeks after the Bid is awarded.

1. Software is capable of downloading programs to the operator interface. Provide any hardware required for a computer to download programming to the operator interface.

2. Software capabilities include:

a. Full documentation capability.

b. Offline programming.

c. Two step commands requiring operator verification prior to deletion of any programming.

B. If required by the software manufacturer provide a "runtime" license of the software to the Owner and provide copies of the license agreement to the Owner.

2.4 PROGRAMMING

A. Provide the following. Unless otherwise stated these functions may require several screens. Some information may be displayed on more than one screen.

1. Display all process variables.

2. Display all process equipment.

3. Equipment set points shall be adjustable.

4. Provide at least one alarm screen.

5. Device tags used in programming shall be as found in the programming of the PLC.

6. Screen Formatting.

Device Function	Displayed Color
Motor Running	Green
Motor Not Running	Red
Valve Open	Green
Valve Closed	Red
Alarm Condition	Flashing Yellow and Red
Acknowledged Alarm	Yellow

The screens shall have an appearance and level of complexity similar to the example screens shown in Figures 1, 2 and 3.

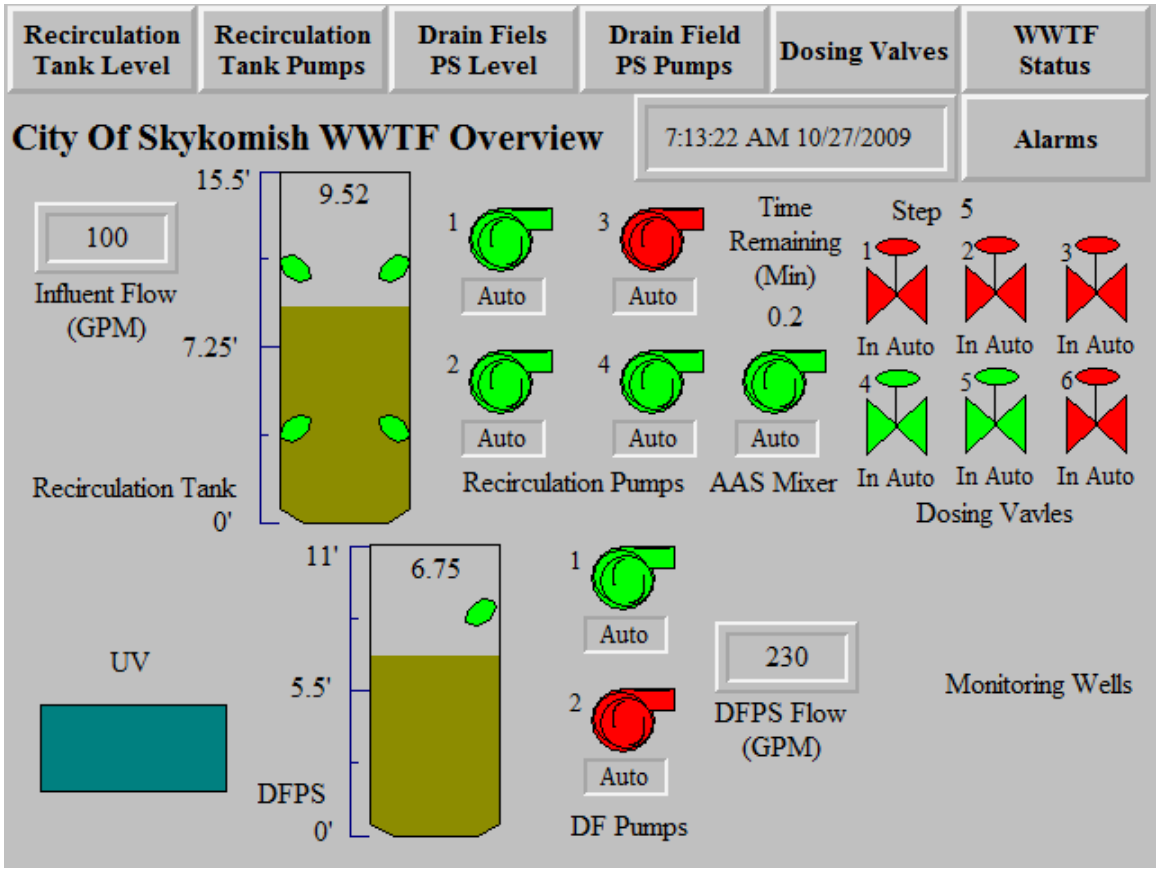

Recirculation Tank Level
Recirculation Tank Pumps
Drain Fiels PS Level
Drain Field PS Pumps
Dosing Valves
WWTF Status
City Of Skykomish WWTF Overview
7:13:22 AM 10/27/2009
Alarms
15.5'
9.52
100
Influent Flow (GPM)
7.25'
Recirculation Tank
0'
1
Auto
3
Auto
2
Auto
4
Auto
Auto
Recirculation Pumps
AAS Mixer
Time Remaining (Min)
0.2
Step 5
1 In Auto
2 In Auto
3 In Auto
4 In Auto
5 In Auto
6 In Auto
Dosing Vavles
11'
6.75
5.5'
DFPS
0'
1
Auto
2
Auto
DF Pumps
230
DFPS Flow (GPM)
UV
Monitoring Wells

FIGURE 1

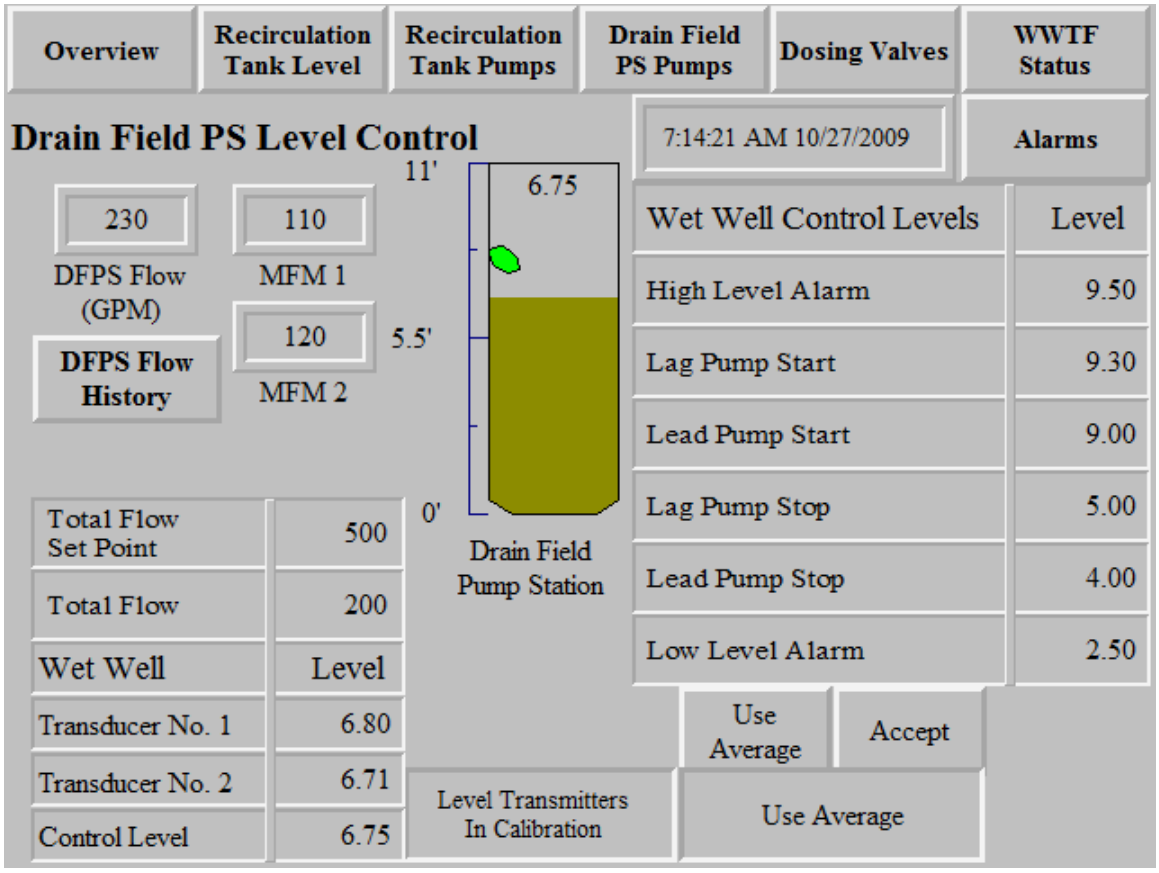

Overview
Recirculation Tank Level
Recirculation Tank Pumps
Drain Field PS Pumps
Dosing Valves
WWTF Status
Drain Field PS Level Control
7:14:21 AM 10/27/2009
Alarms
230
DFPS Flow (GPM)
110
MFM 1
120
MFM 2
DFPS Flow History
11'
5.5'
0'
6.75
Drain Field Pump Station
Wet Well Control Levels
Level
High Level Alarm
9.50
Lag Pump Start
9.30
Lead Pump Start
9.00
Lag Pump Stop
5.00
Lead Pump Stop
4.00
Low Level Alarm
2.50
Total Flow Set Point
500
Total Flow
200
Wet Well
Level
Transducer No. 1
6.80
Transducer No. 2
6.71
Control Level
6.75
Use Average
Accept
Level Transmitters In Calibration
Use Average

FIGURE 2

Overview	Recirculation Tank Level	Drain Field PS Level	Drain Field PS Pumps	Dosing Valves	WWTF Status

Recirculation Tank Pumps 7:14:52 AM 10/27/2009 **Alarms**

Pump Status	No. 1	No. 2	No. 3	No. 4
Rotation Position	Lag	In	In	Lead
Pump Status	Available	Available	Available	Running
HOA Position	Auto	Auto	Auto	Auto
Current	12.5 A	0.0 A	0.0 A	0.0 A
Control Power	Present	Not Present	Not Present	Not Present
480V Power	Present	Present	Present	Present
Circuit Breaker	Closed	Closed	Closed	Closed
Disconnect Switch	Closed	Closed	Closed	Closed
Overload	Not Present	Not Present	Not Present	Not Present
Overtemperature	Not Present	Not Present	Not Present	Not Present
Seal Leak	Not Present	Not Present	Not Present	Not Present
Run Time (Hours)	7.2	7.2	8.3	7.4
Number Of Starts	416	421	419	423

FIGURE 3

A. The operator interfaces shall be programmed to provide the following specific screen displays and functionality as described in the following sections. Each of the screens described in the following sections shall be available at [04 OIU 01] and [05 OIU 01]

1. SOUTH WELLFIELD OVERVIEW SCREEN

a. The overview screen will provide a basic overview of all the south well field water system facilities. The overview screen shall have, at a minimum, the following components:

1. Wiegardt Wellfield (Each Well)

(a) Well Pump Status (On/Off/Alarm)

(b) Current Instantaneous Raw Water Flow

(c) Well Water Level

2. Filters

(a) Status (Filtering/Off/Backwash)

(b) Total Instantaneous Raw Water Flow

3. Chemical Feed Systems

(a) Chemical Feed Status (On/Off/Alarm)

4. South Wellfield Reservoir

(a) Reservoir Level

5. South Wellfield Booster Pump Station

(a) Booster Pump 1 Status (On/Off/Alarm)

(b) Booster Pump 2 Status (On/Off/Alarm)

(c) Booster Pump 3 Status (On/Off/Alarm)

(d) Booster Pump 4 Status (On/Off/Alarm)

6. Power Supply OK/Fail indication

7. PLC OK/Fail Indication

b. Provide a legend display for status with symbols as follows:

1. Off/Closed symbol of red color

2. On/Open symbol of green color

3. Unacknowledged alarm symbol flashing between yellow and red.

4. Acknowledged alarm symbol of yellow color

c. Individual areas should “highlight” when the cursor is over that area and “clicking” that area should display the screen associated with that area. General status information shall be displayed by superimposing text and animated symbols or cells.

2. WIEGARDT WELLS

a. This screen will show a schematic representation of the Wiegardt Wells

b. The following status information shall be displayed for each well:

1. Well Pump Control (Hand/Off/Auto)

2. Well Pump Status (running/not running)

3. Well Pump Alarm Condition (unacknowledged alarm/acknowledged alarm)

4. Well Pump Run Time for Day

5. Well Pump Run Time Total

6. Well Pump Starts

7. Well Position (Lead, Lag 1, Lag 2)

c. The following information shall also be displayed:

1. Current Instantaneous Raw Water Flow for Each Well

2. Current Day Total Flow

3. Previous Day Total Flow

4. Running Total Flow

5. Well Water Level for Each Well.

d. The operator shall be able to adjust the following on this screen:

1. Reset Running Total Flow

2. Well Operating Position (Lead, Lag 1, Lag 2)

3. SWF FILTER SYSTEM (SCHEMATIC)

a. This screen will have a schematic representation of the filters.

b. The following status information shall be displayed for the filter system:

1. Filter Status (Filtering/Off/Backwash)

2. Instantaneous Finished Water Flow Rate

3. Filter Inlet Pressure

4. Filter Outlet Pressure

5. Instantaneous Backwash Flow Rate

c. The following information shall also be displayed:

1. Current Day Total Finished Water Flow

2. Previous Day Total Finished Water Flow

3. Running Total Finished Water Flow

4. Current Day Total Backwash Flow

5. Previous Day Total Backwash Flow

6. Running Total Backwash Flow

7. Total Flow Since Last Backwash

8. Filter Run Time Since Last Backwash

9. Backwash Settings Including:

(a) Backwash Time Interval Setpoint

(b) Backwash Flow Interval Setpoint

(c) Backwash Differential Pressure Setpoint

(d) Backwash Initiate Mode (Time/Flow/Pressure)

d. The operator shall be able to adjust the following on this screen:

1. Filter Differential Pressure High Alarm Set Point

2. Backwash Settings Including:

(a) Backwash Time Interval Setpoint

(b) Backwash Flow Interval Setpoint

(c) Backwash Differential Pressure Setpoint

(d) Backwash Initiate Mode (Time/Flow/Pressure)

3. Manually Initiate a Backwash Sequence

4. Reset Each Running Total Flow

4. SWF CHEMICAL FEED SYSTEM (SCHEMATIC)

a. This screen will have a schematic representation of the chemical feed systems and tanks.

b. The following status information shall be displayed:

1. Metering Pump Status (On/Off/Alarm) for each of three metering pumps.

2. Ferric Chloride Metering Pump Operating Position (Lead/Lag)

c. The operator shall be able to adjust the following on this screen:

1. Ferric Chloride Metering Pump Operating Position (Lead/Lag)

5. SWF RESERVOIR AND BOOSTER PUMPS (SCHEMATIC)

a. The following information shall be displayed for the reservoir:

1. Reservoir Level

b. The following information shall be displayed for the booster pumps:

1. Booster pump status (On/Off) for each of the four booster pumps.

2. Distribution System Pressure

c. The operator shall be able to adjust the following on this screen:

1. South Wellfield Booster Status (Enable/Disable)

2. South Wellfield Booster Pressure Setpoint

6. NORTH WELLFIELD OVERVIEW SCREEN

a. The overview screen will provide a basic overview of all the north well field water system facilities. The overview screen shall have, at a minimum, the following components:

1. North Wellfield

(a) Well Pump Status for Each Well (On/Off/Alarm)

(b) Current Instantaneous Finished Water Flow

2. Filters

(a) Status (Filtering/Off/Backwash)

3. Chemical Feed Systems

(a) Chemical Feed Status (On/Off/Alarm)

4. North Wellfield Reservoirs

(a) Reservoir Level

5. North Wellfield Booster Pump Station

(a) Booster Pump 1 Status (On/Off/Alarm)

(b) Booster Pump 2 Status (On/Off/Alarm)

(c) Booster Pump 3 Status (On/Off/Alarm)

(d) Booster Pump 4 Status (On/Off/Alarm)

(e) Booster Pump 5 Status (On/Off/Alarm)

6. Power Supply OK/Fail indication

7. PLC OK/Fail Indication

b. Provide a legend display for status with symbols as follows:

1. Off/Closed symbol of red color

2. On/Open symbol of green color

3. Unacknowledged alarm symbol flashing between yellow and red.

4. Acknowledged alarm symbol of yellow color

c. Individual areas should "highlight" when the cursor is over that area and "clicking" that area should display the screen associated with that area. General status information shall be displayed by superimposing text and animated symbols or cells.

7. NORTH WELLFIELD (NWF)

a. This screen will show a schematic representation of the North Wellfield showing each well.

b. The following status information shall be displayed for each well:

1. Well Pump Control (Hand/Off/Auto)

2. Well Pump Status (running/not running)

3. Well Pump Alarm Condition (unacknowledged alarm/acknowledged alarm)

4. Well Pump Run Time for Day

5. Well Pump Run Time Total

6. Well Pump Starts

c. The following information shall also be displayed:

1. Current Instantaneous Finished Water Flow.

2. Current Day Total Flow

3. Previous Day Total Flow

4. Running Total Flow

d. The operator shall be able to adjust the following on this screen:

1. Reset Running Total Flow

8. NWF FILTER SYSTEM (SCHEMATIC)

a. This screen will have a schematic representation of the filters.

b. The following status information shall be displayed for the filter system:

1. Filter Status (Filtering/Off/Backwash)

2. Instantaneous Finished Water Flow Rate

c. The following information shall also be displayed:

1. Current Day Total Finished Water Flow

2. Previous Day Total Finished Water Flow

3. Running Total Finished Water Flow

4. Total Flow Since Last Backwash

5. Filter Run Time Since Last Backwash

6. Backwash Settings Including:

(a) Backwash Time Interval Setpoint

(b) Backwash Flow Interval Setpoint

(c) Backwash Initiate Mode (Time/Flow)

d. The operator shall be able to adjust the following on this screen:

1. Backwash Settings Including:

(a) Backwash Time Interval Setpoint

(b) Backwash Flow Interval Setpoint

(c) Backwash Initiate Mode (Time/Flow)

2. Manually Initiate a Backwash Sequence

3. Reset Each Running Total Flow

9. NWF CHEMICAL FEED SYSTEM (SCHEMATIC)

a. This screen will have a schematic representation of the chemical feed system and tank.

b. The following status information shall be displayed:

1. Metering Pump Status (On/Off/Alarm) for the metering pump

c. The operator shall be able to adjust the following on this screen:

1. Ferric Chloride Metering Pump Operating Position (Lead/Lag)

10. NWF RESERVOIR AND BOOSTER PUMPS (SCHEMATIC)

a. The following information shall be displayed for the reservoirs:

1. Reservoir Level

b. The following information shall be displayed for the booster pumps:

1. Booster pump status (On/Off) for each of the five booster pumps.

2. Distribution System Pressure (at north wellfield booster pump station discharge).

3. North Wellfield Booster Pump Station Flow

c. The operator shall be able to adjust the following on this screen:

1. Booster pump pressure setpoints (On/Off) for each booster pump.

2. Booster pump operational position (Lead, Lag 1, Lag 2, Lag 3, Lag 4)

B. EVENT LOG SCREEN

An event log screen shall be provided that details events and the time they occur. The event screen shall show up to 48 hours of events on each screen. The operator shall be able to scroll forward and back in time to review events. Events shall be color coded for control events, alarm events, and alarm acknowledge events.

C. ALARM LOG SCREEN

An alarm log screen shall be provided that summarizes all alarm events. Past alarm events shall be grey. Acknowledged alarm events shall be red. Unacknowledged alarm events shall be flashing red. The operator shall be able to acknowledge all alarms or individual alarms from this screen.

D. TREND SCREENS

Trend screens shall be provided to allow the operator to review historical data trends. The operator shall be able to change the time scale or the value scale for each trend screen. The following trend screens shall be created:

1. Flow trend (displays all flow values)

2. Level trend (displays all level values)

The operator shall be able to select one of the above trend screens from a menu or be able to create a unique trend screen from a list of tags.

E. ADDITIONAL SCREENS

The Programmer shall create up to five additional screens to be determined by the Owner and Engineer with similar functionality to the screens described.

F. AUTODIALER

The software autodialer (part of the City's existing SCADA system) shall be programmed with the names and phone numbers of contacts specified by the City. Call schedules shall be set up to meet the City's needs for weekday working hours, weekday nights, weekends, and holidays. Alarm tags shall be set up to dial-out on alarm conditions. Initial alarm tags to dial out shall include:

1. Critical

    a. Low Reservoir Alarm

    b. Loss of Utility Power

2. Major

    a. Well Pump Fail

    b. Booster Pump Fail

    c. PLC Fail

    d. Reservoir High Level Alarm

3. Minor

    a. Metering Pump Alarm

2.5 ACCESSORIES

Provide all accessories required, whether indicated or not, for a complete operator interface to accomplish the requirements of the Plans and Specifications.

2.6 SOURCE QUALITY CONTROL

A. FACTORY (SHOP) TEST

1. Provide a shop test after factory completion and prior to shipment.

    a. Conduct a burn-in period (minimum of 2 days) where the system is operated continuously and checked for proper operation.

    b. Utilize dummy I/Os to verify proper operation.

    c. Provide a computer, a PLC, and PLC programming software for the testing to allow viewing of system parameters and entering of parameters simulating operator entries of parameters such as setpoints, and alarm values.

    d. Allow for Owner to witness the shop test. Provide a minimum of 15 days notice prior to test.

    e. Do not ship the system prior to successful completion of this testing.

2. Submit a shop test plan indicating how the test will be conducted, and how system operation will be verified.

2.7 EXTRA MATERIALS

A. PROVIDE THE FOLLOWING EXTRA MATERIALS

1. Provide a list of the manufacturer's recommended spares for maintenance purposes. Include in the list any special tools and test equipment necessary or recommended by the manufacturer for the maintenance of the complete system. Provide any recommended spares along with the recommended special tools and test equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install the operator interface in accordance with manufacturer's written instructions.

B. Test, verify and demonstrate access to and functionality of PLC system.

3.2 FIELD QUALITY CONTROL

A. Provide the services of the equipment manufacturer's field service representative(s) to:

1. Inspect equipment covered by these Specifications.

2. Supervise adjustments and installation checks.

3. Maintain and submit an accurate daily or weekly log of all commissioning functions.

a. All commissioning functions may be witnessed by the Owner.

b. All reports shall be cosigned by the Contractor and the Owner if witnessed.

4. Conduct startup of equipment and perform operational checks.

5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

3.3 DEMONSTRATION

Demonstrate the system in accordance with Section 01800 “Testing, Commissioning, and Training.”

***** END OF SECTION *****

DIVISION 14

CONVEYING SYSTEM

SECTION 14610

PALLET LIFT TRUCK

PART 1 GENERAL

1.1 SCOPE

This Section covers furnishing and installing a pallet truck as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
11000	Equipment General Provisions

1.3 PERFORMANCE REQUIREMENTS

The pallet truck shall have a rated capacity of at least 4,400 lbs.

1.4 SUBMITTALS

In addition to the general Submittal requirements, the following shall be submitted:

A. The make, model, and weight of each pallet truck.

B. Complete catalog information, descriptive literature, materials of construction, and specifications on the pallet truck.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

The pallet truck shall be WESCO Model 272855, or equal.

2.2 PALLET TRUCK

The galvanized steel pallet truck shall have a minimum rated capacity of 4,400 pounds and use in corrosive rooms. It shall have fixed base, wheeled supports to straddle a standard 48-inch pallet. The pallet truck was 7″ nylon load wheels and 3″ nylon load wheels.

PART 3 EXECUTION

3.1 GENERAL

The pallet truck shall be set-up on-site in accordance with the manufacturer's instructions and shall be fully operational.

3.2 FIELD TESTS

The Contractor shall conduct field tests with the equipment. Tests shall include a load test in compliance with OSHA requirements and demonstration to the Engineer that under this load condition the equipment shall perform satisfactorily throughout the complete range of operation.

***** END OF SECTION *****

DIVISION 15

MECHANICAL

SECTION 15050

PIPING SYSTEMS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section describes process and utility piping, fittings, supports, and accessories shown on the Plans, described in these Specifications and as required to completely interconnect all equipment with piping for complete and operable systems.

The Contractor shall direct the attention of all subcontractors and suppliers of piping systems and related appurtenances for the work to the applicable provisions in the Contract Documents wherever they may occur.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
01800	Testing, Commissioning and Training
02300	Earthwork
09900	Painting
Division 11	Equipment
Division 13	Special Construction
Division 15	Mechanical
Division 16	Electrical

1.3 STANDARDS FOR THE WORK

Pipe, fittings, and supports shall be provided to produce complete, operable systems with all elements properly interconnected as shown in schematic diagrams or to provide specified operations. If a specific dimensioned location is not shown for interconnections or smaller system elements, the Contractor shall select appropriate locations and show them on Shop Drawing submittals for review.

Piping systems and materials shall be new and without imperfections and shall be erected in a neat and workmanlike manner; aligned, leveled, cleaned and adjusted for satisfactory operation; installed in accordance with the best standard practices for this type of work so that connecting and disconnecting of piping and accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance and repair. In order to meet these requirements minor deviation from the Plans may be made as approved by the Engineer.

1.4 PIPE MATERIALS

The materials to be utilized for the various pipe sizes and applications on the project shall be as follows, unless otherwise noted on the Plans or herein:

		In Buildings/Structures	Buried
Backwash Supply	BS	Ductile Iron, FL	Ductile Iron, MJ
Backwash Water	BW	Ductile Iron, FL	Ductile Iron, MJ
Carbon Drain	CD	Ductile Iron, FL	---
Carbon Fill	CF	Ductile Iron, FL	---
Drain <4"	D	Solvent Welded PVC (40)	Cast Iron, No Hub
Drain ≥4"	D	Ductile Iron, FL	PVC (C900) w/ DI Fittings
Ferric Chloride	FC	Solvent Welded PVC (80)	Welded HDPE
Filter to Waste	FTW	Ductile Iron, FL	---
Finished Water	FW	Ductile Iron, FL	Ductile Iron, MJ
Raw Water <3"	RW	Solvent Welded PVC (80)	Welded HDPE
Raw Water ≥3"	RW	Ductile Iron, FL	Ductile Iron, MJ
Sample	S	Solvent Welded PVC (80)	---
Sewer	SS	Solvent Welded PVC (80)	Welded HDPE
Potable Water	W	Copper, THD/S	Welded HDPE
Well to Waste	WTW	Ductile Iron, FL	Ductile Iron, MJ

1.5 SUBMITTALS

Submittal data shall be supplied in accordance with Section 01300. Detailed installation drawings of all piping and connected equipment shall be submitted. The drawings shall include all piping, valves, fittings, pipe support locations and types, seismic bracing, and appurtenances.

Submit data to show that the following items conform to the Specification requirements:

A. Pipe, fittings, and accessories.

B. Valves.

C. Couplings and couplers.

D. Pipe supports and seismic braces as required herein.

Submit certified test reports as required herein and by the referenced standards.

PART 2 PRODUCTS

2.1 GENERAL

Pipe sizes are nominal inside diameter unless otherwise noted.

All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class and other appropriate data such as thickness for piping.

Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the complete product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified in Part 3 Execution of this Section.

All water piping shall be certified under NSF 61 for potable water use.

2.2 DUCTILE IRON PIPE AND FITTINGS

A. GENERAL

Ductile iron pipe shall be centrifugal cast pipe conforming to AWWA C151, Class 52, unless otherwise noted, bituminous coated and cement mortar lined in accordance with, AWWA C104. All flanged spools shall be Class 53 as shall all piping where grooved couplings are used. Approved grooved couplings may be used instead of flanged spools and fittings as approved by Engineer.

All above ground piping shall be flanged or grooved piping unless otherwise specified or indicated.

Below ground piping shall be push on joint or mechanical joints unless otherwise specified or indicated. Mechanical joints shall comply with AWWA C111.

Where noted on the Plans mechanical joints shall be restrained joints with a restrainer. The restrainer shall utilize the full circumference of the pipe for restraining and utilize standard MJ gasket and bolts. The restrainer shall be Grip Ring as manufactured by Romac Industries, Mega-Lug, or equal.

Where noted on plans, push on joints shall be restrained with field lock gaskets from US Pipe or equal.

Flanges shall comply with ANSI Bl6.1, Class 125. Flange gaskets shall be full face. Approved adaptor flanges shall be used instead of flanges where shown on the Plans.

Grooved couplings shall be Victaulic Style 31, or engineer approved equal and shall comply with AWWA C606. Victaulic Style 341 adaptor flanges shall be installed instead of flanges where shown on the Plans.

Fittings shall be ductile iron and shall comply with AWWA C110 or AWWA C153, bituminous-coated exterior and cement mortar lined, 250-psi minimum pressure. Fittings shall be mechanical joint, flanged, or grooved fittings. Fittings with grooved ends shall comply with AWWA C606 and shall be Victaulic or approved equal. Fittings shall not be "Tyton" or other push-on type joint.

The exterior of buried ductile iron pipe and pipe in contact with concrete shall be coated with an asphaltic coating. The exterior surface of ductile iron pipe inside of buildings, structures, and vaults shall be painted in accordance with Section 09900 of the Specifications.

All bolts, buried and unburied, shall be coated with Armite Anti-Seize Compound No. 609, or equal, prior to installation.

2.3 PVC PIPE AND FITTINGS

A. PRESSURE PIPE

All PVC pipe 3-inch and smaller shall be Schedule 80. Pipe shall be constructed of material that meets or exceeds ASTM D2241 and D1784 and Commercial Standard CS 256. Joints shall be solvent weld with press fit. Fittings shall conform to ASTM D2466 and D2467 for socket type and ASTM D2464 for threaded pipe.

All PVC pipe 4-inch and larger shall be PVC, Cast Iron pipe equivalent O.D., Class 235, conforming to the requirements of AWWA C900. Pipe joints shall be gasketed. Solvent-cement joints will not be acceptable. Fittings for PVC pipe 4-inch and larger shall be ductile iron, as specified in Part 2.2 of this Section.

Provisions for pipe expansion shall be as recommended by the pipe manufacturer.

B. CHEMICAL FEED PIPE

All pipe for chemical feed service shall be Schedule 80 PVC pipe as described in Part B. Glue for the chemical feed piping shall meet ASTM F493 and shall be specifically formulated for chemical resistance to hypochlorite solutions. Acceptable glue products include IPS WELD-ON 724 with P-70 primer, or approved equal.

Where chemical feed pipe joins with equipment that has threaded connections, threaded pipe joints may be used. Threaded pipe joints shall be made in accordance with the pipe manufacturer's recommendations. Pipe tape for threaded joints shall be Military Specification T-27730A tape. Pipe compound shall be used with pipe tape to make all threaded joints.

All plumbers and pipe fitters shall be trained in the ASTM B-31.3 pipe joining procedure by a representative of the PVC pipe company prior to beginning construction of the chemical feed pipe.

2.4 COPPER PIPE

Copper pipe and fittings shall be Type K (buried) or Type L or M (above ground), when used as water service lines, and Type L tube, when used as waste, vent or drainage lines.

Grooved joints may be used in lieu of threaded or soldered joints. Where grooved joints are used, they shall be Victaulic Style 607H couplings with Copper-Connection fittings, or approved equal. Grooved joints for copper tubing shall be manufactured to copper-tube dimensions. Flaring of tube or fitting ends to accommodate alternate size couplings is not permitted.

2.5 POLYETHYLENE TUBING

HDPE tubing for water service shall meet the requirements of AWWA C901. Tubing shall be high molecular mass with a 200 psi rating. Tubing shall be SR 9 (copper tubing size). Fittings shall be brass, either compression or stab type. Stab types fittings shall utilize an internal grip ring and O-ring seal. Stainless steel liners shall be used when utilizing compression fittings on HDPE tubing.

2.6 MISCELLANEOUS FITTINGS

A. FLEXIBLE COUPLINGS

Flexible couplings shall be Romac 501 or approved equal. Middle ring and follower shall have fusion bonded epoxy coating. All buried flexible couplings shall be furnished with stainless steel bolts and nuts.

Harness lugs and tie bolts for harnessed joints on steel pipe shall comply with AWWA M-11, Third Edition and as shown on the Plans. All buried harnessed joints shall be furnished with stainless steel tie bolts and nuts.

B. RESTRAINED FLANGED COUPLING ADAPTERS

Flanged coupling adapters shall be Romac RFCA, Star Pipe Products Star Flange Series 3200 or approved equal. The restrained flanged coupling adapter shall be coated with fusion bonded epoxy and stainless steel bolts and nuts.

C. ADAPTER FLANGES

Adapter flanges for ductile iron pipe shall be manufactured of high strength ductile iron, ASTM A536, Grade 65-45-12. Flange dimensions shall be in accordance with ANSI B16.1, 125-lb. pattern. Gasket shall be Buna-N. Setscrews shall be AISI 4140, high strength, low alloy steel. The adapter flanges shall be Uni-Flange Series 400, or equal.

D. GROOVED PIPE COUPLERS

Grooved pipe couplers for steel pipe shall consist of two ductile iron housing segments conforming to ASTM A536, pressure responsive elastomer gasket, and ASTM A449 zinc electroplated steel bolts and nuts. Couplings shall comply with ASTM F1476 “Standard Specification for the Performance of Fittings for Use with Gasketed Mechanical Couplings Used in Piping Applications.”

1. Rigid Type

   Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

a. 2-Inch through 8-Inch

Installation-Ready, for direct stab installation without field disassembly, with grade EHP gasket rated to +250 degrees F/120 degrees C. Couplings shall be Victaulic Style 107, or approved equal.

b. Couplings shall be Victaulic Zero-Flex Style 07.

2. Flexible Type

For use in locations where vibration attenuation and stress relief are required. The couplings shall be placed in close proximity to the source of the vibration. Couplings shall be Victaulic Style 77, or approved equal.

Grooved pipe couplers for ductile iron pipe shall be Victaulic Style 31, or approved equal.

All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

E. CALDER-TYPE FLEXIBLE COUPLINGS

Flexible couplings shall be Calder-type where specifically indicated on the Plans. Calder-type flexible couplings shall consist of all elastomeric PVC sleeve secured to the pipes with stainless steel clamping bands. Adapter couplings shall be furnished for transitions between piping of different outside diameters as necessary.

Calder-type flexible couplings shall be as manufactured by Calder Co., Fernco, or equal.

F. FLEXIBLE CONNECTORS AND EXPANSION JOINTS

Flexible connectors and expansion joints shall be provided where shown on the Plans. The flexible connectors and expansion joints shall be provided with Class 125 ANSI flanges and be single arch-type multiple ply rubber or synthetic elastomers, complete with steel retaining rings, as manufactured by the Red Valve Company, Inc., the Metraflex Company, or equal.

G. DIELECTRIC INSULATED UNIONS

Dielectric insulated unions shall be used to connect dissimilar metals. They shall separate the metals so that the passage of more than one percent of the galvanic current, which would exist with metal to metal contact, is prevented. Unions shall be of the same material as the pipe to which attached, and pressure and temperature ratings shall be no lower than that of the piping system in which it is installed.

H. WALL SLEEVES AND SEALS

Wall and/or floor pipe penetrations shall be made by means of a sleeve capable of being bolted directly to the formwork to prevent misalignment. Seal of the annular space between the carrier pipe and the sleeve shall be by means of a confined rubber gasket and capable of withstanding 350 psi. Sleeve shall be manufactured from Ductile Iron with an integrally cast waterstop of 1/2-inch minimum thickness and 2-1/2-inch minimum height. Wall sleeves shall be omni*sleeve or equal.

Seals for pipe sleeves shall be bolt-up type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the sleeve. When bolts are tightened the rubber sealing elements shall expand to result in a watertight seal. Bolts and pressure plate nuts shall be Type 316 stainless steel in below grade or "wet" locations, and of carbon steel at other installations. Rubber links shall be suitable for use in water, moist environments, normal atmospheric conditions, and -40 degrees F to 250 degrees F temperatures for standard service.

2.7 PIPING INSULATION

All new above ground exterior pipe carrying liquids, shall be insulated with 1-inch-thick fiberglass insulation and 0.016-inch anodized aluminum jacket; insulated by Owens-Corning, Certainteed, Johns-Manville or equal, unless otherwise noted. Buried piping carrying liquids with less than 36 inches of cover shall be insulated with Rubitex closed cell foam insulation or equal.

PART 3 EXECUTION

3.1 PIPING INSTALLATION

A. GENERAL HANDLING AND PLACING

All piping constructed on this project shall be performed in accordance with the Uniform Plumbing Code. These Plans do not detail all items such as complete venting, etc.; however, it is understood that this work shall be included as a part of this Section and all costs included in the lump sum bid.

Pipe and accessories shall be handled in such a manner as to insure delivery on site in sound, undamaged condition. Particular care taken not to injure pipe coating. No other pipe or material of any kind shall be placed inside of lined pipe or fitting after lining has been applied. All pipe and fittings shall be unloaded, stored, handled in such a manner as to insure against damage. Dropping of pipe or fittings shall be cause for rejection.

The types and sizes of pipes to be used shall be as specified herein and as shown on the Plans. Where sizes of small pipe are omitted from the plans and not mentioned in the Specifications, the sizes to be used shall correspond to plumbing code requirements. In any event, undesignated pipe sizes shall be proper for the function to be performed and as accepted by the Engineer.

All pipe shall be carefully placed and supported at the proper lines and grades and where possible shall be sloped to permit complete drainage. Piping runs shown on the Plans shall be followed as closely as possible, except for minor adjustments to avoid architectural and structural features. If major relocations are required, they shall be approved by the Engineer.

Unions shall be installed in all threaded joint piping to facilitate the removal of sections for maintenance and repair in accordance with the best trade practice. Unions shall be ground joint, malleable iron type. Where unions connect dissimilar materials, the union shall be protected from reaction with dissimilar metals by installation of insulating materials and dielectric unions at contact points.

The interior of all piping shall be cleaned after assembly and before connecting to equipment.

All piping for which no location dimensions are shown shall be installed in a neat and workmanlike manner in accordance with best trade practice. Wherever possible runs and rises shall be grouped and kept parallel. Properly lay out all miscellaneous piping to clear obstructions such as passageways, equipment, larger sized pipes, ventilation ducts, lights, etc.

Whenever pipe requires field cutting to fit in line, work shall be done by a machine in a satisfactory manner so as to leave a smooth end at right angles to axis of pipe.

All piping to be buried below structures, foundations, or slabs shall be installed with extreme care. When all joints have been made, Contractor shall demonstrate to Engineer's satisfaction that all of piping is watertight and that all lines are clear before proceeding with any work above this piping. It shall be Contractor's responsibility to see that these lines are kept clear until final acceptance of the project, providing suitable tight wooden bulkheads or plugs for open end pipes. Any blockage of these systems due to earth, debris, cement slurry or anything else shall be rectified at Contractor's expense before project is accepted.

All pipe shall be installed in strict accordance with manufacturer's recommendations and/or specifications, and best commercial trade practice. Any special tools required for laying, jointing, cutting, etc., shall be supplied and properly used. All pipe shall be kept thoroughly clean until acceptance of completed work, and shall conform accurately to lines and grades given. At all times during pipe laying operations keep trench free of water either by pumping, bailing, or drainage. Seal end of line with a tight-fitting plug when pipe is not being laid.

Valves shall have interiors cleaned of all foreign matter and inspected, both in open and closed positions prior to installation.

All pipes running through concrete walls below water surface or where subject to groundwater pressure shall be assembled as shown on the plans. Pipes running through concrete not subject to water pressure may be installed through standard steel sleeves, one or two pipe sizes larger than pipe in question. The pipe shall be free of all dirt and grease and thoroughly cleaned to insure a tight bond with the concrete.

All above ground outside pipe carrying liquids shall be insulated.

All buried, submerged, or intermittently submerged piping that is bolted together or uses bolts to hold materials together shall use 316 stainless steel nuts, bolts, and washers. This requirement applies to a distance of

12 inches above the highest water level in any tank, channel, or structure. Otherwise, bolts, nuts, and washers may be hot-dip galvanized steel.

B. GENERAL EXPOSED PIPING INSTALLATION

Unless shown otherwise, piping shall be installed parallel to building lines, plumb, and level.

Piping shall be installed without springing or forcing.

All pipe flanges shall be set level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle vertical centerline of pipes.

Flexible couplings shall be provided for all piping connections to motor-driven equipment and where otherwise shown in the Plans. The Contractor may install additional flexible couplings at approved location to facilitate piping installation, provided that he submits complete details describing location, pipe supports, and hydraulic thrust protection.

Unions or flexible couplings shall be installed where shown on the Plans, and at all non-motor-driven equipment to facilitate removal of the equipment.

Where equipment drain connections are provided, they shall be valved, with the discharge pipe carried to the nearest floor drain, drain trench, or sump. Where no receptacle for drain exists, drain valves shall be piped to 1 inch above the floor. Drain piping and valve materials shall conform to the requirements of the system served.

All exposed or submerged piping shall be painted and color-coded in accordance with Section 09900, unless otherwise specified.

3.2 PVC PIPING

A. GENERAL

PVC piping socket weld connections shall be made up in accordance with the pipe manufacturer's recommendations and as follows:

Where pipe is cut, remove all burrs and ream inside to provide smooth flow line. Bevel the plain end pipe 1/16 inch to 1/32 inch. Joints shall be first cleaned with cleaner before making up. Apply primer to the female joint. Apply primer to the male joint. Reapply primer to the female joint.

Apply glue to the male joint. Apply glue to the female joint. Reapply glue to the male joint. Join pipe quickly with a 1/4 turn. If joint cannot be made up to full depth of socket, cut out and discard. Wipe off excessive cement. Hold for 30 seconds and do not move for 15 minutes after making up joint. Pipe joining below 40 degrees F will not be permitted. Cleaner and cement types shall be as recommended by the manufacturer for the size of pipe being used.

3.3 FLANGED PIPING

Flanged joints shall be made in accordance with best trade practice. Screwed flanges for piping shall be run until pipe projects beyond face and no more than one thread is exposed on backside. All flange faces shall then be machined so as to be perfectly parallel. All flanged pipe shall be accurately dimensioned; no "drawing-up" will be allowed. Gaskets shall be full face, rubber.

3.4 GROOVED JOINT PIPING

Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review Contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s)).

3.5 THREADED PIPING

Threads for threaded joint piping shall be neatly cut with sharp tools and jointing procedure shall conform to best practice. Before jointing, all scale shall be removed from pipe by some suitable means such as pounding. After cutting, all pipe shall be reamed. All pipe shall be screwed together with an application of approved pipe compound applied to all male threads. Once a joint has been tightened, it shall not be backed off unless threads are recleaned and new compound applied. This application neatly made; all compound, dirt thoroughly wiped off outside of every joint.

Unions shall be installed in all threaded joint piping to facilitate removal of sections for maintenance, repair in accordance with best trade practice. All such unions shall be included in bid price whether shown on Plans or not.

3.6 MECHANICAL JOINT PIPING

Mechanical joint piping shall be installed in best trade practice with torque wrenches used to avoid overstressing bolts. Piping shall be installed using recommended procedures outlined in "Handbook of Cast Iron Pipe" as published by Cast Iron Research Association which in part requires that all contact surfaces of rubber seal with pipe be wire brushed, spigot be centrally located in bell. When tightening bolts, it is essential that the gland be brought up toward pipe flange evenly, maintaining approximately same distance between gland and face of flange at all points around socket.

3.7 COPPER PIPE

All copper water service lines shall be tested, cleaned, and chlorinated, as described below. All waste, vent or drainage lines shall be flushed clean, and shall be tested by plugging the lowest point and filling the waste, vent or drainage piping with water to the level of the top of the vent pipe, but no joint in the system shall be submitted to a test of less than 10 feet of head. Under this condition, all joints shall remain watertight for a period of not less than 1 hour.

Piping shall be pressure-tested with water to a pressure of 125 psi.

3.8 HIGH DENSITY POLYETHYLENE (HDPE) PIPING

HDPE pipe shall be installed in accordance with the manufacturer's instructions as shown on the Plans and as specified herein. Pipe trenching shall be done in accordance with ASTM D2321. Pipe bedding materials shall be Class I or II as specified by ASTM D2321 Section 6. Bedding and compaction rates for pipe installation shall be performed in accordance with ASTM D2321 Section 8.

3.9 PIPE SUPPORTS

Provide all necessary supports, tie rods, bracing, brackets or other types of supports which may be required, as shown on the Plans, or as specified in Section 15066.

3.10 FLEXIBLE COUPLINGS

Flexible couplings shall be installed in accordance with recommendations of manufacturer and used where indicated on the Plans. Finished joint shall be airtight or watertight under test pressure of pipeline. Buried flexible couplings shall be coated with asphalt base paint after assembly.

3.11 PIPE BEDDING

All pipe shall be bedded as specified in Section 02300.

3.12 TESTING

A. GENERAL

All piping shall be tested and inspected in accordance with the provisions of Division 7 APWA/WSDOT, except as modified herein. Where new piping systems are being connected to existing piping systems the existing piping systems shall be tested prior to connecting to the new pipe to the existing piping. Once the new piping system has been connected to the existing piping system the entire system shall be tested again.

All piping systems will be tested to demonstrate leak tightness prior to acceptance. The Contractor shall provide all equipment and labor necessary to perform all testing required herein, the costs to be included in the lump sum bid price.

Each particular piping system shall be tested as hereinafter specified. All leaks shall be repaired or defective material replaced and the test repeated as directed by the Engineer. After compliance with test requirements and approval of the Engineer, the field painting, where required, may be started. All pressure testing shall be done prior to any finish painting or pipe insulating.

The Contractor shall be responsible for repair of any damage resulting from or caused by leak testing.

All thrust blocks shall be in place for at least 7 days to allow concrete to cure before testing. Install adequate blocking or other means of resisting test pressure.

B. PRESSURIZED LIQUID PIPING

All PVC, ductile iron and steel piping for pressurized liquid, including sludge, shall be pressure tested to 200 psi.

All cross connection protection equipment shall be tested by a certified inspector prior to putting the piping into service. Submit test report to Owner.

C. DISINFECTION

Before being placed into service, all new and modified potable water pipe and appurtenances shall be sterilized and a satisfactory result obtained from a presence/absence (PA) test for total coliform in accordance with Section 02510.

***** END OF SECTION *****

SECTION 15066

PIPE AND CONDUIT SUPPORT SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

The work specified in this Section includes pipe and conduit hangers, brackets, and supports. Pipe and conduit support systems shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, structural attachments, and other accessories as shown on the Plans and specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01300	Submittals
01600	Materials and Equipment
01800	Testing, Commissioning, and Training
09900	Painting
15050	Piping Systems
15100	Valves
15400	Plumbing
16050	Basic Electrical Materials and Methods
16130	Raceways and Boxes

1.3 REFERENCES

All pipe and conduit support materials and methods shall conform to the latest, applicable requirements of documents listed hereafter. In case of conflict between this section and the listed documents, the requirements of this Section shall prevail.

ANSI A13.1	Piping and Piping System
ANSI B31.1	Power Piping
ASME	Boiler and Pressure Vessel Code
ANSI/MSS SP-58	Pipe Hangers and Supports C Materials, Design and Manufacture
ANSI/MSS SP-69	Pipe Hangers and Supports C Selection and Application
SMACNA	Seismic Restraint Manual C Guidelines for Mechanical Systems
UPC	Uniform Plumbing Code

1.4 SUBMITTALS

In accordance with the requirements of Section 01300, submit the following project data prepared by a licensed Professional Engineer:

A. Manufacturer's technical data for all hangers, brackets, supports and documentation of conformance with appropriate standards and these Specifications.

B. Location of pipe and conduit support, including type of structural and pipe attachments, shown on detail drawings and/or specified under paragraph 1.5 of Section 15050.

PART 2 PRODUCTS

2.1 GENERAL

The Contractor shall design, provide, and install pipe and conduit support systems, which include hangers, brackets, supports, anchors, expansion joints, and structural attachments. The support system shall be pipe rack, trapeze pipe hangers or individual pipe clamps, hangers, supports and structural attachments as specified herein. The support system shall be designed in conjunction with the pipe and conduit to be supported. Seismic restraints shall be provided in accordance with SMACNA Manual as referenced in paragraph 1.3.

In certain locations, pipe supports, anchors, and expansion joints have been indicated on the Plans, but no attempt has been made to indicate every pipe support, anchor, and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe and conduit supports. Pipe support schedule under paragraph 2.6 sets forth minimum requirements for pipe supports.

2.2 PIPE RACKS AND TRAPEZE HANGERS

Pipe and conduit racks and trapeze hangers shall be constructed of galvanized steel channels, rods, posts, post base, clamps, brackets, fittings, and accessories for supporting pipes in equipment and pump rooms. All components for pipe and conduit rack and trapeze shall be Unistrut or equal.

2.3 PIPE CLAMPS AND HANGERS

In areas where pipe racks and trapezes are not used, pipe shall be supported with clamp hangers and stanchion saddle support system. The clamps and hangers shall be fastened to threaded rods hanging from structural attachments. Pipe supports shall be selected for the size and type of pipe to which they are applied.

Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item.

All pipe clamps and hangers, including all accessories, shall be galvanized steel for indoor use and 316 stainless steel for outdoor use and submerged application.

Pipe and conduit clamps and hangers shall be as manufactured by Anvil or approved equal and shall be as follows:

Type	Pipe Size (In.)	Pipe Material	Grinnell Figure
Split Ring	3/4 to 6	All type	104
Split Clamp	1/2 to 3	All type	138R
Adjustable Ring	1/2 to 6	All type	97
Adjustable Ring	1/2 to 4	Copper	CT-269
Adjustable Clevis	4 to 30	All type	260
Pipe Clamp	4 to 18	All type	216
Socket Clamp	4 to 24	Cast Iron	590
Stanchion Saddle	4 to 12	All type	259
Adjustable Saddle Support	3 to 24	All type	264
Riser Clamp	2 to 8	All type	40
Adjustable Pipe Roll	6 to 12	Stainless Steel	174

2.4 STRUCTURAL ATTACHMENTS

Structural attachments shall be concrete insert channels or individual inserts for new concrete, surface-mounted channel or individual inserts for existing concrete or where applicable, steel, roof plate supported attachments in the control building, complete with all accessories required. All structural attachments including all accessories shall be galvanized steel for indoor use and stainless steel for outdoor use, and shall be provided by a single manufacturer. Structural attachments shall be as measured by Unistrut Corporation or approved equal.

2.5 PIPE SUPPORT ATTACHMENTS TO CONCRETE

All pipe support attachment to concrete shall be in adhesive anchors unless noted otherwise.

Products which may be incorporated in the work include, but are not limited to, the following:

A. HIT RE 500 Injection Adhesive Anchor, Hilti, Inc.

B. HIT HY 150 Injection adhesive Anchor, Hilti, Inc.

C. Power-Fast, Powers Fasteners, Inc.

2.6 PROTECTION SADDLES

Protection saddles shall be used for protecting pipe insulation against damage at pipe supports or as shown on the Drawings. The nominal thickness of covering shall be the same as that of pipe insulation. The protection saddles shall be curved carbon steel plate and shall be Anvil Figure 160 through Figure 162 or approved equal.

2.7 SPACING

Maximum support spacing shall conform to the following table:

Pipe Size Inches	Pipe Material	Maximum Spacing Feet
1" & Smaller	Iron or Steel Copper Plastic Tubing	6 4-1/2 continuous continuous
1-1/4 to 2"	Iron or Steel Copper or Plastic	8 5
2-1/2 to 4"	Iron or Steel Copper or Plastic	10 6
6 to 8"	Iron or Steel Plastic	12 8

PART 3 EXECUTION

3.1 DESIGN

Pipe and conduit support systems shall be designed in accordance with applicable reference standards specified in paragraph 1.3. Pipe and conduit supports shall be designed and selected to withstand seismic loads for IBC 2012 Seismic Design Category D with Ss=1.395g and S1=0.707g and shall adhere to the following conditions:

A. Weight balance calculations shall be made to determine the required supporting force at each pipe support location and the pipe weight at each equipment location. Design loads for inserts, clamps, and other support items shall not exceed the manufacturer's recommended loads.

B. Pipe supports shall be able to support the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent excessive stress resulting from transferred weight being

induced into the pipe or connected equipment. Allow clearances for pipe expansion and contraction.

C. Wherever possible, pipe attachments for horizontal piping shall be pipe clamps, or as shown on the pipe support detail sheet. Horizontal or vertical pipes should be supported preferably at locations of least vertical movement.

D. All pipe supports shall provide a means or vertical adjustment after erection.

E. Where practical, riser pipe shall be supported independently of the connected horizontal piping. Pipe support attachments to the riser piping shall be riser clamps.

3.2 INSTALLATION

Pipe support system shall be installed strictly in accordance with standards and codes referenced in paragraph 1.3 and piping support system manufacturer and piping manufacturer's recommendations.

In addition, all piping shall be rigidly support and anchored so that there is no movement or visible sagging between supports.

Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper-plated. Those portions of pipe supports, which contact other dissimilar metals, shall be rubber or vinyl coated.

Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as required to force expansion and contract movement to occur at expansion joints, loops, or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellows type expansion joints may be located adjacent to the joint.

Pipe supports and expansion joints are not required in buried piping, but concrete thrust blocking or other approved anchorage shall be provided as indicated on the Plans or specified in other sections.

*****END OF SECTION *****

SECTION 15100

VALVES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section shall consist of valves and accessories as shown on the Plans, described in these Specifications, and as required to completely interconnect all equipment with piping for complete operable systems.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Payment
01300	Submittals
01800	Testing, Commissioning and Training
Division 11	Equipment
Division 15	Mechanical

1.3 SUBMITTALS

Submit Catalog cuts and shop drawings in accordance with Section 01300 to demonstrate that the valves and appurtenances conform to the Specifications requirements.

The Contractor shall furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for all valves.

1.4 QUALITY ASSURANCE

All materials and equipment furnished under this Section shall be by the manufacturer specified.

See Section 15400 for Plumbing specifications and requirements.

PART 2 PRODUCTS

2.1 GATE VALVES

Gate valves 3 inches and smaller shall be bronze, non-rising stem, wedge disc, 125 pound service, Crane No. 438, Kennedy Figure 427 or equal.

Gate valves larger than 3 inches shall be iron body, bronze mounted, resilient seat, wedge disc, left opening, high-strength bronze stem, O-ring with a 2-inch-square

operating nut and complying with AWWA C509 or C515. Gate valves shall be non-rising stem unless noted otherwise.

Above ground gate valves shall be provided with handwheels.

2.2 BUTTERFLY VALVES

Butterfly valves for liquid service shall have iron body and disc, Buna N seats attached to the valve body, stainless steel shaft, corrosion resistant bearings, and flanged style body and shall comply with AWWA C504. Extension bonnets shall be sealed from liquid intrusion and shall encase the valve torque tube from the valve trunnion to the top-mounted geared handwheel actuator. The entire assembly shall be factory assembled and tested. Liquid service butterfly valves shall be DeZurik, Pratt 2FII, or equal.

Where butterfly valves are installed adjacent to check valves or other fittings, which interfere with the valve's full range operation, flange fillers, or other spacers, shall be installed between the valve and the obstructing fitting as necessary to insure unrestricted operation of the butterfly valve from full open to closed.

2.3 CHECK VALVES

Check valves for liquid service 3 inches and smaller shall be swing check, bronze body, composition disc, 125 pound service.

Check valve shall be globe style silent check. Valve shall be ductile iron body with stainless steel trim and resilient seating. Valve shall be a 250 pound pressure class with 150 pound flanged ends, APCO Series 600 or equal.

Check valves for submerged or intermittently submerged service shall be ball check valves. Manufacturer shall be Flowmatic or equal.

2.4 COMBINATION AIR AND VACUUM VALVES

Combination air valves shall have cast iron bodies and covers and stainless steel floats. Float guides, bushings, and lever pins shall be stainless steel. Valves shall be designed for operating service to 200 psi and shall allow unrestricted venting or re-entry of air. Provide a 1-inch shut-off valve and downspout to floor line.

Combination air valves shall be sized as shown on the Plans, single body, double orifice combination air valves, Valmatic 201C. Valves shall be provided with flanged end connections.

2.5 PVC BALL VALVES

Ball valves shall be PVC Class 1245 4-B, conforming to ASTM D1784, single union type, threaded per ANSI B1.20.1, full port design, rated 150 psi, Nibco Chemtrol Tru-Block, Asahi/America, or equal.

2.6 BRASS BALL VALVES

Brass ball valves shall be full port design, rated for 250 psi, with brass body stem and cap, PTFE seats and seals, and chrome plated brass ball. Brass ball valves shall be A.Y. McDonald, or equal.

2.7 BACKFLOW PREVENTERS

Backflow preventers shall be of the reduced pressure type, Febco, Watts, Beeco, or equal as approved by the State Health Department. Sizes to be as indicated on the Plans.

2.8 VALVE IDENTIFICATION TAGS

Each shut-off or control valve, shall be provided with a 1-1/2-inch minimum diameter heavy brass tag. Tags shall bear the identifying number of the valve and one or more identifying letter symbols of the service line.

Numbers and letters shall be block type with 1/2-inch-high numbers and 1/4-inch-high letters stamped on the tags and filled with black enamel.

Attach tags to the valves by split-key rings soldered so that the ring and tag cannot be removed.

Furnish a drawing and a neatly typed valve directory listing each valve number, type of valve and its location. Submit the directory and drawing to the Owner for approval.

2.9 VALVE BOXES

There shall be furnished and installed with all valves installed underground, two piece adjustable cast iron valve boxes with a minimum inside diameter of 5 inches. The valve boxes shall be set concentric with the axis of the stem and adjusted to the finish grade. Valve box lids shall be identified with a letter/number code and opening direction designation as shown on the Plans.

2.10 VALVE INSULATION

All new above ground valves carrying liquids shall be insulated with 1-inch-thick fiberglass insulation and 0.16 of an inch anodized aluminum jacket; insulation by Owens-Corning, Certainteed, Johns-Manville or equal, unless otherwise noted.

PART 3 EXECUTION

3.1 GENERAL

All valves and accessories shall be installed in a manner and location as shown on the Plans or as required for the application and in accordance with manufacturer's instructions. Valve size is fully equal to line piping in which the valve is installed unless otherwise noted on the Plans. Support all valves where necessary. In case on conflict between these Specifications and a governing code, the more stringent standard shall prevail.

All valves of the same style or type shall be furnished by a single manufacturer.

Provide all accessories necessary for proper valve operation as specified or required for the application. Buried valves shall be installed with square operating nuts and adjustable cast iron valve boxes with covers. Valve boxes shall be set such that the slots in the boxes are in line with the run of pipe the valves are in. Provide two sets of T wrenches for buried valve operation.

Buried valves shall be provided with 1-inch solid steel extension stems with rock guards if the operating nut will be 18 inches or more below the ground surface.

Valves shall be installed with the operator in a position for convenient operation. Particular care shall be taken to insure that space is available for operation of lever or handwheel operated valves without interference to walls, piping or equipment. Any valve which is installed, in the opinion of the Engineer, in a manner that operation is inconvenient shall be modified or removed and reinstalled in a manner suitable to the Engineer at the expense of the Contractor. Operations for manual valves shall be lever or handwheel as is standard with the manufacturer unless another type of operator is specified or required by the manufacturer.

For submerged valves, provide stem guides as recommended by the valve manufacturer on a spacing of 6'-0". As an alternate, provide valves with extended bonnets where practical. Provide supports for extended bonnets as required. Stem guides and supports shall be 316 stainless steel. All installation fasteners for submerged valves, guides, and supports (nuts, bolts and washers) shall be 316 stainless steel.

***** END OF SECTION *****

SECTION 15130

FIRE HYDRANTS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes installing fire hydrants as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
Division 2	Site Work
Division 15	Mechanical

PART 2 PRODUCTS

2.1 FIRE HYDRANTS

Fire Hydrants shall be Mueller Centurion A 423, or approved equal. Hydrants shall meet the requirements of AWWA C502.

2.2 PIPE AND FITTINGS

The connecting pipe between the fire hydrant and gate valve shall be 6-inch Gradelock with mechanical joint split glands. The fire hydrant and gate valve shall be restrained with mechanical joint restraint device as indicated in water main fittings.

PART 3 EXECUTION

3.1 GENERAL

Hydrant installation shall conform to AWWA Standard C600 provisions. Fire hydrants shall stand plumb and be set to the finish grade.

The Contractor shall locate fire hydrants with the correct bury (trench depth) in accordance with the specified pipe depth and special conditions of the Project. No additional payment will be made for hydrant extensions, 6-inch lateral piping and 6-inch gate valve.

***** END OF SECTION *****

SECTION 15400

PLUMBING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section shall consist of plumbing to include interior water systems, drain and waste systems, and fixtures and trim as shown on the Plans and specified herein.

All permits shall be obtained in accordance with Section 01160 of these Specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01200	Measurement and Payment
01160	Regulatory Requirements
01300	Submittals
15050	Piping Systems

1.3 REFERENCES

ASTM B62	Specification for Composition Bronze or Ounce Metal Castings
ASTM B88	Specification for Seamless Copper Water Tube
ASTM B371	Specification for Copper-Zinc Silicon Alloy Rod
AWWA C502	American Water Works Association Standard for Dry-Barrel Fire Hydrants

1.4 MANUFACTURERS

Use products of a single manufacturer where two or more units of the same class of equipment are required.

1.5 QUALITY ASSURANCE

All plumbing shall be performed in accordance with the current edition Uniform Plumbing Code. The Plans do not detail all items such as complete venting, etc.; however, it is understood that this work shall be included as part of this Project.

1.6 DELIVERY, STORAGE, AND HANDLING

Material shall be delivered to the project site in its original unopened containers with labels informing manufacturer and product name. Material shall be stored and handled in compliance with manufacturer's recommendation to prevent damage.

1.7 NAMEPLATES

Provide major components of equipment with manufacturer's name, address, catalog number, capacity, and equipment designation securely affixed in a conspicuous place.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS - WATER SYSTEM

A. BURIED PIPE

1. Pipe

   Type "K" copper with wrought copper fittings, ASTM B88, silver solder.

2. Fittings

   Wrought copper; ANSI B16.22.

B. ABOVE GROUND PIPING

1. Pipe

   Type "L," hard drawn copper with wrought copper fittings, ASTM B88, silver or 95-5 solder.

2. Fittings

   Wrought copper; ANSI B16.22.

2.2 PIPE AND FITTINGS - DRAIN AND WASTE SYSTEM

A. BURIED PIPE

Cast iron no hub, standard weight using long pattern cast iron drainage pattern fittings and rubber ring clamp joints.

B. ABOVE GROUND PIPING

Cast iron, bell-and-spigot, long pattern fittings, rubber ring joints. Galvanized, schedule 40, long pattern recessed C.I. screw fittings. DWV copper, long pattern cast brass fittings, 50/50 solder.

C. FITTINGS

Cast iron screwed; ANSI B16.4. Cast iron flanged; ANSI B16.1.

2.3 VALVES

A. GATE VALVES

Gate valves 3 inches and smaller shall be bronze, non-rising stem, wedge disc, 125 pound service, Crane No. 438, Kennedy Figure 427 or equal.

Gate valves larger than 3 inches shall be iron body, bronze mounted, resilient seat, wedge disc, left opening, high-strength bronze stem, O-ring complying with AWWA Standard C509. Gate valves shall be non-rising stem unless noted otherwise.

Above ground gate valves shall be provided with hand wheels. Buried valves shall have 2-inch square operating nuts.

Solder end valves may be used where copper tubing is used.

B. IRON GATE VALVES

Shall be rising stem, OS&Y. In areas of potentially high vibration or line shock, cast steel valves will be substituted.

C. BUTTERFLY VALVES

Butterfly valves for liquid service shall have iron body and disc, Buna N seats attached to the valve body, stainless steel shaft, corrosion resistant bearings, and flanged style body and shall comply with AWWA C504. Extension bonnets shall be sealed from liquid intrusion and shall encase the valve torque tube from the valve trunnion to the top-mounted geared handwheel actuator. The entire assembly shall be factory assembled and tested. Liquid service butterfly valves shall be DeZurik, Pratt 2FII, or equal.

Where butterfly valves are installed adjacent to check valves or other fittings, which interfere with the valve's full range operation, flange fillers, or other spacers, shall be installed between the valve and the obstructing fitting as necessary to insure unrestricted operation of the butterfly valve from full open to closed.

D. BACKFLOW PREVENTER

Backflow preventers shall be of the reduced pressure type, double check valve assembly, or double check detector assembly as indicated on the Plans by Febco , Beeco , Watts or equal. Sizes to be as indicated on the Plans.

E. VALVE COMPONENTS

Material used capable of operating within services required, e.g., hot water heating valve components designed for continued operation at 240 degrees F.

F. NEEDLE VALVES

Brass construction, threaded. Trerice No. 735.

2.4 FLASHING AND COUNTER FLASHING

A. REQUIREMENTS

3-lb. lead soldered joints and seams, 24" x 24" base pad and counterflashed into pipe.

2.5 PIPING SPECIALTIES

A. STRAINERS

0.0045 of an inch perforated 304 stainless steel screen, Armstrong AISC or equal by Yarway, Sarco.

B. GAUGES

Thermometer/temperature indicator shall have coiled bi-metal element, with bulb, stem, and detaching thermowell, accuracy of 2 percent and working range of 32-250 degrees F, 6 bar maximum thermowell rating, aluminum case/and acrylic window. The thermometer shall have dual scale reading for degrees F and C. The thermometer shall be provided with a stainless steel thermowell. Provide 5-inch-diameter type on

mountings over 7 feet above floor, and 2-1/2-inch diameter at other locations.

C. THERMOMETERS

Thermometer/temperature indicator shall have coiled bi-metal element, with bulb, stem, and detaching thermowell, accuracy of 2 percent and working range of 32-250 degrees F, 6 bar maximum thermowell rating, aluminum case/and acrylic window. The thermometer shall have dual scale reading for degrees F and C. The thermometer shall be provided with a stainless steel thermowell. Provide 5-inch-diameter type on mountings over 7 feet above floor, and 2-1/2-inch diameter at other locations.

D. UNIONS

2 inches and smaller; ground joint, malleable iron type. Grinnell, Crane, Walworth, Syspac.

E. ACCESS PANELS

Milcor, Type "DW" with screwdriver operated lock. Stainless steel access panels in tile walls.

F. INSULATING UNION

Epco, Capitol.

G. ESCUTCHEON

Grinnell Fig. 2 or 13, nickel plated.

H. TRAP PRIMERS

J.R. Smith, Josam, Zurn or Wade, equal to J.R. Smith model S-2699.

I. PIPE MARKING

See Section 15050.

2.6 MECHANICAL SUPPORTING DEVICES

A. PIPE HANGERS

Adjustable threaded rod type in accord with MSS SP-58, MSS SP-69, and ANSI B31.1

B. CONCRETE INSERTS

Malleable iron body and nut, Grinnell CB.

C. EXPANSION JOINTS

Stainless steel bellows type, Keflex model 308 or equal by Flexonics.

D. ALIGNMENT GUIDES

Keflex series P or equal by Flexonics.

2.7 WATER HEATER

A. TANK-STYLE WATER HEATER

Tank-style water heaters shall be electric 120-gallon water heater equal to A.O. Smith DRE-120 with the following features: three 4,500-watt elements suitable for 460 volt, three-phase, 60-Hz power supply and meeting ASHRAE 90.1.

Water heaters shall be provided with all code-required accessories such as insulating base-pads, expansion tanks equal to Amtrol #ST-12, and pressure/temperature relief valves.

PART 3 EXECUTION

3.1 PIPE AND PIPE FITTINGS

A. BURIED WATER PIPE

Install with not less than 1 foot of cover, measured from top of pipe to approved finish floor. Install pipe in accordance with the manufacturer's recommendations. Construct water lines under other utilities where necessary to meet the minimum cover requirements.

B. HORIZONTAL SOIL AND WASTE PIPE GRADING

Provide a grade of 1/4 inch per foot where possible, but in no case less than 1/8 of an inch per foot. Install main vertical soil and waste stacks with provisions for expansion and extend full size to roof line as vents.

C. PIPES

Remove burrs by reaming. Use Teflon tape on male threads only.

D. OPENINGS IN PIPES

Keep closed during progress of work.

E. COORDINATION

Install so as not to interfere with light fixtures or other trade components.

F. CLOSE NIPPLES

Not permitted on any part of work. Use standard short nipples for short pipe connections. Use of bushings not permitted.

G. PIPING OF COPPER TUBING

Continuous. Copper tubing inserts in runs of steel pipe not permitted. Solder joints in copper piping. Do not lay copper tubing on rocks or gravel.

H. CONNECTIONS BETWEEN PIPES OF DISSIMILAR METALS

Make with insulating union (Dielectric). Include cast iron valve connections to adapters for copper pipe. Does not apply to waste piping.

I. CUTTING OF COPPER PIPE

Use a cutter. Smooth sharp edges with emery cloth.

J. SADDLES ON PIPE IN LIEU OF TEES AND BENDING PIPE

Not permitted.

K. EQUIPMENT ISOLATION

Provide isolation valves (gate or ball valve) and unions at piping connections to all equipment.

L. CONCEALED PIPING

Conceal all piping in finished areas unless otherwise noted.

3.2 WELDING

A. QUALITY CONTROL

Procedures in accordance with ANSI B31.1.

B. PROCEDURES

Use butt weld joints. Mechanically bevel pipe ends.

C. ELECTRODES

Store in dry heated area. Do not use moist or damp electrodes.

3.3 VALVES

A. RELIEF VALVES

Install at all points required by code and where required for protection of equipment and piping. Set pressure shall be as indicated or directed. Pipe discharge to nearest floor drain where pressure cannot exceed 30 psig or to safe acceptable terminus.

B. PRESSURE REDUCING VALVE ASSEMBLY

Install with a strainer on inlet side and relief valve on low pressure side. Make connections to pressure reducing valve through a gate valve and a union on each side and a full-size globe valve bypass around reducing valve. Install valves so that they are easily accessible for maintenance and removal. Provide pressure gauges on both high and low pressure sides.

C. BACKFLOW PREVENTER

Provide for boilers and chillers, and to comply with "Cross-Connection Control Regulation in Washington State." Install relief valve on downstream side.

D. AIR GAPS

Distance between inlet pipe and flood level rim twice the diameter of supply pipe.

D. VACUUM BREAKERS

Use atmospheric type where vacuum breaker is not upstream of shut-off. Install 12 inches above highest downstream pipe elevation. Use pressure type otherwise. Provide for lawn sprinkling, hose bibs, and faucets with hose end connections.

E. BALL AND BUTTERFLY VALVES

May be used in lieu of gate valves on all services except steam systems.

3.4 AIR GAP UNITS

Air gap units shall be installed as shown on the Plans and in accordance with the pump manufacturer's recommendations. All air gap unit pumps shall be checked for rotation prior to placing into service.

3.5 CLEANOUTS

Provide every 50 feet and install at all locations required by code and to permit cleaning of all sewer piping. Provide cleanouts full size of pipe, but not larger than 4 inches. Close cleanout openings with brass screw plugs. Where cleanouts occur in floor, install a brass ferrule complete with a screwed brass cover, flush with floor. Install cleanout threads with graphite. Locate cleanouts to clear cabinet work and make them easily accessible.

3.6 VENTS

A. FLASH AND COUNTERFLASH

Install vents passing through roof with roof flashing and counterflashing assemblies.

B. TRAP PRIMERS

Install automatic trap primers at all locations as shown on the Plans.

3.7 AIR CHAMBERS

Provide at each water connection to a plumbing fixture, same size as connection. Minimum length 16 inches, except 24-inches length at flush valves.

3.8 PIPING SPECIALTIES

A. GAUGES

Mount so gauges can be easily read from the floor. Provide ball valves to isolate pressure gauges. Cocks or petcocks are not acceptable.

B. THERMOMETERS

Mount to be easily read from the floor. Provide swivel at neck.

C. UNIONS

Install at final connections to all equipment items and on control side of all valves in mains, branches and risers.

D. ESCUTCHEONS

Install at all places where exposed piping passes through walls, floors or ceilings.

E. EQUIPMENT, VALVES, AND PIPING

Tag for identification, indicating equipment, zone and area served. Provide nameplates for access doors and removable ceiling panels to areas containing mechanical equipment, valves, etc. Submit to Engineer for approval proposed list of nameplates. Run all drips and drains for pumps, pans, reliefs, etc., to the drain. Discharge onto floor not permitted.

F. GALVANIZED IRON SLEEVES

Not less than 20 gauge, cast in concrete, and installed wherever piping passes through floors, footings or walls of concrete or masonry construction. Sleeves for insulated pipe shall be of sufficient size to allow the covering to pass through sleeve. Use steel pipe extended 1 inch above finished floor for sleeves in floors of rooms exposed to water. Watch and protect all sleeves and inserts while concrete is poured. For penetration of floors and walls from buried pipe, caulk annular space between pipe and sleeve with first quality oakum and fill with pitch.

G. FIRE PROTECTION

Fire stop pipe penetrations through fire rated walls, floors, and ceilings in accordance with the current edition of the International Building Code.

H. EXPOSED PIPING, VALVES, HANGERS, ETC., AT FIXTURE

Chromium-plated finish.

I. SINK SIZE

Coordinate and verify each sink size with cabinet manufacturer prior to ordering.

J. ROUGH-IN AND CONNECTION FOR FIXTURES AND EQUIPMENT

Connect fixtures and equipment furnished and installed by General Contractor, Owner, or others. It is the Contractor's responsibility to obtain from supplier sufficient information to rough-in properly and connect all fixtures in accordance with manufacturer's recommendation. Furnish all traps, valves tailpieces and other trim not furnished with equipment.

K. SHUT-OFF VALVES

Provide shut-off valves on all water lines to fixture groups.

L. LOCATION OF FIXTURES

Locate in accordance with details and dimensions on Plans.

M. INSTALLATION OF FIXTURES AND EQUIPMENT

Support and fasten wall hung fixtures with concealed floor support type carriers. Align fixtures and equipment installed in batteries in accord with architectural drawings. Fit fixtures on finished walls without noticeable warpage on either the wall or fixture and grout with G.E. silicone or similar approved material.

N. VACUUM BREAKERS

Locate and install on water supply to all fixtures which have water connection located below rim. Install on all hose bibs.

O. WATER CONNECTION STOPS

Install individual loose key stops on all fixtures. If water connections are concealed, install valves in lieu of stops.

3.9 MECHANICAL SUPPORTING DEVICES

A. GENERAL

Mechanical equipment and materials are not to be suspended or supported from pipe, electrical conduit, ceiling systems or any non-structural member.

B. CONCRETE ANCHORING

Use cast inserts in new construction; stamped metal inserts not acceptable. Expansion shells may be used in existing construction; powder actuated inserts are not acceptable.

C. PIPE HANGERS AND SUPPORTS

Item selections, hanger spacings, rod diameters, and protection shields in accord with MSS SP-69 and MSS SP-58, unless otherwise indicated. Pipes shall not be hung or supported from each other. Isolate copper water pipes from dissimilar metals, hangers, steel or aluminum studs, etc.

D. STRUCTURAL ATTACHMENTS

Beam clamps where possible.

E. VERTICAL ADJUSTING DEVICES

Provide on all rigid hangers.

F. PROTECTION SHIELD/PROTECTION SADDLE

Use on insulated pipe.

3.10 EXISTING UTILITIES

Locate well enough in advance of the excavation to prevent damage during construction. The Contractor is responsible for any damage whatsoever resulting from his operations on the project.

3.11 CONTAMINATION

Prevent contamination of the pipeline during construction from any operation or source.

3.12 HOT WATER

Generate at 120 degrees F unless indicated otherwise on the Plans.

3.13 SYSTEM DRAINING

Grade domestic water piping so that it can be drained from low points. Provide a valved drain run to nearest floor drain or approved terminus.

3.14 ACCESS PANELS

When not specifically shown on the Plans, provide in walls, ceilings, etc., to provide adequate access for service and maintenance of concealed valves, dampers, motors, air vents or any other concealed equipment or accessories. Minimum size 12" x 12".

3.15 HEAD PROTECTION

Where duct angles, pipe hangers, equipment support angles, etc., are exposed in walkways or in access ways to equipment for maintenance purposes, cover all such potentially injurious protrusions less than 6'-8" above the floor with padding. Secure padding permanently and finish comparable to adjacent surfaces.

3.16 TESTING AND STERILIZATION

A. WATER SYSTEM (POTABLE AND NON-POTABLE)

Clean piping prior to testing by thoroughly flushing with water until all dirt and foreign materials have been removed. Maintain flushing operations for not less than 1 hour and until piping is clean. Not less than 80-psi flushing pressure.

Conduct for a period of not less than 8 hours at 150-percent operating pressure, 125 psig minimum.

Potable water piping shall be sterilized with calcium hypochlorite at 50 mg/L chlorine for 24 hours prior to line acceptance. Contractor shall furnish hypochlorite. The cost of disposal of water used for sterilization shall be borne by the Contractor.

B. DRAIN AND WASTE SYSTEM

Subject all work to hydrostatic test of 10-feet head of water or as directed by local plumbing inspection authority. Obtain approval for all work or portions of work as tested, in writing, prior to covering or concealment in any manner. Notify Engineer at least two normal working days prior to testing any portion of work and do not conceal any work until so directed by the Engineer.

3.17 INSPECTION

It shall be the Contractor's responsibility to contact the Owner and arrange for final inspection.

***** END OF SECTION *****

SECTION 15700

HEATING, VENTILATION, AND AIR CONDITIONING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section shall consist of the heating, ventilation, and air conditioning equipment and other associated items as shown on the Plans, and as further specified herein.

All permits shall be obtained in accordance with Section 01160.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01160	Regulatory Requirements
01300	Submittals
Division 16	Electrical

1.3 QUALITY ASSURANCE

Submittals shall be in accordance with Section 01300.

All equipment supplied in this Section shall be provided to produce complete, operable systems with all elements properly interconnected as shown in schematic diagrams or to provide specified operations. If a specific dimensioned location is not shown for interconnections or smaller system elements, the Contractor shall select appropriate locations and show them on shop drawing submittal for review.

Equipment and material shall be new and without imperfections and shall be erected in a neat and workmanlike manner; aligned, leveled, cleaned and adjusted for satisfactory operation; installed in accordance with the recommendations of the manufacturers and the best standard practices for this type of work to ensure connecting and disconnecting accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance and repair. Oil and lubrication fittings shall be located clear of and away from guards, base, and equipment and within reach from the operating floor whenever possible. In order to meet these requirements with equipment as furnished, minor deviation from the Plans may be made as approved by the Owner.

The manufacturer's recommendations and instructions of products used in the work are hereby made part of these Specifications, except as they may be superseded by other requirements of these Specifications.

1.4 PROJECT MEETINGS

Attend a minimum of one site meeting, up to 2 hours in duration. The site meeting will be held after the HVAC equipment and controls have been installed. Any required training should be scheduled and performed at this site meeting.

1.5 EQUIPMENT LIST

Refer to Heating, Ventilation and Air Conditioning Schedules shown on the Plans.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

Equipment manufacturers and model numbers shall be as shown on the Plans except where indicated herein.

2.2 LOUVERS

A. BRICK VENTS

Provide and install brick vent(s) as shown on the Plans. Brick vents shall be of heavy gauge aluminum construction, and be 1.5 inches in depth with 1-inch face flange. The vents shall have water stops and deep overlapping blades, each with integral storm drip. The free area of each vent shall be at least 39 percent.

2.3 DAMPERS

Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D.

A. ROUND MANUAL BALANCING DAMPER

The damper shall be suitable for pressures up to 1-inch w.g., velocities to 2,000 ft/min and temperatures to 180 degrees F. Dampers shall consist of: a 20 gauge galvanized steel frame with 6-inch depth; blades fabricated from 20-gauge galvanized steel; 0.375 in square plated steel axles turning in acetal bearings. The damper shall be complete with a locking manual

quadrant. A standoff bracket shall be provided for installations using insulated duct. Provide Greenheck MBDR-50 or equal.

2.4 FANS

Fans shall be bear the AMCA Certified Ratings Seal for both sound and air performance and be UL listed.

A. IN-LINE BELT DRIVE FAN

The fan shall be of the centrifugal, belt driven inline type. The fan, fan housing, and accessories described below shall be one unit supplied by the same manufacturer. The housing shall be of square design constructed of heavy gauge aluminum and include square duct mounting collars. Fan construction shall include two removable access panels. The fan wheel shall be centrifugal backward inclined, constructed of aluminum. The wheel shall be statically and dynamically balanced. Motors shall be heavy-duty ball bearing type carefully matched to the fan load and furnished at the specified voltage, phase, and enclosure as indicated on the Fan Schedules. Motor and drives shall be mounted out of the airstream and readily accessible for maintenance. Fan motor shall be of the high efficiency type. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. The bearings shall be selected for minimum (L10) life at maximum cataloged operating speed. Drives shall be sized for minimum of 150 percent of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed, and securely attached to the wheel and motor shafts. The motor pulley shall be adjustable for final system balancing. The accessories and controls and finish shall be as indicated on the Fan Schedule. Provide model as indicated on the Schedule.

2.5 FLEXIBLE DUCT CONNECTOR

At the inlet and discharge of all air handling equipment provide flexible duct connector. The metal to fabric connection shall consist of fabric material a minimum of 3 inches wide with 3 inch metal on either side of the flex material. Metal shall match the duct material for which it is installed. The fabric and metal shall be joined by means of a double lock seam.

A. INDOOR

Flexible fabric shall be Neoprene material with woven fiberglass as base fabric Neoprene coating and shall be UL listed. Material specification at a minimum shall be Weight: 30 oz./sq. yd, Tensile Strength of 500 psi, Tear

Strength: 13 psi, Low Temperature: -40 degrees F, High Temp: 250 degrees F. Provide Duro Dyne or approved equal.

2.6 ELBOWS

Standard radius or vaned square, as per SMACNA Standards.

2.7 TAPE

Non-combustible, three inches in size, foil backing, pressure-sensitive lap of facing material. NASHUA 357 (Low Pressure), NASHUA FSK (High Pressure) or equal.

2.8 ADHESIVE

Foster, Sealfos #30-36 or Arabol.

2.9 DUCT HANGERS AND SUPPORTS

Comply with requirements and recommendations of Sheetmetal and Air Conditioning Contractors National Association (SMACNA) HVAC Duct Construction Standards.

Conform to requirements of SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems."

Furnish standard and fabricated hangers and supports complete with necessary inserts, bolts, nuts, rods, washers and other accessories.

Hanger straps and rods shall be in accord with SMACNA Duct Construction Standards.

Fasten bracing to ductwork, including riveting, bolting, and tack welding per SMACNA.

Provide galvanized steel band or fabricated angle iron brackets for wall supports, except in wet well area where stainless steel components are required.

A. HANGER RODS

Carbon Steel, with hex nuts and flat washers.

B. CONCRETE INSERTS

1. Continuous channel - Unistrut.

2. Universal, malleable iron - Type 18, FS WW-H-171.

Beam Clamps and Attachments as required.

2.10 SEISMIC SUPPORTS

All HVAC supports, tie rods, bracing, brackets or other types of supports shall be designed in accordance with the 2009 International Building Code (IBC) and ASCE 7-05. Evaluate the seismic loads in accordance with 2009 IBC and Chapter 13 of ASCE 7-05 for the seismic design parameters shown on the Plans.

2.11 FIRE SEALANT

UL listed field installed self-curing fire barrier material (1 hour minimum rating), suitable for insertion in the annual space between a pipe or duct and its wall penetration or sleeve; Dow Corning "Fire Stop" sealant, 3M "Fire Barrier" caulk or putty or Nelson "Flameseal" putty.

Three-hour rated fire seals shall be manufactured modular mechanical type, Thunderline "Link-Seal" Model FS Pyro-Pac with accessory wall sleeve or equal.

2.12 FILTERS

Air filters shall be 80 percent efficiency, disposable type, and not less than MERV 12 rated. Filter shall UL Class 2 listed unless specifically noted otherwise on the Plans.

PART 3 EXECUTION

3.1 INSTALLATION

All materials shall be installed as shown on the Plans and according to manufacturer's recommendations. Adjust all dampers and louvers to provide tight seal when closed and unobstructed flow when open. Provide all necessary controls, and coordinate all control wiring with Division 16. All installed equipment shall function in manner intended.

The heating/cooling system shall be installed as shown on the Plans and shall be connected to any ductwork with flexible connections. The Contractor shall be

responsible for the installation of any condensate drain piping and conduit/wire runs for controllers/thermostats.

3.2 TESTING, ADJUSTING AND BALANCING

A. AIR BALANCE

When systems are complete and ready for operation, the HVAC Contractor will perform a final air balance for all air systems and record the results. The general scope of balancing by the HVAC Contractor will include, but is not limited to, the following:

1. Filters

   Check air filters and filter media and balance only systems with essentially clean filters and filter media.

2. Fan Speed

   Measure and record RPM at each fan speed.

3. Voltage and Amperage Readings

   Measure and record the final operating amperages and voltage for each motor.

4. Equipment Air Flow

   Adjust and record exhaust, return, outside, and supply air CFM and temperatures, as applicable, at each fan and coil. Confirm VG System operation through entire modulation range (0 – 10VDC).

5. Ambient Conditions

   Measure and indicate indoor and outdoor ambient conditions. All outside temperature measurement shall be taken in the shade.

6. Intake Damper Operation

   Verify motorized damper operation. Record time required to fully open damper and the time required for the VG motor to reach maximum exhaust capacity.

B. REPORTS

The report will contain all required information as described within this specification, including the information formatted and shown in the AABC Standard. Include with the data the date tested, personnel present, records of test instruments used, and a list of all measurements taken. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the reports shall be certified by the Agency's Test and Balance Engineer. Four copies of the final report shall be submitted to the Owner indicating a summary of actual operating data and any abnormal operating conditions.

E. EXECUTION

1. Provide clean filters as specified herein and shown on the Plans.

2. Measure and record outside and inside ambient conditions.

3. Put all system and equipment into operation and continue operation until all adjusting, balancing, testing, demonstrations, instructions, and cleaning of systems have been completed.

4. Do not begin testing and balancing until systems are completed and in good working order.

5. Check motors for proper rotation, coupling and drive alignment, belt tension, and freedom from vibration, etc.

6. Make all changes to drives and dampers as necessary to accomplish specified airflows.

*****END OF SECTION*****

DIVISION 16

ELECTRICAL

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the requirements and methods for furnishing and installing the basic electrical materials, and other associated items as shown on the Plans, and as further specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
01800	Testing, Commissioning, and Training
02300	Site Earthwork
Division 3	Concrete
09900	Painting
11000	Equipment General Provisions
Division 15	Mechanical
Division 16	Electrical

1.3 DEFINITIONS

A. ATTICS

Attics shall be considered those closed environments between ceilings and roofing that allow full entry of personnel by use of ladders, pull-down stairs, or other special means.

ATTICS are considered dry crawl spaces (see CRAWL SPACES).

Tight spaces between ceilings and roofs that do not allow full entry of personnel are considered concealed areas (see CONCEALED AREAS).

B. CHEMICAL AREAS

Locations where process chemicals are stored or used within a process in either a confined or open manner. Chemical areas may be exposed to chemical solids, liquids, or gases as a result of normal operation, system maintenance, or spills/leaks.

C. CONCEALED AREAS

Locations that are underground, within walls, or within other areas that do not allow full entry of personnel are considered concealed. Concealed areas are not exposed (see EXPOSED AREAS) or accessible (see ATTICS and CRAWL SPACES).

D. CONTROL PANELS

Control Panels shall be defined as enclosures that contain electrical devices capable of controlling, altering, indicating or displaying the function or conditions of electrical circuits. Unlike junction boxes, Control Panels are not just used for the redirection or reconnection of electrical circuits.

E. CONVENIENCE RECEPTACLES

120 Vac general-purpose receptacles that are not dedicated to a specific function or piece of equipment. Receptacles dedicated to computers, heat tracing, fans, louvers, and etc., are not considered convenience receptacles.

F. CRAWL SPACES

Crawl spaces shall be considered those closed environments that are not normally accessible to personnel, but that allow full entry of personnel by special means.

Crawl spaces are considered exposed areas and may be dry or wet (see ATTICS).

G. DAMP AREAS

Damp areas are considered wet (see WET AREAS).

H. DEDICATED RECEPTACLES

Dedicated receptacles are provided for a specific receptacle load such as computers, heat tracing, fans, louvers, metering pumps, sump pumps, and etc. Dedicated receptacles are not intended for general use.

I. DRY AREAS

Locations not normally subject to dampness or wetness. A location classified as dry may be temporarily subjected to dampness or wetness, as in the case of a building under construction (see FINISHED AREAS).

Rooms containing process water, chemical piping, or related equipment are not considered DRY. Areas that are not considered DRY are considered WET.

J. EXPOSED AREAS

Locations that are visible, outdoors, or exposed to a process or room environment. Exposed areas are not concealed (see CONCEALED AREAS).

K. FINISHED AREAS

Indoor confined areas that are not directly exposed to a process or process chemicals. They typically include closed offices, bathrooms, laboratories, lunch/break rooms, etc. Finished areas are considered DRY.

L. INDOOR AREAS

Confined locations where the equipment is normally protected from wind, dust, rain, snow, and other natural elements. INDOOR areas are not the same as DRY areas.

M. LEGALLY REQUIRED STANDBY SYSTEMS

Those systems required and so classed as legally required to have standby power by Government requirements. All projects have a generator or receptacle for a generator are considered to be a legally required standby system unless stated otherwise.

N. OUTDOOR AREAS

Locations where the equipment is normally exposed, or partially exposed, to weather in the form of wind, dust, rain, snow, and other natural elements.

O. PROCESS AREAS

Process areas are those areas that are directly exposed to process moisture, or that may be subjected to moisture in the event of a process leak or

failure. They typically include pump rooms, chemical rooms, and direct process-exposure areas such as clearwells, open filters, and reservoirs. Process areas are considered WET.

P. SHOP FABRICATED

Manufactured or assembled equipment for which a UL test procedure has not been established.

Q. VIBRATING EQUIPMENT

Equipment that is subject to vibration under normal operating conditions, such as motors, transformers, electrically operated valves, etc.

R. WET AREAS

Locations outdoors, underground, directly or indirectly exposed to the process, in concrete slabs or masonry in direct contact with the earth, or in any other way subject to saturation with water or other liquids.

1.4 REFERENCES

Unless otherwise noted, the requirements of the following code-making authorities and standard organizations apply:

References	Title
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
ASTM A36	Specification for Structural Steel
ETL	Electrical Testing Laboratories, Inc.
FM	Factory Mutual System
ICEA0	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society of North America
ISA	Instrument Society of America
JIC	Joint Industrial Council
JIC EMP-1	Mass production Equipment
LPI	Light Protection Institute
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NEMA ICS-1	General Standards for Industrial Control and Systems
NEMA ICS-2	Industrial Control Devices, Controllers and Assemblies
NEMA ICS-6	Enclosures for Industrial Controls and Systems
NFPA	National Fire Protection Association

NRTL	National Recognized Testing Laboratory
OSHA	Occupational, Health, and Safety Administration
UL	Underwriters Laboratories, Inc.
UL 508	Safety Industrial Control Equipment
UL 698	Industrial Control Equipment for Use in Hazardous Locations
WAC 296-46B	Washington Administrative Code, Electrical Safety Standards, Administration, and Installation

In case of conflict or disagreement between codes, standards, laws, ordinances, rules, regulations, plans, and specifications, the more stringent condition shall govern.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Prior to submittal of shop plans, coordinate all electrical equipment, particularly motor control equipment, process and control panels, and instrumentation, with related manufacturers and with other applicable equipment and systems specified in other divisions of the Specifications.

C. Provide submittals in the following manner:

1. Organize the submittals by CSI code type.

2. Clearly show the Tag Number associated with each submittal within each CSI grouping.

3. Include non-tagged devices such as grounding systems, conduits, wireway, ductbank details, wire, cable, boxes, fittings, switches and receptacles.

4. Clearly show the specific part, part number, order code, etc., associated with the device. Use pointers, highlights, circles, etc., to clearly identify the specific part.

5. Submit on distribution equipment, including but not limited to: Unit substations, Medium voltage switching equipment, motor control centers and control equipment, low voltage switchboards, safety switches, dry-type (specialty) transformers, panelboards, and grounding.

6. Submit on generators and automatic transfer switches.

7. Submit on lamps, lighting, site lighting, and wiring devices.

D. Provide manufacturer's product technical data including, but not limited to:

1. Manufacturer's name, address, and contact number.

2. Manufacturer's product descriptive bulletin.

3. Nameplate data, current, voltage, load, impedance, and other electrical data pertinent to the Project and necessary to assure compliance with the Specifications and Plans.

E. Provide elementary wiring diagrams for the electrical control systems showing the wiring of electrical control items, such as starters, control systems, interlocks, switches, and relays as they apply to this Contract.

F. Provide schematic interconnection diagrams and/or PID diagrams for each control system and each control panel. Each control diagram shall show a schematic representation of the process equipment and the locations of the switches, meters, automatic valves, indicators, controllers, and recorders. Show correct operating settings and ranges for each control instrument on the diagrams.

G. Use diagrams and symbols in shop plans, which conform to JIC Electrical Standards for Industrial Equipment and/or NEMA, ICS, ANSI, and IEEE standards, latest revisions. Prepare plans on 22" x 34", or ANSI Size A, B, or D in a format similar to the Contract Documents or other nationally recognized drawing standard.

H. Clearly, indicate on submittals that the equipment or material is NRTL listed or is constructed of listed or recognized components. Where a NRTL standard has not been established, clearly identify that no NRTL standard exists for that equipment.

I. OPERATION AND MAINTENANCE MANUALS

Manuals for the electrical system shall consist of 3-ringed, expandable metal hinge binders labeled with the job name and the Contractor's name.

1. Provide tab dividers for each major type of equipment. Each divider shall contain detailed information, plans, diagrams, and

instructions for installing, operating, and maintaining the equipment installed in Division 16.

2. Provide a table of contents listing each tab divided section and its contents.

3. In each section, compile a spare parts list and supplier index.

4. Assemble records of all tests, measurements, and calibration settings made for each device.

J. Upon completion of the work, provide Record ("As Built") Plans. Fold, punch, and insert these records into the manual after they are reviewed by the Engineer by folding and punching 11" x 17" or smaller plans and folding larger sheets, and placing in plastic sleeves in manual.

1.6 SYSTEM DESCRIPTION

A. Provide the labor, materials, and equipment necessary to furnish, install, and place into operation complete power, lighting, control, alarm, communications, and instrumentation electrical system of this Contract as shown on the Plans or Specifications herein.

B. Provide a functioning system(s) in compliance with manufacturer's instructions, performance requirements as specified or indicated, and modifications resulting from reviewed shop plans and field coordinated plans.

C. Provide complete wiring and controls for all equipment specified under other divisions and that comply with Division 16.

Connect motors, controls, meters, and any other electrical device installed or provided as part of the project.

D. Pay and make arrangements for necessary permits, licenses, and inspections.

1.7 QUALITY ASSURANCE

A. TESTING AGENCY QUALIFICATIONS

A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7, or a full member company of the InterNational Electrical Testing Association (NETA).

Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies, or equal, to supervise on-site testing specified in Part 3.

B. Comply with NFPA 70 (NEC) for components and installation.

C. LISTING AND LABELING

Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled:" As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

1.8 DELIVERY, STORAGE AND HANDLING

See Section 01600. Ensure that equipment is not used as steps, ladders, scaffolds, platforms, or for storage – either inside or on top of enclosures. Protect nameplates on electrical equipment from being defaced. Repair or replace damaged, corroded, and rejected items at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to individual Division 16 sections.

Similar equipment shall be provided by only one manufacturer throughout the project unless otherwise noted in the Specifications.

B. Submit requests for substitution in accordance with Section 01300.

C. Trade names and catalog numbers may be used in the Plans or Specifications to establish quality standards and basis of design:

1. Other listed manufacturers in the applicable specification sections with equal equipment may be acceptable.

2.2 GENERAL PRODUCT REQUIREMENTS

A. Except as otherwise indicated, provide new materials and equipment, which are standard products of manufacturers, regularly engaged in production of such equipment. Provide material or equipment approved

and labeled for the purpose for which it is to be used by NRTL or other organizations acceptable to the State of Washington Department of Labor and Industries.

B. Where voltage, current, power, temperature or other ratings are specified that do not correspond to standard ratings of the manufacturer selected by the Contractor, furnish the next rating level which is more conservative or increases the capacity of the device or material in question.

C. Furnish materials, devices, and equipment that are non-corrosive or coat them in a manner that renders them non-corrosive and acceptable to the Engineer. Do not provide materials, which contain polychlorinated biphenyls, asbestos, or other hazardous or detrimental materials. Do not install materials in a location or construction manner that produces galvanic action or do not install material combinations with corroding or eroding action.

D. Where changes in the work, or substitutions in material are proposed, ensure that sizes, weights, openings, etc., are provided that do not require changes in the work outside this Division.

E. All terminals shall be suitable for 75 degrees C rated copper conductors.

2.3 FABRICATION

A. When equipment is shop fabricated specifically for this Project, use electrical devices and enclosures, which are NRTL, listed and labeled or recognized.

B. SHOP OR FACTORY FINISHES

1. See Division 11 and Section 09900.

2. Interiors of other painted electrical equipment shall be either white or light gray.

C. Fabricate equipment or devices in the field equivalent in every respect to manufactured items used for the same purpose. Where cutting, drilling, grinding, etc., is done to galvanize or painted metal, regalvanize, or paint to match original finish.

2.4 SUPPORTING DEVICES

A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.

1. Material

Steel, except as otherwise indicated, protected from corrosion with zinc coating, cadmium plating, or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.

2. Metal Items for Use Outdoors or in Damp Locations

Hot-dip galvanized steel, or stainless steel, except as otherwise indicated.

B. ANCHORS

Cadmium plated or galvanized steel in dry areas; stainless steel or hot dipped galvanized steel in wet areas.

1. Lag screws or Type A tapping screws for wood.

2. Rockwell “well-nut” for light loads in masonry.

3. Thru-bolt with fender washers for heavy loads in masonry.

4. Toggle bolts with springhead for hollow partitions.

5. Self-drilling anchors with threaded studs for concrete.

6. Clamps or U-bolts for structural steel.

7. Self-drilling anchors with extension rods for hollow tile over concrete.

C. SHEET-METAL SLEEVES

0.0276 of an inch or heavier galvanized sheet steel, round tube, closed with welded longitudinal joint.

D. PIPE SLEEVES

ASTM A53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

2.5 ELECTRICAL IDENTIFICATION

A. MANUFACTURER'S STANDARD PRODUCTS

Where more than one type is listed for a specified application, selection is Installer's option but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and Specifications.

B. COLORED ADHESIVE MARKING TAPE FOR RACEWAYS, WIRES, AND CABLES

Self-adhesive vinyl tape, not less than 3 mils thick by 1 inch wide.

C. UNDERGROUND LINE WARNING TAPE

Provide bright-colored, vinyl tape not less than 3 mils thick by 6 inches wide compounded for direct-burial service with permanent and continuous print.

D. TAPE MARKERS

Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

E. COLOR-CODING CABLE TIES

Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

F. FASTENERS FOR PLASTIC-LAMINATED AND METAL SIGNS

Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

G. FLASH PROTECTION WARNING

Provide Arc Flash Warning Label on all equipment as required by 110.16 NEC (2014). The label is to contain the following text:

WARNING or DANGER
Arc Flash Hazard!
Follow requirements in NFPA 70E
for safe work practices and
appropriate PPE. Failure to comply
can result in death or injury.

2.6 TOUCHUP PAINT

Use touchup paint on equipment provided by equipment manufacturer and select color to match existing equipment finish.

A. FOR NON-EQUIPMENT SURFACES

Matching type and color of undamaged, existing adjacent finish.

B. FOR GALVANIZED SURFACES

Zinc-rich paint recommended by equipment manufacturer.

PART 3 EXECUTION

3.1 ELECTRICAL SUPPORTING METHODS

A. WET AREAS

1. For pullboxes and equipment vaults, reference Specification Section 16130.

2. For wet areas which are not pullboxes or equipment vaults, hot-dip galvanized materials, stainless steel materials, or nonmetallic, U-channel system components unless otherwise noted on the Plans.

B. DRY AREAS

Hot-dip galvanized materials unless otherwise noted on the Plans.

C. METHODS

Support raceway, equipment, and devices from framing members or building structure with sufficient clearance for maintaining and servicing. Provide backing plates, and/or framing material to support equipment, devices, and materials, which are located between the building or facility structure-framing members.

3.2 RECORDS

A. Maintain and annotate on the job at all times a separate set of Record Drawings in accordance with the General Conditions. Show changes from the Contract Documents, routing of hidden raceways, actual fixture and equipment locations, equipment sizes and dimensions and building outline changes. At the end of the Project, provide the Engineer a complete set of Plans marked in red pencil in a manner consistent with the Contract Plans, indicating the changes made on the job.

B. Record voltage, current, and megohmeter and ground ohmic resistance test measurements made on the electrical work, the trip units, fuses, and overload relay elements installed in the equipment and the setting of all pressure, flow, level, etc., control devices. When the Project is completed and operating, turn over these records to the Owner.

C. Equipment and raceways installed under this contract for future work shall be dimensioned on the Record Drawings.

3.3 COORDINATION

A. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations. Obtain approval from structural Engineer for penetration of structural components prior to penetrating the component.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

C. Coordinate the location of motors, switches, panel connections, and other points of connection with the equipment manufacturers or vendors prior to conduit installation. Route circuits to the actual connection point. Even if removal and reinstallation of building materials is necessary, remove and reinstall conduit, outlet boxes, and other electrical connections, if initial electrical connections are not made to the appropriate equipment location.

D. Coordinate and schedule connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

E. Coordinate and verify work under Division 16 with work under other Divisions, cooperate in locating equipment to avoid interference with

work of others, and plan work to harmonize with the work of other trades so that all work may proceed as expeditiously as possible. Coordinate the installing of built-in work, attaching items to buildings, and cutting and patching. Coordinate connecting electrical circuits to components furnished under other Divisions. (Portions of the electrical design are based upon the equipment specified in other Divisions.) No extras are allowed because of moving work required to avoid interference with work of other Contractors.

F. Coordinate the interruption of electrical systems to any part of the facility in use by the Owner at least 2 working days before interruption of the system.

G. Coordinate installing electrical identification after completion of finishing work where identification is applied to field-finished surfaces.

H. Where changes in the work, or substitutions in material are proposed, ensure that sizes, weights, openings, etc., are provided that do not require changes in the work outside this Division.

3.4 INSTALLATION

A. ENCLOSURES FOR USE WITH ELECTRICAL EQUIPMENT

Unless specifically called out otherwise on the Plans, electrical enclosures shall meet the following specification:

1. Dry Areas

NEMA 1.

2. Wet Areas

a. Indoors

NEMA 3R with HVAC equipment.

NEMA 4 where the enclosure will be subjected to splashing water or hose-directed water.

NEMA 12 where the enclosure will not be subjected to splashing water or hose-directed water.

b. Outdoors

NEMA 3R where the enclosure will not be subjected to splashing water, hose-directed water, or windblown dust.

NEMA 4 where the equipment is not HVAC and where the enclosure will be subjected to splashing water, hose-directed water, or windblown dust.

3. Corrosive Locations

NEMA 4X.

4. Exceptions

a. As otherwise indicated on the Plans.

b. As modified in other Division 16 sections.

5. Standards

a. NEMA ICS-6, Enclosures for Industrial Controls and Systems.

b. UL 508, Rainproof Enclosures.

c. UL 698, Industrial Control Equipment for use in Hazardous Locations.

B. WORKMANSHIP

Install the equipment and materials in a neat and workmanlike manner employing workers skilled in the particular trade and in accordance with the manufacturer's instructions, the National Electric Code, National Electric Safety Code, applicable local regulations, ordinances, and industry standards. A person in charge at the site shall maintain adequate supervision of the work under this division when necessary for coordination with other work.

C. SELF-SUPPORTED EQUIPMENT

Install self-supporting equipment in a level and plumb manner, shimming with full width stainless steel shims, as necessary. Bolt units to the floor with stainless steel expansion anchors and bolts, or weld units to embedded steel channels. Floor or pad shall be level within plus or minus

1/8 of an inch in a square yard before installing equipment. Grout or caulk enclosure to floor or pad. Provide bushings on conduits entering from above or at the side. For conduits entering from below, install grounded insulating bushings bonded to the ground bus or pad.

Install concrete pads and bases according to requirements of Section 03300.

Provide concrete foundations or pads required for electrical equipment as indicated or specified:

1. Floor-mounted equipment shall be mounted on a 4-inch-high concrete housekeeping pad. Pad shall be poured on top of the finished floor or slab.

D. MOUNTING HEIGHT

Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated. Mount enclosures for individual units at 54 inches above floors to centerline of controls unless otherwise indicated in the Plans.

E. ACCESSIBILITY

Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, while minimizing interference with other installations.

F. EQUIPMENT ORIENTATION

Install items parallel and/or perpendicular to other building systems and components, except where otherwise indicated.

G. EQUIPMENT MOUNTED ENCLOSURES

Attach enclosures mounted on equipment with machine screws or clamps as required. Do not drill equipment frames or sheets without permission of supplier/manufacturer or the Engineer.

Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

H. COORDINATION

Give right of way to raceways and piping systems installed at a required slope.

I. WALL MOUNTED ENCLOSURES

Stand equipment off wall surfaces a minimum of 1/4 of an inch where enclosures are mounted on walls in WET AREAS with neoprene or plastic shim washers.

J. MISCELLANEOUS SUPPORTS

Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices, except where components are mounted directly to a structural member of adequate strength.

K. SLEEVES

Install for cable and raceway penetrations of concrete slabs and walls, except where core-drilled holes are used. Install for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

L. FASTENING

Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure.

1. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or any other items.

2. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.

M. FIREPROOFING

1. Do not remove or damage fireproofing materials.

2. Install hangers, inserts, supports, and anchors prior to installation of fireproofing.

3. Repair or replace fireproofing removed or damaged.

N. PENETRATIONS

Make all penetrations of electrical work through walls and roofs water and weather-tight.

O. MISCELLANEOUS REQUIREMENTS

1. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.

2. Equipment fabricated from aluminum shall not be placed in direct contact with earth or concrete.

3. Do not exceed the dimensions indicated for equipment except as approved in writing by the Engineer.

4. Do not use equipment or arrangements for equipment that reduce the required clearance or exceed the space allocations.

P. DIMENSIONS

Dimensions indicated for electrical equipment and dimensions indicated for the installation of electrical equipment are restrictive dimensions.

Field measurements take precedence over dimensioned plans.

3.5 IDENTIFICATION

A. LABELS

Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment. Conduit labeling is further described in Section 16130. The labeling of conductors is further described in Section 16120.

B. NOMENCLATURE

Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated on the Contract Documents or required by codes and standards. Use consistent designations throughout the Project.

C. SELF-ADHESIVE IDENTIFICATION PRODUCTS

Clean surfaces of dust, loose material, and oily films before applying.

D. IDENTIFY PATHS OF UNDERGROUND ELECTRICAL LINES

During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above power and communication lines. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches, use a single line marker.

E. ENGRAVED, PLASTIC-LAMINATED LABELS, SIGNS, AND INSTRUCTION PLATES

Engraving stock shall be melamine plastic laminate punched for mechanical fasteners with a minimum thickness of 1/16 of an inch for signs up to 20 square inches, and 1/8 of an inch thick for larger sizes. Engraved legend in white letters on black face. Provide nameplates on equipment enclosures giving the name and circuit identification of the enclosed device/equipment in 1/4 of an inch lettering.

F. PANELBOARD SCHEDULES

For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

G. ARC FLASH HAZARD

Provide and install warning labels for arc flash hazard on all switchboards, panelboards, control panels, motor control centers, and other equipment per the requirements of the NEC and Washington State Administrative Code (WAC).

3.6 DEMOLITION

A. EQUIPMENT TO BE DEMOLISHED

Demolish all existing electrical devices and circuits, which are noted for demolition. Demolition includes, but is not limited to:

1. Removing all conduit, conductors, fittings, device boxes, hangers, panels, devices, etc., which are not concealed in the building structure or below grade/slab.

B. TEMPORARY POWER

Provide temporary power to existing branch circuit panels, branch circuits, and/or directly to electrical devices as required to keep all portions of the existing facility, which are occupied by the Owner, or required for operation, in operation at all times. Obtain approval by all appropriate code authorities, including the Department of Labor & Industries Electrical Inspection Department, or the local jurisdiction having authority, for any temporary connections required.

C. DAMAGED ELECTRICAL EQUIPMENT

Where remaining electrical work is damaged or disturbed in the course of the work, remove damaged portions, and install new products of equal capacity, quality, and functionality.

D. ABANDONED WORK

Remove existing conductors from conduits, unless otherwise indicated. Cut and cap buried raceway indicated to be abandoned in place 2 inches below the surface. Cap and patch surface to match existing surface finish.

E. REMOVAL

See Section 01900.

F. TEMPORARY DISCONNECTION

Remove, disconnect, store, clean, reinstall, reconnect, and make operational those components that are indicated for relocation and/or reconnection. Coordinate the process, mechanical, HVAC, and other equipment scheduled to be relocated and/or reused with other Divisions.

3.7 CUTTING AND PATCHING

Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.

Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.8 TOUCHUP PAINTING

Thoroughly clean damaged areas and provide primer, intermediate, and finish coats to suit the degree of damage at each location.

Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

3.9 EXTRA MATERIALS

Extra materials in this Section cover all spare parts for electrical devices under this contract and are centrally listed here for clarification and completeness. Spares shall match products installed, and shall be packaged with protective covering for storage and identified with labels describing the contents within.

A. GENERATOR ASSEMBLIES (ASSOCIATED CSI SECTION – 16230)

1. Power Fuses (line power)

   Provide three spare power fuses of each type and rating.

2. Control Fuses

   Provide 10 percent (minimum of two) spare control fuses of each type and rating to cover all motor starters (not per starter).

   Provide one control fuse puller.

3. Filters

   Provide two sets each of lubricating oil, fuel, and combustion air filters.

4. V-Belts

   Provide one complete replacement set of all V-belts.

5. Touchup Paint

   Provide 1 quart (minimum) of touchup paint matching each color utilized on generator set.

6. Provide spare parts in suitable boxed watertight container marked "GENERATOR SPARE PARTS" and deliver to the Owner. Label

with supplier's/manufacturer's name, the model number of the generator set, and the 24-hour service telephone number.

B. MOTOR CONTROLLERS (ASSOCIATED CSI SECTION – 16420)

The following quantities cover all motor starters under this contract (quantities are not per starter).

1. Power Fuses (line power)

   Provide three spare power fuses of each type and rating.

2. Control Transformer Fuses (primary and secondary)

   Provide 10 percent (minimum of two) spare control transformer fuses of each type and rating.

   Provide one control fuse puller.

3. Control Fuses

   Provide 10 percent (minimum of two) spare control fuses of each type and rating.

   Provide one control fuse puller.

4. Control Relays

   Provide 10 percent (minimum of two) spare control relays of each type and rating.

5. Control Timing Relays

   Provide 10 percent (minimum of two) spare control timer relays of each type and rating.

6. Provide a single latching plastic container with a printed label adhered to the lid stating "MOTOR STARTER SPARE PARTS".

C. PANELBOARDS (ASSOCIATED CSI SECTION – 16440)

1. Cabinet Keys

   Provide three spares of each type of key for panelboard cabinet locks.

2. Provide a latching plastic container with a printed label adhered to the lid stating “PANELBOARD SPARE KEYS”.

D. CONTROL PANELS (ASSOCIATED CSI SECTION – 16940)

The following quantities cover all control panels fabricated by the fabrication shop (quantities are not per panel).

1. DIN-rail Fused Terminals

Provide five spare DIN-rail fused terminals of each type and rating.

2. DIN-rail Feed-Through Terminals

Provide five spare DIN-rail feed-through terminals of each type, color, and rating.

3. Power Fuses (line power)

Provide three spare power fuses of each type and rating.

4. Control Power Fuses

Provide 10 percent (minimum of two) spare control power fuses of each type and rating.

Provide 1 control fuse puller.

5. PLC I/O Fuses

Provide 10 percent (minimum of two packets of five fuses each) spare control fuses of each type, voltage, and rating. Fuse ampacity should be clearly shown or marked.

6. PLC Buffer Relays

Provide 10 percent (minimum of four) spare PLC buffer relays of each type, style, and rating.

7. Control and Timing Relays

Provide 10 percent (minimum of four) spare control and timing relays of each type, style, and rating.

8. Control and Timing Relay Sockets

   Provide two spare control and timing relay sockets of each type, style, and rating.

9. Relay/Solenoid Surge Protective Devices

   Provide two spare Metal Oxide Varistors (MOVs) for AC relays and solenoids and two spare diodes for DC relays and solenoids.

10. Provide a single latching plastic container with a printed label adhered to the lid stating "CONTROL PANEL SPARE PARTS."

3.10 TESTING

A. Test electrical equipment before energization and placing into service. Report all test results in writing. Where tests disclose a defect in the work, rework, or repair the work at no additional expense to the Owner and retest to confirm the rework or repair until testing confirms that the defect has been corrected. Test in accordance with the manufacturer's installation and testing instructions and the applicable electrical standards (i.e., NEMA, NFPA, IEEE, ISA, ANSI) for the class of equipment.

   1. Test the equipment and electrical circuits for proper connection, tightness, continuity, and absence of undesirable shorts and grounds. When complete and 72 hours prior to energizing of the system, test the wire and cable installation. Check for continuity, visual damage, marking, and proper phase sequence before performing insulation testing.

   2. Megger power equipment, bus work, switches, breakers, and associated devices phase-to-phase and phase-to-ground. Megger at or near the rated voltage, but not above. Disconnect and reconnect equipment which cannot be meggered when connected. The minimum acceptable steady-state value is 50 megohms. Record ambient temperature and humidity during testing. Call any reading less than 100 megohms to the attention of the Engineer. Take appropriate steps to improve such values to permanent levels greater than 100 megohms.

   3. Reference Section 16120, FIELD QUALITY CONTROL for impedance testing of power, control, and instrumentation conductors.

4. Test operation, calibration, and settings of the meters, relays, and indicating devices.

5. Test all operating controls for proper operation.

6. Test all auxiliary equipment, i.e., heaters, thermostats, lights, all illuminated indicating devices and lamps, and all audible alarm devices which are an integral part of transformers and panels to verify that they function properly.

7. Check fuses with an ohmmeter. Ring out wiring and busing. Check operation of control and safety interlocks. Check grounding of potential transformers, current transformers, lightning, and surge arresters. Check control connections and tightness at terminal blocks, relays, meters, switches, etc.

B. Rework or repair equipment, which performs unsatisfactorily during, or as a result of, testing at no additional expense to the Owner.

C. Additional testing requirements specific to other sections are specified in those sections.

3.11 TEST DOCUMENTS

The following test documents shall be signed and submitted for review prior to energizing associated electrical circuits:

A. Provide third party ground test documents for Wiegardt Well Field (Area 01) and new 480 V 3ph services at the North Well Field (Area 05) as per Section 16060. These documents shall be signed by the independent testing agency and the contractor and issued and approved by the Engineer prior to energizing the power distribution system. A copy of these signed test results shall be included in the O&M Manual.

B. Provide third party circuit breaker test documents as per Sections 16410 and/or 16440. These documents shall be signed by the independent testing agency and the contractor and issued and approved by the Engineer prior to energizing the breakers. A copy of these signed test results shall be included in the O&M Manual.

C. Provide a Power Conductor Megger Testing Report. A blank copy of this report, specifically associated with this contract, is available from Engineering on request. Execute megger testing as per the procedures described in Section 16120 – Conductors and Cables. A copy of these

signed test results shall be submitted to the Engineer for approval prior to startup and shall be included in the O&M Manual.

D. Provide a Motor Commissioning Test Report for each new or refurbished motor. A blank copy of this report, specifically associated with this contract, is available from Engineering on request. Motor Commissioning Test Reports shall be signed by the Contractor and approved by the Engineer prior to energizing the motors. A copy of these signed test results shall be included in the O&M Manual.

3.12 DEMONSTRATION

Demonstrate to the Owner that the electrical installation is working by operating all electrical systems and equipment. Simulate control and emergency conditions, artificially where necessary, for complete system tests. Demonstrate equipment in accordance with each section in Division 16.

3.13 CLEANING

Clean dirt and debris from all surfaces. Apply touchup paint as required to repair scratches, etc. Replace nameplates damaged during installation. Thoroughly vacuum the interior of all enclosures to remove dirt and debris.

***** END OF SECTION *****

SECTION 16060

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes grounding of electrical systems, equipment, and basic requirements for grounding, and protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Sections	Items
01300	Submittals
16050	Basic Electrical Materials and Methods
16120	Conductors and Cables
16130	Raceway and Boxes

1.3 DEFINITIONS

A. BONDING JUMPER (from NEC 2008, Article 100 - Definitions, Bonding Jumper, Main)

The connection between the GROUNDED CIRCUIT CONDUCTOR and the EQUIPMENT GROUNDING CONDUCTOR at the service.

B. EQUIPMENT GROUNDING CONDUCTOR (from NEC 2008, Article 100 - Definitions)

The conductive path installed to connect normally non-current-carrying metal parts of equipment together and to the SYSTEM GROUNDED CONDUCTOR or to the GROUNDING ELECTRODE CONDUCTOR, or both. Code requirements associated with equipment grounding is referenced to NEC 250, Section VI – Equipment Grounding and Equipment Grounding Conductors.

C. GROUNDED CIRCUIT CONDUCTOR

See GROUNDING ELECTRODE CONDUCTOR.

D. GROUNDING ELECTRODE (from NEC 2008, Article 100 - Definitions)

A conducting object through which a direct connection to earth is established.

E. GROUNDING ELECTRODE CONDUCTOR (from NEC 2008, Article 100 - Definitions)

A conductor used to connect the SYSTEM GROUNDED CONDUCTOR or the equipment to a GROUNDING ELECTRODE or to a point on the grounding electrode system.

F. GROUNDING ELECTRODE SYSTEM

See SYSTEM GROUNDING.

G. SUSE

The term SUSE is an acronym for "SUITABLE FOR SERVICE ENTRANCE." It is the point in the electrical grounding system where the SYSTEM GROUNDING CONDUCTORS connect to the EQUIPMENT GROUNDING CONDUCTORS. For each separately-derived source, this shall occur at the SUSE point. These two points are connected by a BONDING JUMPER.

H. SYSTEM GROUND GRID

The SYSTEM GROUND GRID refers to all portions of SYSTEM GROUNDING. It may be as simple as a pair of ground rods and their associated GROUNDING ELECTRODE CONDUCTORS or a complex ground system with multiple types of GROUNDING ELECTRODES.

I. SYSTEM GROUNDED CONDUCTOR

See GROUNDING ELECTRODE CONDUCTOR.

J. SYSTEM GROUNDING

System Grounding (also referred to as a GROUNDING ELECTRODE SYSTEM) consists of all GROUNDING ELECTRODES, GROUNDING ELECTRODE CONDUCTORS, and associated connecting devices. The utility grounded service conductor, typically referred to as the "utility neutral", is also associated with the system ground. Code requirements

associated with system grounding is referenced to NEC 250.50 – Grounding Electrode System.

1.4 SUBMITTALS

Submit under provisions of Section 01300, and Section 16050.

1.5 QUALITY ASSURANCE

See Section 16050.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS

Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.2 WIRE AND CABLE GROUNDING CONDUCTORS

Comply with Section 16120.

A. EQUIPMENT GROUNDING CONDUCTORS

1. Insulated Conductors

   Color coded green, per Section 16120.

2. Sized in compliance with NEC Table 250.122 or as shown on the Plans, whichever is larger.

B. GROUNDING-ELECTRODE CONDUCTORS

1. Bare Conductors

   Soft drawn stranded copper meeting ASTM B8.

2. Sized in compliance with NEC Table 250.66 or as shown on the Plans, whichever is larger.

C. GROUNDING BRAIDS

1. Copper, manufactured, sized at 26,240 circular mils minimum (#6 AWG equivalent).

2. Certified C22.2, No. 41, Grounding and Bonding Equipment.

3. UL Listings: UL-467 and UL486A.

2.3 GROUND RODS

A. SIZE AND TYPE

1. Ground rods shall be 3/4-inch diameter by 10-feet long unless otherwise stated on the Plans.

2. Ground rods shall be copperclad steel rods as follows:

a. Heavy uniform coating of electrolytic copper molecularly bonded to a rigid steel core.

b. Corrosion resistant bonding between the copper and steel.

c. Hard drawn for a scar-resistant surface.

2.4 GROUND ROD BOX

A. GROUND ROD BOXES

1. Ground rod boxes shall be “Fogtite Ground Rod Box” or equal.

B. GROUND ROD BOX LIDS

1. Ground rods associated with vaults, pullboxes, or handholes that may be subjected to road traffic or heavy loads shall have their ground box lids match the road rating load value of the associated vaults, pullboxes, or handholes.

2. The minimum ground rod box lid shall be rated H20.

2.5 CONNECTOR PRODUCTS

A. COMPRESSION CONNECTORS

1. Compression type for interior locations:

a. Standards: UL 467.

b. High copper alloy content.

c. Non-reversible.

d. Terminals for connections to bus bars shall have two bolt holes.

2. Compression type suitable for direct burial in earth or concrete:

a. Standards: UL 467, IEEE 837.

b. High copper alloy content.

c. Non-reversible.

B. BOLTED CLAMPS

1. Standards: UL 467.

2. High copper alloy content.

3. Heavy-duty type.

PART 3 APPLICATION

There are two types of grounding systems covered in this specification; 1) Grounding Electrode Systems and 2) Equipment Grounding Circuits.

1. Grounding Electrode Systems shall comply, as a minimum, to the requirements of NEC Sections 250.50 through 250.104, including Table 250.66, "Grounding Electrode Conductor for Alternating-Current Systems."

2. Equipment Grounding Circuits shall comply, as a minimum, to the requirements of NEC Sections 250.110 through 250.148, including

Table 250.122, "Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment."

3.1 GROUND ROD BOX

The connection of Grounding Electrode Conductors to each ground rod shall be accessible through a ground rod box as described herein.

A. Each ground rod shall be provided with a separate ground rod box which shall provide access to the ground rod, its Grounding Electrode Conductor, and its associated ground clamp.

Exceptions:

- *Unless specifically stated or detailed otherwise on the Plans.*
- *Ground rod boxes shall not be required if the ground rod is exposed in a manhole, handhole, or seal-off vault as described in this specification.*

B. Each ground rod box shall be mounted flush to grade.

Exceptions:

- *Unless specifically stated or detailed otherwise on the Plans.*

3.2 GROUNDING ELECTRODE SYSTEMS

Comply with NEC Article 250, Section III for types, sizes, and quantities of Grounding Electrode Conductors, except where specific types, larger sizes, or more conductors than required by NEC are shown on the Plans.

Provide grounding system as shown on the Grounding One Line Diagram of the Plans if provided.

A. GROUNDING ELECTRODE SYSTEM

A GROUNDING ELECTRODE SYSTEM shall have a minimum of two ground rods spaced a minimum of 6 feet apart and connected with Grounding Electrode Conductors as described in this Section.

B. MANHOLE AND HANDHOLE GROUNDING

1. Provide a ground rod inside each manhole that contains metal parts.

2. Install grounding around and inside Manholes, Handholes, and Seal-Off Vaults as described in INSTALLATION; MANHOLE, HANDHOLE, AND SEAL-OFF VAULT SYSTEM, GROUNDING in Part 4 herein.

C. OTHER GROUNDING ELECTRODE DEVICES AND METHODS

1. Hydraulic Piping Systems

a. Provide and connect a Grounding Electrode Conductor pigtail to metal hydraulic piping on each major riser. Connect the conductors to the pipe using NEC-approved hardware and methods.

b. Provide a ground jumper across both sides of a hydraulic piping electrical insulator to continue ground continuity past the insulator.

Exceptions:

i. Unless specifically stated or detailed otherwise on the Plans.

c. Ground shall be derived from:

i. SYSTEM GROUND GRID

ii. System SUSE connection point.

2. Magnetic Flow Meters

a. Provide and connect a Grounding Electrode Conductor to the flow meter manufacturer's ground rings as per the manufacturer's recommendations. Provide a #6 AWG ground conductor unless shown otherwise on the Plans.

Exceptions:

- *Unless manufacturer provides documentation verifying that ground rings are not required.*

3. Separately Derived Sources

   a. Ground step-down power transformer secondary neutral "XO" terminals to Grounding Electrode Conductors.

      i. System Ground Grid

   b. Ground step-down power transformer secondary neutral "XO" terminals to Grounding Electrode Conductors.

3.3 EQUIPMENT GROUNDING

Comply with NEC Article 250, Section VI for sizes of Equipment Grounding Conductors, except where specific larger sizes are shown on the Cable and Conduit Schedule in the Plans.

A. EQUIPMENT GROUNDING CIRCUITS

Install insulated Equipment Grounding Conductors with circuit conductors in the manner listed below and in compliance with Code.

1. Service and Feeders.

   Bond the Equipment Grounding Conductor to the equipment to which the circuit connects and to the raceway if it is metallic.

2. Single-phase motor or appliance branch circuits.

3. Three-phase motor or appliance branch circuits.

4. Flexible raceway runs.

B. EQUIPMENT GROUNDING CONDUCTORS

Equipment Grounding Conductors shall be insulated and color-coded green.

C. ISOLATED GROUNDING-RECEPTACLE CIRCUITS

Install a separate insulated Equipment Grounding Conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at the Equipment Grounding Conductor terminal of the applicable derived system or service, except as otherwise indicated.

D. NONMETALLIC RACEWAYS

Install an Equipment Grounding Conductor in nonmetallic raceways unless they are designated for telephone or data cables. Bond the conductor at each end to grounded metallic raceway or equipment.

E. METALLIC RACEWAYS

Install grounding bushings at the end of each conduit and connect to the equipment ground or GROUNDING ELECTRODE SYSTEM.

F. WATER HEATER, HEAT-TRACING, AND ANTIFROST HEATER CIRCUITS

Install a separate Equipment Grounding Conductor to each electric water heater, heat-tracing assembly, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

G. CONTROL PANELS WITH A PLC

Provide an insulated Equipment Grounding Conductor from the panelboard ground bus directly to a block of isolated ground terminals in the control panel. These terminals shall not be connected to the control panel's chassis ground. This ground shall considered "Clean Ground" and shall be dedicated to the termination of instrument cable shields. This "clean" ground shall be #10 AWG minimum.

3.4 FREE-STANDING ELECTRICAL SUPPORT STRUCTURES

Metal support structures used to support electrical equipment, devices, cabinets, panels, or enclosures shall be connected to the GROUNDING ELECTRODE SYSTEM by Grounding Electrode Conductors sized as shown on the Plans or per NEC Table 250.66, whichever is larger. Provide a ground conductor to each vertical support member within 6 inches after rising out of the concrete pad.

3.5 METAL FRAME BUILDING AND SIMILAR STRUCTURES

The metal frame of a building, metal roofs, and other large metal surfaces on buildings shall be bonded to the grounding electrode conductor sized in accordance with NEC Table 250-66. Use a heavy-duty clamp or lug bolted to the metal. Welded metal frame members will be considered to be bonded together. Bolted metal frame members will be considered bonded together under all of the following conditions:

A. Members are cleaned and a conductive corrosion inhibitor is applied between the mating surfaces.

B. Bolts are fully torque.

C. It is proved that from no point on the framework there is more than 5-ohms measured from it to the attachment point of the grounding electrode.

PART 4 EXECUTION

4.1 INSTALLATION

A. GROUNDING ELECTRODE CONDUCTORS IN RACEWAYS

1. GROUNDING ELECTRODE CONDUCTORS shall not be installed in metallic raceway. Where required to be in raceway, use PVC-Schedule 80 unless shown otherwise on the Plans. Reference Specification Section 16130.

Ground electrical systems and equipment according to NEC requirements, except where Plans or Specifications exceed NEC requirements.

Coordinate grounding connections made to the water system with the mechanical work and install bonding jumpers wherever deemed necessary.

B. MANHOLE AND HANDHOLE VAULT SYSTEM GROUNDING

1. Provide a ground rod inside each handhole that contains metal parts.

2. Expose a minimum of 4 inches of the ground rod above the floor for field inspection and connections to the rod.

3. Connect the manhole/handhole vault SYSTEM GROUND GRID to the main SYSTEM GROUND GRID with Grounding Electrode

Conductors sized per NEC Table 250.66 unless shown larger on the Plans. The minimum conductor size shall be #6 AWG.

4. Connect the Grounding Electrode Conductor to each metal lid with braided ground conductors of equivalent size and ampacity of the ground ring. Connect braid to metal lids as per manufacturer's recommendations.

5. Connect the Grounding Electrode Conductor to each metal device (conduits, cable tray, j-boxes, support structures, etc.).

4.2 CONNECTIONS

A. GENERAL

Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to the contact surfaces.

B. EQUIPMENT GROUNDING-WIRE TERMINATIONS

Make the grounding conductor connections to motors or equipment 10 hp and above or 20 amperes and above, with conductor termination and a 5/16 of an inch minimum bolt tapped to the motor frame or equipment housing. Ground connection to smaller motors and equipment may be made by fastening the conductor termination to a connection box.

C. METAL RACEWAY TERMINATIONS

Where metallic raceways terminate at metallic or non-metallic enclosures, panels, or housings, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous

conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.

D. CONNECTION TORQUE

Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.

E. COMPRESSION-TYPE CONNECTIONS

Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

4.3 QUALITY CONTROL

A. INDEPENDENT TESTING AGENCY

Engage an independent electrical testing organization to perform tests described below for the Wiegardt Well Field (Area 01) and new 480 V 3-phase services at the North Well Field (Area 05).

B. TESTS

1. Subject the completed GROUNDING ELECTRODE SYSTEM to a 3-point fail-of-potential ground test according to IEEE 81. Perform the test not less than 2 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance.

2. These 3rd party measurements shall be documented, signed, and submitted to the Engineer for approval prior to commissioning at the site.

C. MAXIMUM GROUNDING RESISTANCE VALUES

Maximum grounding resistance values shall be as listed below:

1. Equipment grounding connections: 25 ohms.

2. Main Service (grounding electrode): 5 ohms.

D. EXCESSIVE GROUND RESISTANCE

Where resistance to ground exceeds specified values, notify the Engineer. Check connections of affected equipment and conductors. Replace or repair defective connections or conductors. Provide additional ground rods where the grounding electrode resistance is greater than specified. Revise and retest until resistance is within specifications.

E. REPORT

Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

***** END OF SECTION *****

SECTION 16120

CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes building wires, cables, and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.2 RELATED WORKS SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
16050	Basic Electrical Materials and Methods
RCW 19.28.261	Revised Code of Washington, Exemptions from RCW 19.28.161 through RCW 19.28.271
16940	Control Panels

1.3 SUBMITTALS

See Section 01300.

Indicate Field Test Reports and interpret their results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

See Section 16050.

PART 2 PRODUCTS

2.1 BUILDING WIRES AND CABLES

A. STRANDING

1. All power, control, and instrumentation conductors shall be stranded.

Exceptions:

- *Conductors #20 AWG and smaller may be solid.*

2. All equipment ground conductors shall be stranded.

Exceptions:

- *Conductors #16 AWG and smaller may be solid.*

3. All grounding electrode conductors shall be stranded.

Exceptions:

- *Conductors #10 AWG and smaller may be solid.*

B. POWER AND CONTROL WIRE

All power and control wire and conductors in raceways shall be rated 600 VAC.

1. XHHW, XHHW-2

a. Conductor

Class B, stranded, annealed, uncoated copper. Conductors shall comply with:

i. UL Standard 44.

ii. ASTM-B3, ASTM-B8, and ASTM-B7B8.

b. Insulation

Cross-Linked Polyethylene (XLP) High Heat Water Resistant. Insulation shall comply with:

i. UL-83 Thermoplastic-Insulated Wires and Cables.

ii. UL-1063 Machine-Tool Wires and Cables.

c. The cable shall meet the following Standards and Agency approvals:

i. NEMA WC70/ICEA S-95-658.

ii. ASTM Stranding Class B3, B8, B7B8

iii. Federal Specification A-A-59544

2. THHN, THWN, THHN/THWN-2

a. Conductor

Copper, annealed, uncoated. Conductors shall comply with:

i. ASTM-B3, ASTM-B8, and ASTM-B7B8.

b. Insulation

Polyvinyl Chloride (PVC), Nylon jacket. Insulation shall comply with:

i. UL-83 Thermoplastic-Insulated Wires and Cables.

ii. UL-1063 Machine-Tool Wires and Cables.

c. The cable shall meet the following Standards and Agency approvals:

i. NEMA WC70/ICEA S-95-658.

3. MTW (Machine Tool Wiring)

a. Conductor

Copper, annealed, uncoated. Conductors shall comply with:

i. ASTM-B3, ASTM-B8, and ASTM-B7B8.

b. Insulation

Polyvinyl Chloride (PVC). Insulation shall comply with:

i. UL-83 Thermoplastic-Insulated Wires and Cables.

ii. UL-1063 Machine-Tool Wires and Cables.

c. The cable shall meet the following Standards and Agency approvals:

i. NEMA WC70/ICEA S-95-658.

ii. UL Standard UL 83, UL 1063, UL 758 cUL file: E156879 and E123744

iii. AWM Specification 1316, 1317, 1318, 1319, 1320, 1321

iv. ASTM Stranding Class B3, B8, B7B8

v. Federal Specification A-A-59544

vi. CSA 22.2 No. 75, UL E156879 and E123744

C. INSTRUMENTATION, COMMUNICATION, AND NETWORKING CABLES

All instrumentation, communication, and networking cables and conductors in raceway shall be rated 600 VAC.

Exceptions:

- *Telephone cables.*
- *Antenna cables.*
- *Fiber optic cables.*

1. Analog Instrument Cables

Paired and triad analog instrument cables shall be #18 AWG stranded tinned copper 600 V tray cable, rated for wet applications at 75 degrees C in a sunlight resistant PVC jacket. Cables shall be plenum and direct burial rated, and shall be provided with individual pair/triad isolated 100 percent foil shields with independent drain wires and an overall isolated shield with drain wire.

These cables shall also be used for totalizing pulse signals from flow meters.

The following cables shall be used for multiple conductor applications:

a. 2-Conductor, 1 twisted pair, 100 percent overall shield. Belden #9341 or #1120A or equivalent.

b. 3-Conductor, 1 twisted triad, 100 percent overall shield. Belden #1121A or equivalent.

c. 4-Conductor, 2 twisted pairs, 100 percent individual shields plus 100 percent overall shield. Belden #1048A or equivalent.

2. Ethernet Copper Cables

Ethernet cables shall be 600 V, bonded pair, shielded.

a. Enhanced Category 5 (5e).

i. 600 V, polyolefin insulation, with inner PVC jacket and Industrial Grade, Sunlight and Oil Resistant, Black, PVC outer jacket.

ii. 8-Conductor, 4 twisted bonded pairs, #24 AWG, solid bare copper, 100 percent overall foil shield plus 70 percent overall braided tinned copper shield.

iii. 22.0 dB attenuation per 100 meters at 100 MHz.

iv. Beldon #7957A or equivalent.

2.2 SPLICES, TAPS AND TERMINAL BLOCKS

Splices are only allowed under the conditions of Section 4.2.E.

A. SPLICES IN OUTDOOR AREAS, HANDHOLES, VAULTS, OR DIRECT BURIED

For inline butt splices, use inline resin splice kits for non-shielded cables, 600 V; 3M Scotchcast 82-A series or equal. UL listed 486D.

For odd-shaped and odd sized splices, use multi-mold resin splice kits for non-shielded cables, 600 V; 3M Scotchcast 85-14CP or equal. UL listed 486D.

B. INDOOR SPLICES AND TAPS FOR RECEPTACLES AND LIGHTING

Use quick spin, wing torque Electrical Spring and Grounding Connectors; 3M 312, 412, 512, and 512G or equal.

C. TERMINAL BLOCKS

1. Power Terminal Blocks

All power terminals shall be 600 Vac, suitable for 75 degrees C rated copper conductor.

Power terminal blocks may be copper or aluminum and shall have a short circuit current withstand rating following the guidelines described in UL 1059 and shall meet or exceed the available bolted fault current at the point of application

2. Control and Instrumentation Terminal Blocks

Reference Specification 16940 for terminations in Control Panels.

D. MOTOR LEAD CONNECTORS

Motor terminal connectors shall be insulated multiple tap connectors rated for 600 Vac; N.I.S. Polaris or equal.

2.3 INSULATING MATERIALS

A. ELECTRICAL INSULATION PUTTY

Scotchfill, or equal.

B. INSULATING ELECTRICAL TAPE

7 Mil/0.18 mm Plasticized PVC, rubber-based adhesive, 200 percent elongation, 26 N/cm tensile strength, 8 kV breakdown voltage, meeting CE, CSA, UL certifications.

C. CONDUCTOR COLOR-MARKING TAPE

7 Mil/0.18 mm Plasticized PVC, rubber-based adhesive, 200 percent elongation, 26 N/cm tensile strength, 8 kV breakdown voltage, meeting CE, CSA, UL certifications, in required color.

D. ELECTRICAL HEAT SHRINK TUBING

Heat shrink tubing shall be dual-wall polyolefin, 3-1 shrink ratio, 600 Vac, -55 to 110 degrees C operating range meeting UL 224 600 V, 125 degrees C.

PART 3 APPLICATIONS

3.1 WIRE APPLICATIONS

A. CABLE AND CONDUIT SCHEDULE

The Cable and Conduit Schedule shall be considered absolute. No changes to wire sizes, wire count, insulation type, or circuit type shall be allowed without approval from the Engineer.

B. WIRES IN RACEWAYS

Wires installed in raceways shall be considered "FIELD" wiring and shall be installed and terminated by qualified and licensed electrical contractors.

Exceptions:

- *Installation and termination may be by the owner under the provisions of "RCW 19.28.261, Exemptions from RCW 19.28.161 through RCW 19.28.271."*

- *If the raceway is installed inside a control panel fabricated by a certified UL 508 shop, then these wires may be installed and terminated per the provisions of WIRES IN CONTROL PANELS as listed below.*

1. Power Wire

   a. Insulation

   All service, feeder, and branch circuit conductors shall be XHHW-2.

   Exception:

   - *Unless called out otherwise in the Cable and Conduit Schedule.*

   - *Unless approved in writing by the Electrical Engineer.*

   - *Unless both ends of wire are installed in the same control panel.*

2. Class 1 And 2 Control Wire

a. Insulation

All control circuits in raceways shall be XHHW-2.

Exception:

- *Unless called out otherwise in the Cable and Conduit Schedule.*
- *Unless approved in writing by the Electrical Engineer.*

C. WIRES IN CONTROL PANELS

Wires in control panels are those wires that are not routed through raceways external to control panels.

1. Control Panel Power and Control Wire

a. Insulation

Power and control conductors in control panels shall be MTW or THHN/THWN-2.

Wire minimum size and color:

Circuit Type	Wire Size	Wire Color
120 Vac Circuits		
120 Vac, Line	#12 AWG	Black
120 Vac, Neutral	#12 AWG	White
120 Vac Control Circuits	#14 AWG	Yellow
Ground Circuits		
Chassis Ground	#12 AWG	Green
Isolated (Shield) Ground	#12 AWG	Light Blue
24 Vdc Circuits		
+24 Vdc Power	#14 AWG	Red
24 Vdc Common	#14 AWG	Dark Blue
24 Vdc Control Circuits	#14 AWG	Orange

D. CONDUCTORS DIRECT BURIED

Refer to the Plans for specifications regarding directly buried conductors and cables.

E. POWER CORDS

SO power cords shall be allowed in control panels for circuits not greater than 120 Vac or 48 Vdc. Such applications require installation by a UL 508 shop.

F. SPECIALTY WIRE

Refer to the Plans for specifications regarding "Specialty Wire."

PART 4 EXECUTION

4.1 EXAMINATION

Examine raceways and surfaces receiving wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

4.2 INSTALLATION

A. GENERAL INSTALLATION METHODS

1. Install wires and cables in raceway system, according to manufacturer's written instructions and NECA's "Standard of Installation," after raceway system is complete.

2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3. Install cables and conductors neatly in all enclosures. Bend or form wires in neat runs from conduits to terminals. Arrange wires so that they may be grouped by conduit or function in the enclosure. Install cable ties and straps to support and bundle wires in enclosures. Arrange wires to allow wire tags and numbers to be easily read without bending or flexing wiring.

4. Leave 6 inches or more of free conductor at each connected device or equipment terminal and 9 inches of free conductor at each unconnected outlet. Tape free ends of conductors at unconnected outlets and coil neatly in outlet box.

5. Install wiring to equipment neutral and grounding blocks on the bottom or furthest back row first. Leave unconnected blocks accessible for future neutral or grounding connections.

6. Provide individual neutral conductors for each associated circuit. Common neutral conductors for multi branch circuits are not permitted.

7. All power distribution raceways shall contain at least one continuous copper grounding conductor with a minimum size as per NEC 250.122. Larger sizes shall be used if identified in the Cable and Conduit Schedule on the Plans.

B. CONDUCTORS SHARING RACEWAYS

1. Power conductors shall not be run in the same raceway with control conductors.

Exception:

- *Unless specifically shown otherwise in the Cable and Conduit Schedule.*

2. Power conductors shall not be run in the same conduit or raceway with instrumentation cables/conductors.

3. Control conductors shall not be run in the same conduit or raceway with instrumentation cables/conductors.

Exception:

- *Unless specifically shown otherwise in the Cable and Conduit Schedule.*

C. CONDUCTORS IN CONTROL PANELS

1. Control Panel Instrumentation (Signal) Wiring

a. Signal cables between analog input and output field terminals and a PLC shall be connected to the field terminals as shown in Section 16940.

b. All cables shields shall be terminated at the field terminal end. Connections to the PLC analog input and output terminals shall not land the shield.

c. Signal cable conductors and their shields/drains shall not be separated greater than as described below.

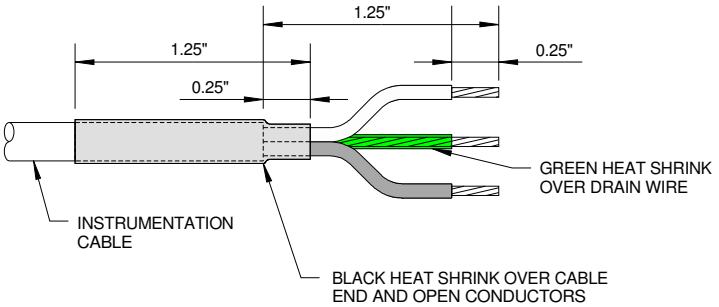
2. Control Panel Communication and Networking Wiring

a. All communication and networking cables inside control panels shall have their ends made up with terminal connectors. No cables shall be left open-ended.

b. Cables shall be routed inside Panduit™ or neatly tied to other conductor bundles.

D. INSTRUMENTATION (SIGNAL) CABLES

1. Preparing the Shielded End



a. Neatly trim the end of the cable.

b. Strip back 1.25 inches of the outer jacket taking care not to cut into the conductor insulation.

c. Neatly trim the foil back to the edge of the outer jacket taking care not to damage the drain wire.

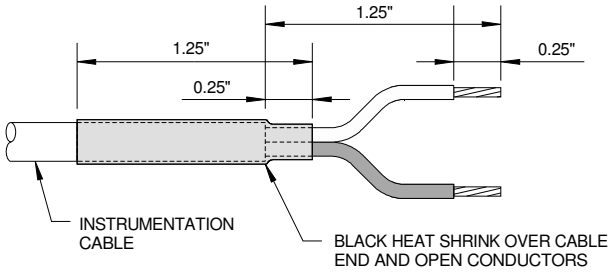
d. For signal cables with a braided shield over a foil shield, carefully cut the braid back to the edge of the outer jacket.

e. Provide a green heat shrink tube over the drain wire, leaving 0.25 inch of exposed conductor.

f. Provide a 1.25 inches black heat shrink over the jacket, covering 0.25 inch of the exposed conductors. This properly insulates and protects the ends of the shields and the outer jacket.

g. Strip the signal conductors exposing 0.25 inch of conductor.

2. Preparing the Unshielded End



a. Neatly trim the end of the cable.

b. Strip back 1.25 inches of the outer jacket taking care not to cut into the signal conductor insulation.

c. Neatly trim the foil back to the edge of the outer jacket.

d. Cut the drain wire at the edge of the outer jacket taking care not to damage the signal conductor insulation.

e. For signal cables with a braided shield over a foil shield, carefully cut the braid back to the edge of the outer jacket.

f. Provide a 1.25 inches black heat shrink over the jacket, covering 0.25 inch of the exposed conductors. This properly insulates and protects the ends of the shields and the outer jacket.

g. Strip the signal conductors exposing 0.25 inch of conductor.

E. SPLICING CONDUCTORS

1. Install service, feeder, and motor circuits continuous without splices from equipment terminal to equipment terminal or motor lead.

Exceptions:

- *Service entry feeders at weatherheads.*

- *Branch circuits at taps for convenience receptacles and lighting.*

- *As specifically called out.*

- *With written permission from the Engineer.*

2. Install instrumentation and control circuits continuous without splices or terminations from source equipment terminal to destination equipment terminal.

   Exceptions:

   - *On terminal strips in control panels.*

   - *On terminal strips in termination panels.*

   - *As specifically called out.*

   - *With written permission from the Engineer.*

3. Where splicing is allowed, or specifically called out, install in the following manner:

   a. Splicing Inside Vaults, Handholes, Outdoor J-Boxes, or J-Boxes in Wet Areas

      Power and control conductors shall be spliced per Section 2.2.A. Provide a minimum of 24 inches of length on both wires for future re-splicing.

   b. Splicing Inside Motor J-Boxes

      Power connections inside motor j-boxes shall be made using insulated multiple tap connectors rated for 600 Vac; N.I.S. Polaris or equal. Cover the splice with a minimum of three layers of black insulating electrical tape. Provide a single band with a minimum of two wraps of the appropriate phase color tape to the entry T-lead. Bend the connections away from the sides of the j-box and motor frame to prevent abrasion from motor vibration.

      Control connections inside motor j-boxes shall be made with crimped butt-splices with heat shrink covers. The heat shrink shall overlap the butt barrel ends by a minimum of

1/2 inch on each side. Cover the splice with a minimum of three layers of black insulating electrical tape.

c. Splicing in J-Boxes and Control Panels Mounted Indoors in Dry Rooms

i. Conductors size #12 AWG through #6 AWG:

For conductors less than #6 AWG, provide crimped butt-splice with heat shrink cover. The heat shrink shall overlap the butt barrel ends by a minimum of 1/2 inch. Cover the splice with a minimum of three layers of black electrical tape. Provide a two-wrap (minimum) single band of the appropriate phase color tape.

Exception:

- *For receptacles and lighting, reference Section 2.2.B.*

ii. Conductors size #4 AWG and larger:

(1) Terminal Connectors

For conductors larger than #6 AWG, connections shall be made using insulated multiple tap connectors rated for 600 Vac; N.I.S. Polaris or equal.

Cover the splice with a minimum of three (3) layers of black electrical tape. Provide a two-wrap (minimum) single band of the appropriate conductor color tape.

(2) Terminal Blocks

All power terminals shall be 600 Vac, suitable for 75 degrees C rated copper conductor.

Connect using properly sized terminal blocks.

Exception:

- *If splices are allowed by the Engineer, then use plated copper alloy compression splicing sleeves installed by high-pressure compression tools and insulated with heat shrink Raychem sleeves.*

F. REPLACING FAULTY CONDUCTORS

When replacing a faulty conductor or cable that shares a raceway with other conductors or cables, all conductors and cables must be removed and replaced with new.

Exceptions:

- *If the raceway is straight and without bends or offsets and its length is less than 30 feet, and the conductors are not bound together in the raceway, then only the faulty cable must be pulled and replaced with new. A manufacturer-approved pulling compound or lubricant must be used to minimize degradation to the remaining conductors. The contractor is responsible for the integrity of the remaining conductors.*

- *With specific approval by the Engineer.*

G. CONDUCTOR LABELLING

All conductors shall be labeled in the following manner.

Exceptions:

- *Conductors supplying power to lighting and convenience receptacles.*

- *Non-insulated ground conductors.*

- *At each motor tag for winding lead numbers. Make all phase rotation changes for motor direction changes at the motor to maintain correct color phase sequence in equipment.*

- *In each enclosure or box where more than one ungrounded power conductor is spliced or connected, tag for panelboard identification and pole number (reference Section 3.3C.).*

1. Conductors shall be labeled the same at each end in a place where the label can be clearly read without moving other wires or rotating the label.

2. Conductor labels shall reference the device (destination) tag as provided on the "TAG LIST" in the Plans. For example, conductors from panelboard [01 PB 01] to dedicated receptacle [01 DREC 05] shall be labeled as follows:

Line:	01DREC05.L
Neutral:	01DREC05.N
Ground:	01DREC05.G

3. Conductor labels shall each be unique for each circuit. For example, 10 control conductors from Main Control Panel [02 CP 01] (source) to Automatic Transfer Switch [02 ATS 01] (destination) shall be labeled as follows:

Wire #1:	02ATS01.01
Wire #2:	02ATS01.02
|	|
Wire #9:	02ATS01.09
Wire #10:	02ATS01.10

4. The labels shall be white heat shrink sized appropriately for the associated conductor with typed lettering in black indelible ink.

5. Label each conductor. When terminating cables, if there is insufficient room to provide a label on each conductor, then label the cable sheath.

6. Tag for phase rotation at each power connection.

Exception:

- *At motor connections.*

H. CONDUCTOR COLORS

1. For conductor colors inside control panels, reference Section 3.1 C.1.

2. Do not use white, gray, green, or green with yellow stripes color for any power, lighting, or control conductor not intended for neutral or equipment grounding purposes.

   Exception:

   - *Instrumentation and control multi-conductor cables may use white, gray, or green singly or as part of a trace color in addition to the base color.*

3. Equipment grounding conductors: Green or green with yellow stripes.

4. 480/277 volt, 3-phase systems:

Phase A	**Phase B**	**Phase C**	**Neutral**
Brown	Orange	Yellow	Gray

5. 208/120 or 240/120 volt, 3-phase systems:

Phase A	**Phase B**	**Phase C**	**Neutral**
Black	Red	Blue	White

6. 240/120 volt, single phase systems:

Phase A	**Phase B**	**Neutral**
Black	Red	White

7. Use wire with insulation of required color for conductors of #8 AWG and smaller. For wire larger than No.8 AWG, where not available in specified colors, use conductor color marking tape per Section 2.3.C. When conductors are marked in this manner, mark each conductor at all accessible locations such as panelboards, junction boxes, pullboxes, auxiliary gutters, outlets, switches, and control centers.

8. Use control wiring of colors different than power wiring or supplied with a trace of color in addition to the basic color of the insulation. Use the same color scheme throughout a given system for any control wires performing the same function.

9. Connect power conductors of the same color to the same phase throughout the installation. Viewing all equipment from the front, make connections so phase color sequence is in the same order as that for panelboards, switchboards, motor control centers, etc.

I. PULLING CONDUCTORS

1. Instrumentation, Communication, Networking, and Fiber Cables

   Make all cable pulls by hand using a manufacturer-approved pulling compound or lubricant where necessary.

2. Power and Control Conductors

   a. Make all cable pulls by hand where possible. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, or wrapping extra conductor into an eye, that will not damage cables or raceway.

   b. On mechanically-assisted pulls use a manufacturer-approved pulling compound or lubricant where necessary. The compound used must not deteriorate the conductors or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values. Install pullboxes where necessary to prevent exceeding manufacturer's recommendations.

3. Cut cable or conductor ends off after pulling and clean all pulling compound from exposed conductors before terminating.

J. CABLE SUPPORTS

Support cables according to Section 16050.

Provide vertical conductor support per NEC Table 300.19(A).

K. WIRING AT OUTLETS

1. Install conductor at each outlet, with at least 6 inches of slack. Connect only to receptacle screw terminals using insulated spade-type lugs.

2. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer, and in compliance with other Sections of Division 16.

4.3 FIELD QUALITY CONTROL

A. TESTING

On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures

   Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.2. Certify compliance with test parameters.

2. Remove and replace conductors with visible insulation damage on conductor ends due to installation in an incomplete or damaged conduit system such as, but not limited to, missing bushings or burrs on conduit ends.

3. On THWN, THHN, THHW conductors, a tear, rip, or blister in the outer insulation sheath shall be considered damaged insulation and shall be replaced as described in Section 4.3 A.2.

B. POWER CONDUCTOR TESTING

After pulling and prior to connection, perform a Megger test between all conductors (including the equipment ground) and between each conductor and earth ground in the following manner:

1. Perform megger tests at 600 V.

2. Record ambient temperature and humidity during testing.

3. Cables or conductors with a steady-state value less than 100 megohms shall be considered "failed."

4. Complete a Power Conductor Megger Testing Report and submit as per Section 16050.

C. CONTROL AND INSTRUMENTATION CONDUCTOR TESTING

Control and instrumentation circuits shall not be meggered.

1. Perform insulation tests with a Digital Voltmeter.

2. Record ambient temperature and humidity during testing.

3. Cables or conductors with a steady-state value less than 100 megohms shall be considered "failed."

D. CORRECTIVE ACTION FOR FAILED CABLES AND CONDUCTORS

Failed cables and conductors shall be removed and replaced with new and retested per Section 4.2 D.

***** END OF SECTION *****

SECTION 16130

RACEWAY AND BOXES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Sections	Items
01300	Submittals
16050	Basic Electrical Materials and Methods
16060	Grounding and Bonding
16120	Conductors and Cables
16140	Wiring Devices

1.3 DEFINITIONS

A. 100 PERCENT CONTINUOUS

100 percent continuous means that electrical continuity shall be maintained over a conduit's entire length and that such conduits shall consist of only RGS (whether PVC-coated or not), LFMC, or combinations of these types. There can be no break in the electrical continuity by non-metallic components.

EMT conduits are not considered 100 percent continuous.

B. CONDUIT BODIES

A separate portion of a conduit system that provides access through a removable cover to the interior of the system at a junction of two or more sections of the system.

C. CONTROL CONDUITS

Control conduits typically contain cables or conductors in the range of 12 Vdc to 120 Vac. These cables/conductors are used to provide discreet field inputs and outputs to motor drives, PLC controllers, operator stations, etc. They typically connect to discreet I/O field devices like local panel

pushbuttons, indicating lights, selector switches, field limit switches, relay circuits, etc.

D. CONTROL PANELS

Control panels are enclosures in which one or more circuits are changed, unlike junction boxes where circuits are simply routed through the panel. Control panels may be as simple as an enclosure with a pilot light or they may be very complicated with hundreds of I/O terminations. For Control Panel considerations, reference Section 16940.

E. CONVENIENCE RECEPTACLES

Reference Section 16140, Definitions.

F. DEVICE BOXES

Device boxes are electrical boxes used for receptacles, light switches, dimmers, and other similar devices. Selector switches, indicating lights, displays, etc., are mounted in control panels and equipment enclosures, not in device boxes.

G. DRIP FITTINGS

Drip fittings are used to drain water from conduit entry points, junction boxes, or other enclosures where accumulation of moisture must be removed. They are also intended to disable the entry of foreign materials, including tools and fingers, through the drain.

H. DRY LOCATIONS

Reference Section 16050, Definitions.

I. EMT

Electrical Metallic Tubing (a type of RMC).

J. EQUIPMENT VAULT

An Equipment Vault is a VAULT that contains one or more electrical devices that are terminated within the vault; such as flow meters, control valves, control or power panels, lighting, and etc.

SEE VAULTS

K. FINISHED AREAS

Reference Section 16050, Definitions.

L. FMC

Flexible Metal Conduit (a type of RMC).

M. FRP

Fiberglass Reinforced Plastic (a type of RNC).

N. HANDHOLES

A handhole is a pullbox that is not sufficiently sized for entrance of personnel (reference PULLBOXES).

O. INSTRUMENTATION CONDUITS

Instrumentation conduits contain cables and conductors that carry low-power modulated or communication signals. They may include 4-20 mA current loops, 0–10 volt analog signals, 5 to 12 Vdc digital (TLL) data, analog or digital communications signals, etc. They may also include low-voltage compliance power to instruments such as 5 Vdc, ±15 Vdc, or 24 Vdc.

P. JUNCTION BOXES

Junction boxes are electrical enclosures used for combining, splitting, pulling, or redirecting electrical circuits. Junction boxes may terminate one conduit or join multiple conduits. Circuits are not *altered* inside a junction box. Enclosures where circuits are altered are called CONTROL PANELS. With the exception of terminal strips, junction boxes do not contain electrical devices.

Q. LFMC

Liquidtight Flexible Metal Conduit (a type of RMC).

R. LINEAR POWER LOADS

Linear power loads are those that are not VFD circuits (both line or load), and are not UV ballast circuits. Although actually non-linear, fluorescent lighting circuits shall be considered linear power loads.

S. POWER CONDUITS

Power conduits contain branch and feeder conductors with voltages 120 Vac and above. These conductors provide operating power to MCCs, panels, motors, lighting, receptacles, HVAC, etc. Conductors can be of #12 AWG wire gauge and larger, either separate or in power cables.

T. PROCESS AREAS

Reference Section 16050, Definitions.

U. PULLBOXES

Pullboxes are underground electrical enclosures, sufficiently sized to allow the entrance of personnel, used for combining, splitting, pulling, or redirecting electrical circuits. Pullboxes may terminate one conduit or join multiple conduits. A pullbox can be considered an underground junction box.

Circuits are not altered or terminated inside a pullbox. Pullboxes do not contain electrical equipment or devices.

Exception:

- *Pull boxes may include a sump pump.*

Handholes are types of pull boxes but are not sufficiently sized to allow the entrance of personnel (reference HANDHOLES).

V. PVC

Polyvinyl Chloride Conduit (a type of RNC).

W. PVC-RGS

Polyvinyl chloride, externally coated RGS (a type of RMC).

Alias: May be called or shown on Plans and elsewhere in specifications as PVC-Coated RGS or PVC-RMC.

X. PVC-RMC

Reference PVC-RGS.

Y. RGS

Rigid Galvanized Steel (a type of RMC).

Z. RMC

Rigid Metal Conduit (General NEC Category).

AA. RNC

Rigid Nonmetallic Conduit (General NEC Category).

BB. SURFACE RACEWAYS

A metallic raceway that is intended to be mounted to the surface of a structure, with associated couplings, connectors, boxes, and fittings for the installation of electrical conductors.

CC. VAULTS

A vault is an underground structure, serviceable or accessible only from the top. Handholes, Equipment Vaults, and Pullboxes are considered vaults.

DD. WET LOCATIONS

Reference Section 16050, Definitions.

EE. WIREWAYS

Sheet metal troughs with hinged or removable covers for housing and protecting electric wires and cable in which conductors are laid in place after the wireway has been installed as a complete system.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Provide data for surface raceways, wireways and fittings, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

See Section 16050.

1.6 COORDINATION

Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

Coordinate electrical work with outside utilities associated with the project.

Non electrical piping and structural has priority over underground conduit routing.

Exception:

- *Unless specifically coordinated otherwise with the General Contractor.*

PART 2 PRODUCTS

2.1 METALLIC CONDUIT TYPES

A. EMT

1. Conduit

   Galvanized steel tubing meeting ANSI C80.3.

2. Conduit bodies shall be galvanized, or epoxy coated cast iron or aluminum one piece with galvanized, or epoxy coated cast cover, gasket, and threaded hubs. Use stainless steel screws or other approved non-corroding screws to hold cover in place.

3. EMT connectors shall be compression type only. Set screw connectors shall not be allowed.

4. Conduit clamps for EMT shall be stamped galvanized steel.

B. FMC

1. Conduit

Flexible, galvanized steel convolutions forming a continuous raceway.

2. Connectors

Galvanized steel, screw in, approved for grounding.

C. LFMC

1. Conduit

Flexible, galvanized steel convolutions forming a continuous raceway, covered by a liquid tight PVC layer. Electri-Flex Type LA or American Sealtite, Type UA

2. Connectors

Galvanized steel, screw in, grounding type with a ferrule, which covers the end of the inside and outside of the conduit.

D. RGS

1. Conduit

Hot dipped galvanized with threaded ends meeting ANSI C80.1.

2. Couplings

Steel, cast iron, or malleable iron compression type employing a split, corrugated ring and tightening nut, with integral bushings and locknuts. No indent or set screw type.

a. Couplings

Unsplit, NPT threaded steel cylinders with galvanizing equal to the conduit.

b. Nipples

Factory made through 8 inches, no running threads.

c. Conduit bodies shall be galvanized, or epoxy coated cast iron or aluminum one piece with galvanized, or epoxy coated cast cover, gasket, and threaded hubs. Use stainless steel screws or other approved non-corroding screws to hold cover in place.

3. Conduit Clamps

Conduit clamps for RGS shall be cast iron.

E. PVC-COATED RGS, PVC-RMC

1. General

a. A proprietary colored urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.

b. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30 degrees F (-1 degrees C).

c. All male and female threads on conduit, elbows, and nipples shall be protected by application of an electronically conducting corrosion resistant compound.

d. Installation of the PVC coated conduit system shall be performed in accordance with the manufacturer's installation manual.

e. Conduits and fittings shall meet the following standards:

i. ASTM D870

ii. ASTM D1151

iii. ASTM D3359

iv. ASTM D1308

v. NEMA RN1

2. Conduit

a. The PVC coated rigid metal conduit must be UL listed. The PVC coating must have been investigated by UL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be UL listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed. All conduit and fittings must be new, unused material. Applicable UL standards may include: UL 6 Standard for Safety, Rigid Metal Conduit, UL 514B Standard for Safety, Fittings for Conduit and Outlet Boxes.

b. The conduit shall be hot dip galvanized inside and out with hot dipped galvanized threads.

3. Fittings and Accessories

The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 inches of mercury (vacuum for 72 hours shall be available).

a. A PVC sleeve extending one pipe diameter or 2 inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.

b. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.

c. Conduit Form 8 Bodies shall be 1/2 inch through 2-inch diameter, shall have a tongue-in-groove “V-Seal” gasket to effectively seal against the elements. Conduit bodies shall be Form 8 and shall be supplied with plastic encapsulated stainless steel cover screws.

d. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. Al U bolts will be supplied with plastic encapsulated nuts that cover the exposed portions of the threads.

e. Conduit clamps and fittings for PVC-Coated RGS conduits shall be 316L stainless steel.

4. Approved Material

a. Plasti-Bond REDH2OT, Perma-Cote, or KorKap manufactured by Robroy Industries.

b. Ocal-Blue Steel conduit and fittings as manufactured by Ocal, Inc.

c. Any deviation from the above approved materials must be approved by the Engineer.

2.2 NONMETALLIC CONDUIT TYPES

A. PVC

1. Conduits

NEMA TC 2, Schedule 40 or 80 PVC.

2. Fittings and Accessories

NEMA TC 3; match to conduit type and material, but elbows shall be RMC.

3. Conduit bodies

Where allowed, shall match type, material, and gauge of conduit.

2.3 OUTLET AND DEVICE BOXES

A. STANDARD METAL BOXES

Assembled from stamped steel hot dipped zinc galvanized coated flat pieces, welded or mechanical assembled into a device box, with knockouts for conduit or connector entrance, meeting NEMA OS 1, with plaster or

extension rings and necessary mounting appurtenances to suite construction and application.

B. CAST BOXES

1. Cast Aluminum

Epoxy coated cast aluminum box, one piece, with mounting lugs, with threaded holes or hubs, with internal green ground screw and with neoprene gaskets.

2. Cast Iron

Cast iron with electro-galvanized and aluminum acrylic paint finish, one piece, with mounting lugs, with threaded holes or hubs, with internal green ground screw and with neoprene gaskets.

C. DEVICE COVERS

1. Plastic: Thermoplastic nylon, device-mount, ivory.

2. Aluminum: Sheet Aluminum.

3. Cast Iron: Iron alloy.

D. SWITCH ACTUATORS

1. Aluminum: Lever-arm type, raintight, cast aluminum matching the metallurgy of the device box.

2. Cast Iron: Lever-arm type, raintight, cast iron alloy matching the metallurgy of the device box.

E. WEATHERPROOF COVERS AND PLATES

Weather proof, self-closing, die-cast aluminum, UL listed.

F. IN-SERVICE COVERS

Shall be weather proof and hinged from top with removable cord slots.

2.4 JUNCTION BOXES, HANDHOLES, AND VAULTS

A. JUNCTION BOXES

1. Standard

Stamped steel, deep drawn one piece (without welds or tab connections), galvanized, with knockouts for conduit or connector entrance, meeting NEMA OS 1. Boxes 6" x 6" x 4" or larger may be code gauge fabricated steel continuously welded at seams and painted after fabrication.

2. Cast

Cast iron with electrogalvanized and aluminum acrylic paint finish, one piece, with threaded cover of the same metallurgy and finish, with mounting lugs, with threaded holes or hubs, with internal green ground screw and with neoprene gaskets; explosion-proof, dust-ignition-proof, raintight, rated for Class I, Divisions 1 and 2, Groups C, D.

3. Stainless Steel

NEMA 4X 316L stainless steel with gasketed screw down cover.

B. HANDHOLES

1. Material and Strength

Handholes shall be made from Concrete or Polymer Concrete. The boxes and covers are required to conform to all test provisions of ANSI/SCTE 77 2002 “Specification for Underground Enclosure Integrity” for Tier 15 applications (Design Load Vertical 22,500 lbs. and Lateral 800 lbs/sq. ft.) and to be Listed and Labeled. The boxes must physically accommodate and structurally support compatible covers, which possess the Tier rating. In no assembly can the cover design load exceed the design load of the box. All components in an assembly (box and cover) are to be manufactured by the same manufacturer. All covers are required to have a minimum coefficient of friction of 0.50 in accordance with ASTM C1028. Independent third party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this specification have been met are required with each submittal. The cover is to have an identifying function

descriptor imprinted on it. The Descriptor shall be ELECTRICAL, CONTROL, SIGNAL, TELEPHONE, STREET LIGHT, or similar approved by the Engineer.

Handholes with metallic lids shall be grounded per Specification Section 16060.

Handhole lid assemblies comprised of steel shall have a factory-applied galvanized finish.

Exception:

- *Unless the assembly is fabricated from stainless steel.*

2. Manufacturers

Quazite (Strongwell Corp.)
Carson Industries

PART 3 APPLICATION

3.1 CONDUIT BODIES

This section describes the types of raceways, junction boxes, and device boxes that can used for different circuits and different environments. Reference Section 4.1 for methods and practices required for installation.

A. CABLE AND CONDUIT SCHEDULE

The Cable and Conduit Schedule shall be considered absolute. No changes to wire sizes, wire count, insulation type, circuit type, or conduit size shall be allowed without approval from the engineer.

The Cable and Conduit Schedule does not indicate conduit type (PVC, EMT, RGS, etc.) since, in many cases, a conduit's type may change between its source and destination. The rules stated in this specification define the necessary and allowed conduit type(s) for various applications and routes.

B. RACEWAY REQUIREMENTS

The term "RGS conduits" refers to a type of conduit body and does not imply whether the conduit is PVC-coated or not. Certain applications require RGS conduits with PVC coating, others do not. Reference

Section 3.2, “RGS RACEWAY PROTECTIVE COATINGS” for these requirements.

1. Circuit Types And Categories

   a. Circuit Types

      Conduits are broken into three general circuit types; 1) Power, 2) Control, and 3) Instrumentation (see Definitions).

      On the Cable and Conduit Schedule, Power conduits are those starting with the letter “P,” Control conduits are those starting with the letter “C,” and Instrumentation conduits are those starting with the letter “S.”

2. Conduit Shape

   Wiring shall be routed in pipe or tubular conduits, NOT in fabricated wireways or gutters.

   Exception:

   - *Unless specifically called out otherwise in the Plans.*

C. PVC SCHEDULE 40 RACEWAY APPLICATIONS

1. All straight portions of conduits completely concealed in walls, attics, concrete, or below ground (not exposed) shall be PVC Schedule 40.

   Exceptions:

   - *All Instrumentation conduits shall be 100 percent continuous over their entire length.*

   - *All conduits containing grounding electrode conductors shall be PVC Schedule 80 over their entire length.*

   - *Where specifically called out otherwise in the Cable and Conduit Schedule.*

D. PVC SCHEDULE 80 RACEWAY APPLICATIONS

1. All portions of conduits which contain grounding electrode conductors shall be PVC Schedule 80 and shall contain no metal fittings, connectors, or devices. Such conduits containing grounding electrode conductors shall contain no other types of conductors.

2. PVC conduit areas under roads or heavy traffic areas.

3. As stated in the Cable and Conduit Schedule.

E. RGS RACEWAY APPLICATIONS

1. All conduits requiring 100 percent continuity per Section 3.1 B.1 shall be RGS over their entire length. For coating requirements, reference Section 3.2.

Exception:

- *LFMC conduit shall be allowed per the "LFMC Raceway Applications" section herein.*

2. Underground factory or bent elbows and offsets greater than or equal to 30 degrees shall be RGS.

Exceptions:

- *Where the radius of a conduit bend is greater than or equal to 15 feet per inch of trade size.*

- *Raceways used for the containment and protection of bare grounding electrode conductors shall be PVC Schedule 80. Reference PVC Schedule 80 raceway applications.*

3. All portions of conduits exposed outdoors shall be RGS.

Exception:

- *All conduits containing grounding electrode conductors shall be PVC Schedule 80 over their entire length.*

4. All portions of conduits under covered structures open on any side shall be RGS.

Exception:

- *All conduits containing grounding electrode conductors shall be PVC Schedule 80 over their entire length.*

- *LFMC conduit shall be allowed per the "LFMC Raceway Applications" section herein.*

5. All portions of conduits exposed on the inside of below-ground pullboxes, equipment vaults, wet wells, and dry wells (vaults) shall be RGS.

Exceptions:

- *All conduits immediately terminating after penetrating a vault wall, that are allowed to be PVC Schedule 40 underground, shall terminate as a PVC conduit bell-end.*

  If the conduit is connected inside the vault to any device, conduit body, junction box, control panel, or any other conduit, then all portions of the conduit inside the vault, through the wall penetration, and 24 inches outside the vault shall be RGS and shall be grounded.

- *All conduits containing grounding electrode conductors shall be PVC Schedule 80 over their entire length.*

6. All portions of conduits penetrating concrete floors, walls, or ceilings shall be RGS.

Exception:

- *In below ground vaults as described above.*

7. All conduit penetrations from grade shall be RGS.

Exception:

- *All conduits containing grounding electrode conductors shall be PVC Schedule 80 over their entire length.*

8. All portions of exposed conduits inside closed buildings shall be RGS.

Exceptions:

- *EMT conduit shall be allowed per the "EMT Raceway Applications" section herein.*
- *LFMC conduit shall be allowed per the "LFMC Raceway Applications" section herein.*
- *All conduits containing grounding electrode conductors shall be PVC Schedule 80 over their entire length.*
- *Unless otherwise specifically called out on a separate plan or detail.*

F. LFMC RACEWAY APPLICATIONS (reference Definitions)

1. LFMC conduit shall be used for the last 18 inches of connection to motors, transformers and other vibrating equipment.

2. LFMC conduit shall be used for the last 18 inches of connection to field instruments such as flow meters in vaults and ultrasonic level transducers.

3. LFMC conduit shall be used for the last 18 inches of connection to any device that may require minor movement during maintenance or repair or that may require physical adjustment.

G. EMT RACEWAY APPLICATIONS (reference Definitions)

1. Exposed conduits may be EMT in completely enclosed dry (see Definitions) rooms.

2. EMT conduits may be used in attics and where concealed in walls.

Exception to the use of EMT:

- *Where conduit is required to 100 percent continuous.*

3.2 RGS RACEWAY PROTECTIVE COATINGS

Protected RGS conduits are used to minimize conduit degradation from moisture and chemicals.

Where called in the Plans or Specifications as “Protected RGS,” “PVC-Coated RGS,” “PVC-Coated,” “PVC-RGS,” or “PVC-RMC,” all such conduits, elbows, and fittings shall be factory coated PVC as defined in Section 2.1.

A. PVC-COATED RGS CONDUIT APPLICATIONS

1. All portions of RGS elbows, bends, straight pipes, couplings, and fittings buried underground shall be PVC-Coated.

2. All portions of RGS elbows, bends, straight pipes, couplings, and fittings encased in concrete shall be PVC-Coated.

3. All portions of RGS elbows, bends, straight pipes, couplings, and fittings exposed outdoors shall be PVC-Coated.

4. All portions of RGS elbows, bends, straight pipes, couplings, and fittings inside underground vaults, pullboxes, wet wells, and dry wells shall be PVC-Coated.

5. All portions of RGS elbows, bends, straight pipes, couplings, and fittings exposed in Chemical Rooms (reference Definitions) shall be PVC-Coated.

6. All portions of RGS conduits penetrating concrete floors and below-ground walls and ceilings shall be PVC-Coated at least 12 inches into the exposed area and extending at least 24 inches underground.

Exceptions:

- *Where specifically noted to be otherwise in the Plans.*
- *Non-metallic conduits that terminate at the wall of a pullbox.*

3.3 JUNCTION AND DEVICE BOX APPLICATIONS

A. JUNCTION BOXES

1. Junction boxes for Instrumentation, Intrinsically Safe, and Non-Linear Power circuits (see Definitions) shall be hinged steel, 6" x 6" x 4" minimum.

2. Dry Areas (see Definitions).

a. Flush-mounted junction boxes may be the standard type.

b. Wall-mounted junction boxes shall be the NEMA 1 gasketed.

3. Wet Areas (see Definitions).

a. NEMA 4X 316L stainless steel.

Exceptions:

- *Except in pullboxes, cast junction boxes shall be allowed for applications where three conduits or less approach from three different directions and no terminations are made inside the junction box.*

- *Unless called out otherwise on the Plans*

B. DEVICE BOXES, ACTUATORS, AND COVERS

All exposed boxes shall be of cast construction.

All aluminum and cast iron covers shall be provided with a weatherproof gasket.

1. Outdoors, In Pullboxes, In Equipment Vaults

a. Receptacles

Cast iron device box body with cast aluminum gasketed cover and top-opening "in-service" cover.

Exception:

- *Cast aluminum device box bodies may be used if specifically called out on the Plans or approved by the Engineer.*

b. Light Switches

Cast iron device box body with cast iron gasketed cover and lever-arm actuator.

Exception:

- *Cast aluminum device box bodies with gasketed die cast aluminum covers and lever arm actuators may be used if specifically called out on the Plans or approved by the Engineer.*

2. Indoor, Wet Areas (see Definitions).

   Flush-mounted (recessed) junction boxes may be the standard metal type.

   These boxes will usually be mounted in wood or steel stud framed walls with gypsum plasterboard or similar surfacing cover. Boxes mounted in Concrete Masonry Unit (Block) walls shall be Masonry type boxes.

   a. Receptacles

      i. Recessed (flush-mount) – standard device box body with gasketed die cast aluminum, snap-action, weatherproof cover.

      ii. Surface-mounted – cast aluminum device box body with gasketed die cast aluminum, snap-action, weatherproof cover.

   b. Light Switches

      i. Recessed (flush-mount) – standard device box body with gasketed cast aluminum switch cover.

      ii. Surface-mounted – die cast aluminum device box body with gasketed cast aluminum switch cover.

3. Indoor, Dry Areas (See Definitions)

   a. Receptacles

      i. Recessed (flush-mount) – standard device box body with plastic cover.

ii. Surface-mounted – cast aluminum device box body with plastic cover.

b. Light Switches

i. Recessed (flush-mount) – standard device box body with plastic switch cover.

ii. Surface-mounted – cast aluminum device box body with plastic switch cover.

3.4 HANDHOLE APPLICATIONS

A. HANDHOLES

Handholes are used as pull and splice points in underground installations and are typically installed in driveways, parking lots, and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic.

PART 4 EXECUTION

4.1 EXAMINATION

Examine surfaces and spaces to receive raceways, boxes, for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

4.2 INSTALLATION, GENERAL

A. COORDINATION WITH OTHER WORK

Wherever practical, route conduit with adjacent ductwork or piping.

1. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes or other heat sources operating at temperatures above 100 degrees F.

2. When installing utility conduits, comply with the spacing and depth requirements of the utilities.

3. Non-electrical buried piping has routing priority over electrical burials.

B. MOUNTING PRACTICES

1. All conduits in process areas shall be surface mounted unless specifically called out otherwise on the Plans.

2. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.

3. Where several conduits follow a common route, stagger pull boxes, junction boxes, pulling sleeves, and fittings.

C. DEVICE BOX INSTALLATION

1. Coordinate box locations with building surfaces and finishes to avoid bridging wainscots, joints, finish changes, etc.

2. Recess boxes in the wall, floor, and ceiling surfaces in finished areas. Set boxes plumb, level, square and flush with finished building surfaces within 1/16 of an inch for each condition. Set boxes so that box openings in building surfaces are within 1/8 of an inch of edge of material cut-out and fill tight to box with building materials. Back boxes with structural material to prevent rotation on studs or joists. Use gang boxes wherever more than one device is used at one location.

3. Surface mount boxes to building structures with a minimum of 1/4-inch spacing and with a minimum of two fasteners. Provide attachments to withstand an additional force of 100 pounds applied vertically or horizontally.

4. Set recessed boxes at the following heights to the bottom of the box, except where noted otherwise on the Plans:

   a. Convenience outlet receptacles in finished areas at 18 inches above floor.

   b. Lighting switches, dimmers, etc., at 42 inches above floor.

   c. Wall mounted telephones at 60 inches above floor.

   d. Boxes for outlets on cabinets, countertops, shelves, and above countertops at 2 inches above the finished surface or 2 inches above the back splash. Verify size, style, and

location with the supplier or installer of these items before installation.

5. Set surface-mounted receptacle and lighting boxes in wet areas 42 inches above the finished floor to the center of the box, unless called out otherwise on the Plans.

6. Set surface-mounted boxes for lighting switches within 12 inches of the door opening on the strike or lock side of the door or on the side closing last unless indicated otherwise on the Plans.

7. Arrange boxes used in wet areas to drain moisture away from devices or enclosures for equipment and make conduit connections from below.

8. Set floor boxes level and adjust to finished floor surface.

D. CONDUIT INSTALLATION

Install conduit as a complete and continuous system without wires. Mechanically secure to boxes, fittings, and equipment. Electrically connect conduits to all metal boxes, fittings, and equipment.

1. All field or manufactured ferrous metal threaded connections of conduits and fittings shall be installed with a coating of electrically conductive, corrosion resistant, copper colloidal compound such as "Shamrock Kopr-Shield™ Compound" or equivalent.

2. Keep conduits clean and dry. Close each exposed end.

3. Properly ground each metallic box, cover, lid, hatch, conduit, etc., in compliance with the National Electrical Code and Specification Section 16060.

4. When blowing through conduits, cover electrical components installed in enclosures to avoid blowing dirt, shavings, or moisture into equipment.

5. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel, monofilament plastic line, or woven polyester pull line with not less than 200-lb tensile strength. Leave at least 8 inches of slack at each end of the pull wire.

6. Install exposed raceways in lines parallel or perpendicular to the building or structural member's lines except if structure is not level then follow the surface contours as much as practical. Do not crossover or use offsets if they can be avoided by installing the raceway in a different routing.

7. Run parallel or banked conduits together, on common supports where practical.

8. Make bends in parallel or banked runs concentric (common radius point, expanding radius). Use factory elbows only where elbows can be installed concentrically; otherwise, provide field bends for parallel raceways.

9. Select surface raceway outlet boxes to which lighting fixtures are attached of sufficient diameter to provide a seat for the fixture canopy.

10. Provide surface metal raceway outlet box and the backplate and canopy at the feed-in location of each end-stem suspension fluorescent lighting fixture.

11. Labeling

    With the exception of conduits supplying power to lighting and convenience receptacles, all conduits shall be labeled in the following manner.

    a. Conduits shall be labeled at each entrance and exit of a raceway, box, and device. Labels shall be placed no more than 3 inches from the relevant entrance or exit and shall be positioned in a manner where they can best be read by technicians and maintenance personnel.

       Exception:

       - *Only one label shall be required for conduits less than 6 feet in length where the entire conduit can be seen from a single point.*

    b. The labels used shall be permanent items manufactured specifically for tagging conduits in direct sunlight and wet environments.

c. The conduit label shall be the full conduit number as listed on the Cable and Conduit Schedule.

d. The conduit label shall be attached near the ends of conduit stub ups through floors and penetrations into vaults even if equipment is set over the conduit.

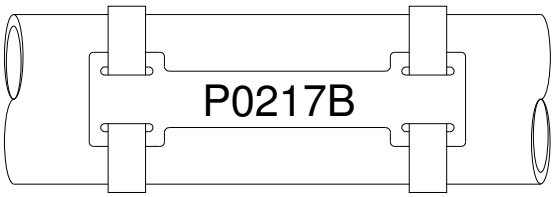


Figure 4.2.D.11

Example of a Conduit Label

E. RACEWAY TERMINATIONS AND CONNECTIONS

1. Join raceways with fittings designed and approved for the purpose and make joints tight.

2. Make connections waterproof and rustproof by application of a watertight, conductive thread compound. Clean threads of cutting oil before applying thread compound.

3. PVC–RMC Conduits

   Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

4. Apply PVC adhesive by brush.

5. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

6. Cut ends of conduit square with hand or power saw or pipe cutter. Ream cut ends to remove burrs and sharp ends. Make conduit threads cut in the field with the same effective length and same thread dimensions and taper as specified for factory-cut threads.

7. Flexible Connections

   Use maximum of 18 inches of flexible conduit for equipment subject to vibration, noise transmission, removal, or movement; and for all motors. Do not use flexible conduit in place of elbows, offsets, or fittings to attach to fixed equipment. Recessed and semirecessed lighting fixtures may use up to 6 feet of flexible conduit, or 11 feet of premanufactured lighting "whips." Use LFMC in wet or damp locations. Do not strap flexible conduit to structures or other equipment.

8. Provide double locknuts and insulating bushings at conduit connections to boxes and cabinets. Align raceways to enter squarely and install locknuts with dished part against the box. Use grounding type bushings where connecting to concentric or eccentric knockouts.

   Exception:

   - *In wet areas, use Myers hubs.*

9. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.

10. Support conduit connections to motors or other equipment independently of the motor or equipment. Raise or drop vertically to the nearest practicable point of connection to the unit. Run vertical drops to the floor and fasten with a floor flange. Unsupported drops are not permitted. Horizontal runs on the floor or on equipment are not permitted. Drop or raise at the appropriate closest location. Run conduit on equipment frames or supports to closely follow the contours of the equipment. Locate conduit to maintain access to all equipment services and adjustment points and so as not to interfere with operation of the equipment.

11. Connect conduit to hubless enclosures, cabinets, and boxes with double locknuts and with insulating type bushings. Use grounding type bushings where connecting to concentric or eccentric knockouts. Make conduit connections to enclosures at the closest point possible where the devices are located to which the circuits contained in the conduit will connect.

Exception:

- *In wet areas, connect to enclosures, boxes, and devices from the bottom side using Myer-type hubs.*

F. EXPANSION FITTINGS

Where conduits cross building expansion joints, use suitable sliding or offsetting expansion fittings. Unless specifically approved for bonding, use a suitable bonding jumper.

Exception:

- *For 100 percent continuous conduits, provide an LFMC loop to compensate for expansion. Include conduit outlet boxes for maximum bend compliance.*

G. RACEWAY SUPPORT

Support raceways as specified in Section 16050.

1. Provide anchors, hangers, supports, clamps, etc., to support the raceways from the structures in or on which they are installed. Do not space supports further apart than 10 feet.

2. Provide sufficient clearance to allow conduit to be added to racks, hangers, etc., in the future.

3. Support raceway within 3 feet of every outlet box, junction box, panel, fitting, etc.

4. Support raceway and boxes in an approved manner by:

   a. Expansion shields in concrete or solid masonry;

   b. Toggle bolts on hollow masonry units;

   c. Wood screws on wood;

   d. Metal screws on metal.

5. Raceway in wet areas shall have clamp backs or other appropriate spacers to hold them a minimum of 1/2 inch off the surface.

Horizontal runs on the roof surface shall be blocked at every 5 feet to hold them a minimum of 2 inches above roof surface.

H. INSTALLING PVC-COATED RGS CONDUITS

1. Follow the manufacturer's requirements and recommendations when installing PVC-Coated RGS conduits.

2. Seal the connections to protect the conduit.

3. Provide manufacturer's PVC repair compound where the thickness of the conduit coating has been reduced or damaged (from bending, threading, nicking, etc.)

I. BENDS AND OFFSETS

Bend and offset metal conduit with hickey or power bender, standard elbows, conduit fittings or pull boxes. Bending of PVC shall be by hot box bender and, for PVC 2-inches in diameter and larger, expanding plugs. Make elbows, offsets and bends uniform and symmetrical. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

J. PENETRATIONS FOR RACEWAYS

1. Do not bore holes in floor and ceiling joists outside center third of member depth or within 2 feet of bearing points. Holes shall be 1-inch diameter maximum.

Exception:

- *Unless specifically approved by Structural Engineer.*

2. Penetrate through roofs with core drill hole 1/2 to 1 inch larger than conduit, flash with neoprene, caulk conduit in place and seal with silicone sealant under flashing. Sleeve roof opening where non-concrete roof construction occurs.

4.3 HANDHOLES

A. HANDHOLE INSTALLATION

Install handholes for underground raceway systems true to line and grade. Provide a compacted foundation of fine sand or 3/8 minus crushed rock for the bearing surface edges of the handholes.

The handholes shall be installed per the NEC Sections 314, and other applicable sections of the NEC.

B. HANDHOLE CONDUIT INSTALLATION

1. End all conduits with a vertical riser.

2. Conduits NOT identified as 100 percent continuous shall be allowed to extend into the handhole as a PVC conduit. Provide a PVC bell-end in each conduit as shown in Figure 4.5.B.2. Provide a removable filler at the end of each conduit to eliminate the possibility of water entry.

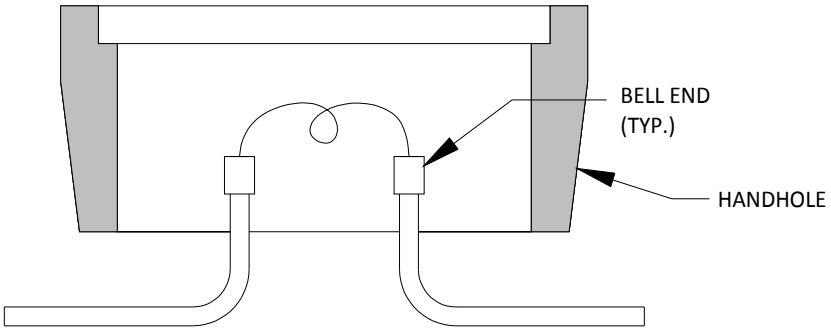


Figure 4.5.B.2

Typical PVC Conduit Terminations in a Handhole

3. Conduits identified as 100 percent continuous shall terminate into the bottom of a junction box, with Myer-type hubs, in PVC-Coated RGS conduit as shown in Figure 4.5.B.3. The door of the J-Box shall face upwards.

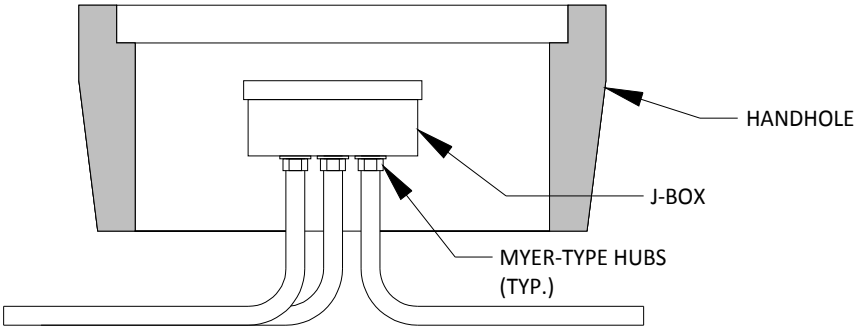


Figure 4.5.B.3

Typical 100 Percent Continuous Conduit Terminations in a Handhole

Exception:

- *Where a handhole contains only two conduits, and is being used solely as a pulling point, where one conduit is simply an extension of the other, a junction box may be replaced with a PVC-Coated RGS conduit pulling body.*

C. HANDHOLE GROUNDING

1. All handholes with metal conduits or with metal lids shall be grounded per Section 16060-3.

4.4 INSTALLATION OF CONDUITS UNDERGROUND AND IN CONCRETE

A. UNDERGROUND RACEWAYS

1. The minimum conduit depth shall be 24 inches.

Exceptions:

- *Electrical utility conduit depth shall be 36 inches.*
- *Unless required otherwise by utility company.*
- *Unless required to be shallower due to physical constraints (see requirements below).*
- *Unless under a concrete slab (see requirements below).*

- *Conduits contains a grounding electrode conductor shall be 30-inches deep.*

2. Conduits that require a buried depth of less than 18 inches shall require a 6-inch-thick concrete covering over that portion of such conduits. Such concrete covers need not be formed but shall be colored red or shall be painted red on top.

3. Conduits under a concrete slab-on-grade shall be separated from the slab and from the supporting soil by at least 3 inches with soft sand on all sides.

4. Provide separation of underground instrumentation conduits from power and control conduits by a minimum of 12 inches. Avoid parallel runs of instrumentation conduits with power and control conduits as much as possible. Where instrumentation conduits are required to crossover power or control conduits, maintain the 12-inch separation using depth and make the crossover as close to 90 degrees as possible.

5. Run conduits as straight as practicable. Make changes in direction and/or grade of sufficient length to allow a gradual change (3-foot radius minimum). Make slight offsets with 5-degree couplings.

6. Run trenches true and clear of stones or soft spots. Place 4-inches of fine sand in the trench bottom and tamp into place. Provide preformed plastic spacers on top of sand spaced 5-feet on center.

   After the raceway is placed in the trench, backfill 6 inches with sand, then with native earth backfill passing a No. 8 sieve, free of stones. Do not tamp on top of the conduit until the final backfill is placed. Tamp or water-settle the final backfill to finish the grade. Compact the backfill as specified under Section 02300 "Site Earthwork."

7. Mark direct buried conduit by placing a red marking tape a minimum of 12 inches below grade during backfilling of the trench.

8. Seal conduit connections to eliminate leakage.

B. CONDUIT TRANSITIONS

Where raceway exits from grade or concrete, provide the following:

1. All conduits exiting grade or concrete shall be PVC-Coated RGS.

   Exception:

   - *Raceways used for the containment and protection of bare grounding electrode conductors shall be PVC Schedule 80. No portion of these conduits shall be metallic.*

2. For equipment to be moved into place at a later date, install a PVC-Coated RGS coupling flush with the floor slab. Insert a threaded flush plug into the coupling. Provide a pull wire looped backed into the conduit that can be reached after removal of the plug.

3. Only the straight portion of conduits shall exit grade or concrete. No curved portion of a factory or field-bent conduit shall be visible existing the penetration, even when covered or hidden by equipment.

C. CONDUIT STUB-UPS INTO EQUIPMENT AND ENCLOSURES

1. Where conduits are stubbed up into open bottom equipment and enclosures, extend the bottom of the conduit threads 1/2 inch above grade. Provide ground bushing and end fittings, flush with fitting and 2-inch stub, above the bottom of the enclosure. Stub conduits to a uniform height (plus or minus 1/8 of an inch) and align within plus or minus 1/4 inch.

   Exception:

   - *Conduits that do not meet the requirements of being 100 percent continuous, stubbing up directly under a Motor Control Center that is mounted on a housekeeping pad, shall be allowed to terminate as a PVC conduit with a bell-end.*

2. Locate stub-ups directly under the section gutter into which the conductors they contain are to be routed. Terminate conduit with insulating, grounding type bushing bonded to the ground bus of the equipment.

3. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends are not visible above the finished slab.

4. Unless otherwise noted on the Plans, spare conduits stubbing up through concrete floors and not adjacent to a wall shall be finished flush with floor with an RGS coupling. Provide an in-set metal plug (male thread) into coupling flush with floor.

5. Unless otherwise noted on the Plans, spare conduits stubbing up through concrete floors or grade, and adjacent to a wall or housekeeping pad shall extend 12 inches above slab/grade. The exterior edge of the conduit shall be a minimum of 1 inch from the wall/pad.

6. All stub-ups shall be provided with pull string.

7. Provide conduit labels on all stub-ups which are not flush mounted.

4.5 PROTECTION

Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensures coatings, and finishes are without damage or deterioration at the time of Substantial Completion.

A. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

B. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

4.6 CLEANING

On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

4.7 QUALITY CONTROL

A. TESTS

1. Conduits identified as meeting the requirements of 100 percent continuity shall be tested between source and destination as follows:

    a. Testing shall be performed using a Digital Voltmeter or Biddle ohmmeter.

    b. Testing values shall not exceed 5 ohms.

    c. If testing values exceed 5 ohms, then corrective action shall be taken to reduce the resistance to 5 ohms or below.

    d. These measurements shall be documented, signed, and submitted to the Engineer for approval.

***** END OF SECTION *****

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the various types of receptacles, connectors, switches, and finish plates.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Items
16050	Basic Electrical Materials and Methods
16130	Raceways and Boxes

1.3 SUBMITTALS

See Section 01300.

1.4 QUALITY ASSURANCE

See Section 16050.

1.5 COORDINATION

A. WIRING DEVICES FOR OWNER FURNISHED EQUIPMENT

Match devices to plug connectors for Owner-furnished equipment.

B. CORD AND PLUG SETS

Match cord and plug sets to equipment requirements.

1.6 DEFINITIONS

Reference Section 16050, “Definitions.”

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. AVAILABLE MANUFACTURERS

Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include the following:

1. Wiring Devices

   a. Arrow Hart Div., Cooper Industries.

   b. Bryant Electric, Inc.

   c. Hubbell Inc.

   d. Killark Electrical Mfg. Co.

   e. Leviton Mfg. Co., Inc.

   f. Pass & Seymour/Legrand.

2. Multi-Outlet Assemblies

   a. Wiremold Co.

2.2 WIRING DEVICES

Comply with NEMA Standard WD 1, "General Purpose Wiring Devices."

A. ENCLOSURES

NEMA 1 equivalent, except as otherwise indicated.

B. COLOR

Ivory except as otherwise indicated or required by Code.

C. RECEPTACLES, STRAIGHT-BLADE AND LOCKING TYPE

Except as otherwise indicated, comply with Federal Specification W-C-596 and heavy-duty grade of UL Standard 498,

"Electrical Attachment Plugs and Receptacles." Provide NRTL labeling of devices to verify compliance.

1. General Purpose Convenience Outlets

    a. Duplex receptacle configuration

    b. Nylon face

    c. Staked screw terminals for line, neutral, and ground connections.

    d. Provisions for split bus

    e. NEMA 5-20R

2. Special Purpose Receptacles

    a. Staked screw terminals for line, neutral, and ground connections.

    b. NEMA configuration as indicated.

D. RECEPTACLES, STRAIGHT-BLADE, SPECIAL FEATURES

Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicated, and with the following additional requirements:

1. Ground-Fault Circuit Interrupter (GFCI) Receptacles

    UL Standard 943, "Ground Fault Circuit Interrupters," with integral NEMA 5-20R duplex receptacle arranged to protect only the connected receptacle and no other receptacles connected on the same circuit. Design units for installation in a 2-3/4-inch-deep outlet box without an adapter.

E. CORD AND PLUG SETS

Match voltage, current ratings, and number of conductors to requirements of the equipment being connected.

1. Cord

   Rubber-insulated, stranded copper conductors, with type SOW-A jacket. Grounding conductor has green insulation. Ampacity is equipment rating plus 30 percent minimum.

2. Plug

   Male configuration with nylon body and integral cable-clamping jaws. Match to cord and to receptacle type intended for connection.

F. SNAP SWITCHES

Quiet-type ac switches, NRTL listed and labeled as complying with UL Standard 20 "General Use Snap Switches," and with Federal Specification W-S-896.

1. Lighting Switches

   120/277 Vac only, rated 20 amperes.

2. Motor Rated Switches

   Horsepower rated for application indicated.

G. OCCUPANCY SENSING LIGHT SWITCH

Provide occupancy sensing light switches in all office, lab, kitchen and break rooms.

1. Switches shall be 120/277 V, passive infrared, commercial grade, white, with adjustable time delay of 30 seconds to 30 minutes, Leviton ODS10-IDW or equal.

H. WALL PLATES

Single and combination types that mate and match with corresponding wiring devices. Features include the following:

1. Color

   Matches wiring device except as otherwise indicated.

2. Plate-Securing Screws

Metal with heads colored to match plate finish.

3. Material for Interior Finished Spaces

Lexan, except as otherwise indicated.

4. Material for Interior Unfinished Spaces: Galvanized steel.

5. Material for Laboratories: Stainless steel.

6. Material for Exterior or Wet Locations: Cast Aluminum.

2.3 MULTI-OUTLET ASSEMBLIES

A. Comply with Standard UL 5, "Surface Metal Raceways and Fittings."

B. COMPONENTS OF ASSEMBLIES

Products of a single manufacturer designed to be used together to provide a complete matching assembly of raceways and receptacles.

C. RACEWAY MATERIAL

Metal, with manufacturer's standard corrosion-resistant finish.

D. WIRE

No. 12 AWG.

PART 3 EXECUTION

3.1 INSTALLATION

A. IDENTIFICATION

Each receptacle, whether convenience, or dedicated, shall be labeled with the circuit from which its power is derived. Label as "CKT-XX" where XX = numerical circuit number

1. Only one Panelboard servicing the site:

   Label as “CKT-XX” where XX = numerical circuit number within the Panelboard.

2. More than one Panelboard servicing the site:

   Label as “CKT XX-YY” where XX = Panelboard number and YY = numerical circuit number within the Panelboard.

   Example:
   A receptacle powered from circuit 03 of Panelboard [01 PB 02] would be labeled “CKT 02-03”

B. RECEPTACLE BOXES

1. Reference Section 16130 for box types.

2. Mounting Height

   a. Indoor, in DRY Areas

      Indoor receptacle boxes in DRY areas shall be mounted 12 inches above the floor unless shown otherwise on the Plans.

   b. Indoor, in WET Areas

      Indoor receptacle boxes in WET areas shall be mounted 42 inches above the floor unless shown otherwise on the Plans.

   c. Outdoor

      Outdoor receptacle boxes shall be mounted 18 inches above grade unless shown otherwise on the Plans.

3. Reference Section 16130 for box cover types.

C. CONVENIENCE RECEPTACLES

Convenience receptacles shall be 20 A, duplex, white, GFCI, straight blade, 3-wire, grounding, unless called out otherwise on the Plans.

In addition to any GFCI requirements, all receptacles, convenience or dedicated, located in break rooms and kitchens shall be AFCI.

D. DEDICATED RECEPTACLES

Dedicated receptacles shall be 20 A, simplex, gray, non-GFCI, straight blade, 3-wire, grounding, unless called out otherwise on the Plans.

Power must be connected to a dedicated GFCI breaker in the panelboard.

In addition to any GFCI requirements, all receptacles, convenience or dedicated, located in break rooms and kitchens shall be AFCI.

Dedicated receptacles shall include a red phenolic placard with 3/8-inch lettering over the receptacle stating:

NON-GFCI RECEPTACLE
FOR (*specific device*)
NOT INTENDED FOR GENERAL USE

E. ARRANGEMENT OF DEVICES

Except as otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.

1. See "Raceways and Boxes" Section for mounting height of devices.

2. Verify locations of outlets and switches in cabinetry with cabinet supplier and Owner prior to installation.

F. INSTALLATION PRACTICES

1. Install devices and assemblies plumb, level, flush and secure. Provide spacers on device screws to flush yokes or flanges to surface of wall within 1/16 of an inch where boxes are not flush with the wall surface. Install wiring devices such as receptacles to withstand 50 pounds force applied perpendicular to the device face with a maximum deflection of 1/16 of an inch.

2. Protect devices and assemblies during painting.

3. Use corrosion resistant devices in kitchen areas and outdoors.

4. Wiring connections shall be made by compression on the screw terminals. The wire shall be neatly and symmetrically wrapped around the screw a minimum of 180 degrees.

G. LIGHT SWITCH ORIENTATION

Install switches with the "off" position down. Install three and four way switches so the load is "off" when all switch handles are down.

H. TERMINATION PRACTICES

Connect phase, neutral, and grounding wires to devices with full loops around screws installed to tighten with tightening of the screw. Trim insulation to within 1/8 of an inch of screw terminal.

I. WALL PLATES

Install after painting is complete. Install with an alignment tolerance of 1/16 of an inch to plumb. Install at flush mounted devices so that all four edges are in continuous contact with finished wall surface without the use of mats or similar devices.

3.2 GROUNDING

Connect receptacle or switch ground lug to device box for devices other than isolated ground type.

3.3 FIELD QUALITY CONTROL

Test wiring devices for proper connections, polarity, and ground continuity. Perform this testing with testing equipment designed for testing polarity and connections.

Operate each operable device at least six times.

Test ground-fault circuit interrupter operation with local fault simulations, using a tester designed for such testing, and according to manufacturer recommendations. Testing with integral test switches on the receptacle is not sufficient for this testing.

Replace damaged or defective components, and retest.

***** END OF SECTION *****

SECTION 16280

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section describes the materials and installation requirements for Surge Protective Devices (SPD).

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
16050	Basic Electrical Materials and Methods
16060	Grounding and Bonding
16442	Motor Control Equipment

1.3 DEFINITIONS

A. SURGE PROTECTIVE DEVICE (SPD)

Device(s) used for the protection of all AC electrical circuits from the effects of lighting induced currents, substation switching transients, and internally generated transients. The primary technology is a metal oxide varistor(s) (MOV). This term is typically used in our Plans and Specifications with reference to providing system wide protection at the highest voltage level in the system on the Owner side of the Utility and lower voltage distribution.

B. SURGE SUPPRESSOR

A surge protective device which protects AC circuits as above. All surge suppressors are SPDs but the term is typically used in our Plans and Specifications with reference to protection of process and instrumentation circuits at 120 Vac or less. The protective amp rating specified for what we call a surge suppressor is less than that of what we call a SPD. Refer to specific Section 16940 for control system surge suppressors.

C. TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS)

This term has the same definition as SPD above.

D. UL DEFINED "TYPES" OF SPDs

1. Type 1

A permanently connected SPD intended for installation between the secondary of the service transformer and the line side of service disconnect/overcurrent device, as well as the load side, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device.

2. Type 2

A permanently connected SPD intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

E. USER DEFINED TYPES OF SPDs

1. Power SPDs

Power SPDs are those units >= 150 VAC and >= 30 A.

2. Control SPDs

Control SPDs are those units < 150 VAC and < 30 A.

1.4 REFERENCES

Most recent editions of:

A. ANSI/IEEE: C62.41.1, C62.41.2, C62.45, and C62.48.

B. National Electric Code: Articles 240 and 285.

C. Underwriters Laboratories: UL1449 3rd Edition, UL1283 and UL 964.

D. Milstandard 220: Test Method Standard.

1.5 SUBMITTALS

A. Submit under the provisions of Section 01300.

Submittals shall include the following:

1. Published specifications, cut sheets and product data showing that all the requirements of the Plans and Specifications have been met. Clearly identify the product series, model(s) and part numbers being submitted.

2. The Engineer reserves the right to accept or reject any or all submittals, to request additional information as deemed necessary, or to request submittals for a different unit deemed more appropriate for this installation.

3. Proof of UL1449 Third Edition compliance from Nationally Recognized Test Lab (NRTL) accepted by local authority having jurisdiction, including Voltage Protection Rating (VPR) and Nominal Discharge Ratings.

4. UL1283 filter compliance documentation (where filtering is provided).

5. Warranty Terms, Conditions and Documentation.

6. Electrical and mechanical shop drawings.

7. Installation requirements/instructions.

1.6 QUALITY ASSURANCE

A. See Section 16050.

B. Manufacturer shall have local representation and distribution within 400 miles of the project location to provide technical, warranty claim, and installation support for the project.

C. Only firms regularly engaged in the manufacture of SPD products for not less than 5 years, shall be considered.

D. Single manufacturer shall be capable of providing all power system SPDs.

E. Manufacturer shall have ISO 9001 Certification for products.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturer(s) have been preapproved and are the only products which shall be accepted. Additional manufacturers shall contact the Engineer for consideration on future projects but shall not submit here.

1. Innovative Technology – PTX and PTE series.

2. Schneider Electric – EMA and EBA series.

3. Total Protection Solutions – ST series and LP series.

2.2 SURGE PROTECTIVE DEVICE

A. DESIGN

1. Surge Protective Devices shall be NRTL listed in accordance with 1449 3rd Edition and UL 1283.

2. This specification includes power SPDs only. Reference Section 16940, Control Panels for control SPDs.

3. SPD shall be compatible with the electrical system voltage, current, system configuration and intended applications.

4. Parallel design only with individual protection components for the following modes:

   a. Line to Ground and Line to Line for Delta and High Resistance Grounded systems.

   b. Line to Ground, Line to Neutral and Neutral to Ground for Wye and Single Phase distribution systems.

5. SPD shall be NRTL listed and SCCRs shall have a 200 kA rating. It is providers' responsibility to obtain this information and verify SPD is appropriately rated for application.

6. At the service entrance, on the load side of the service disconnect, a UL approved disconnect switch shall be provided as a means of disconnect if a breaker is not available.

7. Metal-Oxide Varistors (MOV) components shall be utilized as primary energy mitigation. Selenium cell, air gaps, gas tubes are not allowed.

8. Protection Status

   Visual indication of protection status on each phase, or indication of a failure, visible from the front of the equipment.

9. Enclosure

   a. NEMA rated metal enclosure appropriate for environmental conditions and exposure at point of installation. NEMA 12 unless otherwise shown in the Plans.

   b. Designed to allow connection of the SPD without sharp bends in the conductors without exceeding NEC maximum bending radius of conductors.

10. SPD shall also include a passive filter circuit which allows the SPD to actively follow the voltage waveform and provide a clamping envelope to limit low level IEEE C62.41 ringwaves (of either polarity) at all locations on the sine wave. This circuit shall also perform in the Neutral to Ground Mode.

11. Maximum continuous operating voltage (MCOV) of all components (based on ANSI C84.1 standard voltages), not less than 115 percent for all installations.

12. Surge Protective Device Warranty Requirements

    a. Period

       20 years from the date of substantial completion of service and activation of the system to which the SPD is attached.

    b. Full replacement of a suppressor which is damaged or fails to meet manufacturers published specifications and specifications provided within, without pro-rating value.

    c. No exclusions from failure or damage from any system anomaly (over-voltage, single phasing, lightning strike, etc. (IEEE 62.41.1). Exceptions: failure caused by wiring error, loose or missing Neutral to Ground Bond or Meggar Testing with SPD connected to power system.

d. Factory or third party testing shall not be required.

e. Warranty shall apply independent of facility ownership/purchaser.

f. Replacement unit to be at facility within 10 business days of receipt of written notification of failure at no cost to the customer (exception – custom configuration or special order units).

g. Replacements

Same make, model and configuration as original unit unless otherwise requested or approved.

h. No shipping, handling, examination or other fees are allowed.

B. PERFORMANCE AND RATINGS

1. Minimum durability and performance requirements are described below in accordance with test procedures outlined in ANSI/IEEE C62.45 and UL 1449 Third Edition.

a. Provide Peak Surge Current (Single Pulse Rated, 8/20 µS, by mode, amperes) with submittals document for each SPD proposed. Ratings shall be provided for each applicable protection mode (L-L, L-N, L-G & N-G).

b. Unless shown otherwise in the Plans, the minimum surge current capability (single pulse rated) per phase shall be:

i. Service Entrance: 160 kA per phase/80kA per mode

ii. Distribution panelboards and MCC: 160 kA per phase/80 kA per mode

iii. Branch panelboards: 120 kA per phase/60 kA per mode

c. All SPD devices (including branch panel) shall withstand a minimum of 2,000, 20kV/10kA, 1.2 x 50 µS - 8x20 µS combination waveform hits delivered at a rate not exceeding one pulse per minute without failure or

degradation exceeding 5 percent using IEEE B3 6 kV/3 kA combination waveform for pre and post durability let through measurement evaluation. Lead length for testing and let through measurements shall be 6 inches.

d. UL Third Edition Nominal Discharge Current Ratings shall be a minimum of 20 kA per mode for SPD's to be installed at the Service Entrance and a minimum of 10 kA per mode for all other locations.

e. EMI/RFI attenuation values shall be provided (as per Mil Std-220). Attenuation shall be 40dB at 100 kHz.

f. Maximum SPD let through voltage values are provided in Tables 1 and 2 below.

Table 1 - Peak Voltage Let Through Voltage Table for ≥ 160 kA Units (at/ near Service Entrance locations)

*Peak Let Through Voltages (measured from zero reference) shall not exceed:

Voltage/Configuration	Test/IEEE Wave	L-N	L-G	L-L	N-G	Phase Angle
480/277 Wye - Grounded	C3 – 20kV/10kA	1500	1800	2200	1600	90
480/277 Wye - Grounded	B3/C1 – 6 kV/3kA	1000	1075	1725	1075	90
480/277 Wye - Grounded	A1 – 2kV/67A	520	530	830	250	90
480/277 Wye - Grounded	A1 – 2kV/67A	85	155	115	110	180
480/277 Wye - Grounded	UL1449 VPR	1000	1000	1800	1000	----
480 Delta	C3 – 20kV/10kA	N/A	2200	2200	N/A	90
480 Delta	B3/C1 – 6 kV/3kA	N/A	1775	1750	N/A	90
480 Delta	A1 – 2kV/67A	N/A	1300	780	N/A	90
480 Delta	A1 – 2kV/67A	N/A	1200	100	N/A	180
480 Delta	UL1449 VPR	N/A	1800	1800	N/A	----
120/208 Wye	C3 – 20kV/10kA	1000	1200	1300	1100	90
120/208 Wye	B3/C1 – 6 kV/3kA	565	590	925	550	90
120/208 Wye	A1 – 2kV/67A	260	390	360	260	90
120/208 Wye	A1 – 2kV/67A	75	115	90	100	180
120/208 Wye	UL1449 VPR	600	700	900	600	-----
120/240 Split Phase	C3 – 20kV/10kA	1000	1200	1300	1100	90
120/240 Split Phase	B3/C1 – 6 kV/3kA	565	590	925	550	90
120/240 Split Phase	A1 – 2kV/67A	260	390	360	250	90
120/240 Split Phase	A1 – 2kV/67A	75	115	90	100	180
120/240 Split Phase	UL1449 VPR	600	700	900	600	-----

*Testing shall be completed with a minimum of 6 inches of lead length outside of device enclosure and shall be measured from zero voltage crossing.

Note: Category A1 Ringwave applicable for locations where Active Tracking units are to be installed, including 120/208 and 120/240 Branch Panels and protection for dedicated equipment loads (where noted).

Table 2 – Peak Limiting (Let Through) Voltage Table for ≥ 80 kA Units (Branch/Sub Panel, MCC, etc.)

*Peak Let Through Voltages (measured from zero reference) shall not exceed:

Voltage/Configuration	Test/IEEE Wave	L-N	L-G	L-L	N-G	Phase Angle
480/277 Wye - Grounded	C3 – 20kV/10kA	1500	1800	2200	1600	90
480/277 Wye - Grounded	B3/C1 – 6kV/3kA	1050	1070	1750	970	90
480/277 Wye - Grounded	A1 – 2kV/67A	490	530	830	270	90
480/277 Wye - Grounded	A1 – 2kV/67A	100	150	150	100	180
480/277 Wye - Grounded	UL1449 VPR	1000	1000	1800	1000	----
480 Delta	C3 – 20kV/10kA	N/A	2200	2200	N/A	90
480 Delta	B3/C1 – 6 kV/3kA	N/A	1700	1700	N/A	90
480 Delta	A1 – 2kV/67A	N/A	1300	780	N/A	90
480 Delta	A1 – 2kV/67A	N/A	1100	75	N/A	180
480 Delta	UL1449 VPR	N/A	1800	1800	N/A	----
120/208 Wye	C3 – 20kV/10kA	1000	1200	1300	1100	90
120/208 Wye	B3/C1 – 6 kV/3kA	560	575	900	500	90
120/208 Wye	A1 – 2kV/67A	260	400	370	250	90
120/208 Wye	A1 – 2kV/67A	75	100	75	75	180
120/208 Wye	UL1449 VPR	600	700	900	600	-----
120/240 Split Phase	C3 – 20kV/10kA	1000	1200	1300	1100	90
120/240 Split Phase	B3/C1 – 6 kV/3kA	560	575	900	500	90
120/240 Split Phase	A1 – 2kV/67A	260	400	370	250	90
120/240 Split Phase	A1 – 2kV/67A	75	100	75	75	180
120/240 Split Phase	UL1449 VPR	600	700	900	600	-----

*Testing shall be completed with a minimum of 6 inches of lead length outside of device enclosure and shall be measured from zero voltage crossing.

Note: Category A1 Ringwave applicable for locations where Active Tracking units are to be installed, including 120/208 and 120/240 Branch Panels and protection for dedicated equipment loads (where noted). Please note the phase angle is 90 degrees and measurement is positive peak voltage measured from zero reference. Measurements at 180 degrees will show significantly lower let through voltages (sine wave peak voltage is zero at 180 degrees).

2.3 EXECUTION

A. Surge Protective Devices shall be installed per manufacturer's installation instructions with lead lengths not to exceed 24 inches. Gently twist conductors together. Sharp bends shall not be made.

B. Surge Protective Devices shall be installed in electrical circuit locations shown on the Plans.

C. Units other than Type 1 devices shall not tap directly to the bus without upstream over-current protection unless tap conductors are protected at their termination by NRTL listed Disconnect, Over-current and Short Circuit Protective Devices (Fuse with Disconnect and/or Circuit Breaker)

properly rated for conductor and SPD Device Protection as per NRTL listing and NEC requirements.

D. Inspect and test SPD devices as per manufacturer specification and installation guidelines.

E. The Owner or their appointed representative may perform inspection of the installed suppressors. Owner reserves the right to require corrections to the installation to comply with manufacturer installation requirements and project specifications.

F. Service Entrance Installation Requirements

1. One primary suppressor at each utility service entrance to the facility or as indicated on the Plans.

2. Suppressors shall be connected to properly rated disconnect with overcurrent and short circuit protective device connected on the load side of the service entrance disconnecting means in accordance with NEC requirements.

3. Conductors between suppressor and point of attachment shall be kept as short and straight as possible and shall be grouped together (via tie wrap) where possible. Lead length of connecting conductor shall not exceed 2 feet without written permission of the Engineer.

4. Suppressor's ground shall be bonded to enclosure frame and the service entrance ground bus, and conduit between the SPD and the switchboard must provide secure electrical/mechanical connections.

G. DISTRIBUTION CENTERS, MOTOR CONTROL CENTERS, BUSWAY AND BRANCH PANEL APPLICATIONS

1. Where required, suppressor shall be connected to properly rated disconnect with overcurrent and short circuit protective device in accordance with NEC requirements.

2. The SPD shall not limit the use of feed through lugs, sub-feed lugs and sub-feed breaker options. Where feed through lugs, bus tap or circuit breaker is used to feed adjacent sub-panel, SPD shall be installed at first panel served by feeder and conductor terminations between primary panel and adjacent panel shall be installed in such a manner to keep wiring as short as possible (i.e., use bottom lug on output of panel and bottom lugs on input of second panel).

3. Conductors between suppressor and point of attachment shall be kept as short and straight as possible and shall be grouped together (via tie wrap) where possible. Mount the SPD directly adjacent to the circuit breaker closest to the neutral bus, so the maximum length of connecting wiring shall not exceed 18 inches for all leads without written permission of the Engineer.

4. Suppressor's ground shall be bonded to enclosure frame and the equipment ground bus, and the electrical fitting between the SPD and the switchboard must provide secure electrical/mechanical connections.

5. The electrical gear shall be capable of being re-energized upon removal of the SPD.

***** END OF SECTION *****

SECTION 16410

ENCLOSED SWITCHES, FUSES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of individually mounted switches and circuit breakers used for the following:

A. Feeder and equipment disconnect switches

B. Feeder and branch-circuit protection

C. Motor safety disconnect switches

1.2 RELATED WORK SPECIFIED ELSEWHERE

Sections	Item
01300	Submittals
16050	Basic Electrical Materials and Methods
16140	Wiring Devices

1.3 SUBMITTALS

Submit under the provisions of Section 01300.

Manufacturer's Product Data for disconnect switches, circuit breakers, and accessories specified in this Section.

Maintenance data for tripping devices to include in the operation and maintenance manual specified in Section 16050.

1.4 QUALITY ASSURANCE

See Section 16050.

Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. AVAILABLE MANUFACTURERS

Subject to compliance with requirements, manufacturers offering disconnect switches and circuit breakers that may be incorporated into the work include, but are not limited to, the following:

1. General Electric Co.; Electrical Distribution and Control Division.

2. Siemens Energy & Automation, Inc.

3. Square D Co.

4. Eaton, Cutler Hammer.

2.2 DISCONNECT SWITCHES

A. MOTOR SAFETY DISCONNECT SWITCHES

Motor safety disconnect switches shall be provided when the motor starter is not in sight of the associated motor or when shown on the Plans. Motor safety disconnect switches shall be provided with the following specifications.

1. Switches shall not be fused unless specifically shown otherwise on the Plans.

2. Switches shall include pad lockable handles, lockable in both the open and closed positions.

3. Switches shall be rated at 600 V.

4. Switches shall include two auxiliary contacts, rated at 10 A at 250 Vac each, connected to the switch pivot arm that are open when the switch is open, closed when the switch is closed.

5. Switches shall be rated at motor horsepower or as per the Plans, whichever is the larger.

6. Switch enclosures shall be NEMA 4X stainless steel unless specifically stated otherwise in the Plans or through the approval of the Engineer.

2.3 ENCLOSED CIRCUIT BREAKERS

A. ENCLOSED, MOLDED-CASE CIRCUIT BREAKER

NEMA AB 1, with lockable handle in both the open and closed positions.

B. CHARACTERISTICS

Frame size, trip rating, number of poles, and auxiliary devices as indicated on the Plans with interrupting rating to meet available fault current.

1. Main and feeder breakers shall be molded case breakers with thermal magnetic trip.

2. Motor circuit breakers shall be magnetic only trip with adjustable trip setting.

3. Branch circuit breakers shall be molded case, thermal-magnetic trip, trip-free with non-interchangeable, non-adjustable trip unless otherwise noted.

C. APPLICATION LISTING

Appropriate for application, including switching fluorescent lighting loads (SWD) or heating, air-conditioning, and refrigerating equipment (HACR).

D. CIRCUIT BREAKERS, 200 A AND LARGER

1. Trip units shall be interchangeable within frame size.

2. Assure ability to selectively coordinate circuit breakers.

E. MOLDED-CASE SWITCH

Where indicated, molded-case circuit breaker without trip units.

F. LUGS

Mechanical lugs and power-distribution connectors suitable for copper conductors of the number and size indicated.

G. SHUNT TRIP

Where indicated.

H. ACCESSORIES

As indicated.

PART 3 EXECUTION

3.1 COORDINATION OF ELECTRICAL PROTECTION DEVICES

A. The Contractor shall provide coordination of circuit breakers, fuses, and other associated protective devices.

1. For adjustable breakers, provide the values for continuous, short-time, instantaneous, ground fault, and other relevant trip and delay settings. Adjust breakers as per 3.4.

2. Provide to the Owner and Engineer calculations, plots, and overlays that clearly show proper coordination of protection circuits.

3.2 INSTALLATION

A. Install the disconnect switches and circuit breakers level and plumb in locations as indicated, according to manufacturer's written instructions.

B. Install wiring between disconnect switches, circuit breakers, control, and indication devices.

C. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and as instructed by manufacturer.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Identify each disconnect switch and circuit breaker according to requirements specified in Section 16050.

3.3 FIELD QUALITY CONTROL

A. TESTING AGENCY

Provide the services of a qualified independent testing agency to perform specified field quality-control testing.

B. TESTING

1. Prior to Energization

After installing disconnect switches and circuit breakers, perform visual and mechanical inspection of enclosure and devices.

Check connections and mounting for proper torque.

For molded case circuit breakers 100 Amps and larger, provide independent testing agency to perform switch tests as stated in NETA ATS, Section 7.5 and circuit breaker tests as stated in NETA ATS, Section 7.6. Certify compliance with test parameters.

Provide to the Engineer separate copies of test results signed by testing agency. Include the manufacturer's circuit breaker curve for each breaker tested.

Correct or replace malfunctioning units and retest.

Remove any burrs, filings, or other foreign materials from enclosure. Completely wipe down and vacuum enclosure.

2. After Energization

After electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

Correct malfunctioning units on site where possible and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.4 ADJUSTING

Set field-adjustable disconnect switches and circuit-breaker trip ranges as indicated.

Provide fuses for fused disconnect switches to coordinate with manufacturer's listed maximum fuse size for equipment supplied by the disconnect switch.

***** END OF SECTION *****

SECTION 16415

AUTOMATIC, NON-AUTOMATIC, AND MANUAL TRANSFER SWITCHES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of the following types of power transfer switches:

A. Automatic Transfer Switches.

B. Manual Transfer Switches.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
01600	Materials and Equipment
01800	Testing, Commissioning, and Training
02300	Site Earthwork
Division 3	Concrete
09900	Painting
11000	Equipment General Provisions
Division 15	Mechanical
Division 16	Electrical
16120	Conductors and Cables
16130	Raceway and Boxes

1.3 DEFINITIONS

A. 2-POSITION

A 2-position ATS transfers immediately from one switch position to another. 2-position ATS can apply to both “Open Transition” and “Closed Transition” switches.

B. 3-POSITION, DELAYED TRANSFER

A 3-position “delayed transfer” ATS can be held in the “center” (no load connection) position for a programmable delayed period of time before completing its transfer to the calling position. Delayed transfer applies to

transfers in either direction. Delayed transfers can only apply to "Open Transition" switches.

C. AUTOMATIC TRANSFER SWITCH

Automatic transfer switches shall be defined as power transfer switches used to automatically switch system power away from faulty utility service power to backup generator power then back again to utility power when valid utility power is reacquired.

Automatic transfer switches can be configured for automatic generator starting, waiting for generator stability, then transferring the system bus to the generator. They are also configurable for switching back to utility power under selectable conditions.

Automatic transfer switches can be set up for automatic generator testing and shutdown.

D. CLOSED TRANSITION

A "Closed Transition" ATS provides a "make-before-break" transition when performing automatic generator tests. To make this type of transition, the voltage, frequency, and phase shift between the power sources must be within specified and programmable tolerances. Typical tolerances are $\delta V <= \pm 5$ percent, $\delta f = \pm 0.2$ percent, and the phase shift between ±5 electrical degrees. This may take from several seconds to several minutes and is only used during system testing where transition delays are not critical. During power failures, the transitions are "break-before-make" like an open-transfer switch where time delays are minimal.

E. DELAYED TRANSFER

A "Delayed Transfer" ATS provides a programmable delay in the "neutral position." When in this mode, the load circuit is completely disconnected from both the normal and standby power sources. A delay in this position allows load circuits to dissipate electrical and mechanical energy before being re-energized.

F. NEUTRAL POSITION

The neutral position describes a position of the transfer switch when the load leads are connected to neither the normal nor the standby source. In this position, the load circuit is completely disconnected. This position should not be confused with the neutral bus or with neutral bus switching.

G. NON-AUTOMATIC TRANSFER SWITCH

Non-Automatic Transfer Switches are identical to ATS switches with the exception that they include a selector switch that allows manual transfer.

Non-Automatic Transfer Switches shall not be permitted.

H. MANUAL TRANSFER SWITCH

Manual transfer switches are double-throw switches with a center "OFF" position. Transfers are manually made by physically operating a switch handle to any one of three positions, "NORMAL," "OFF," "STANDBY."

I. NEUTRAL SWITCHING

In a neutral-switching ATS, the neutral load bus is switched between power source neutrals in the same manner as the power leads.

J. NORMAL POSITION

A switch is in its "NORMAL" position when it is connected to the primary (utility) power source.

K. OPEN TRANSITION

An "Open Transition" ATS provides a "break-before-make" transition under all transition conditions.

L. STANDBY POSITION

A switch is in its "STANDBY" position when it is connected to the secondary (generator) power source. This position may also be referred to as the back-up position.

M. UVTL

Utility Voltage Transition Level.

N. GVTL

Generator Voltage Transition Level.

1.4 SUBMITTALS

Submit four copies of the following:

A. Manufacturer's Product Data for transfer switches and accessories specified in this Section.

B. O&M Manual requirements are outlined in Section 01300 and shall also contain the following information:

1. Two-year maintenance service agreement as described below.

2. Screenshots and descriptions detailing how to step through the setup and configuration menus.

3. Field test results as described herein.

1.5 MAINTENANCE

A. ATS

Beginning at the time of Substantial Completion, provide a 24 months full maintenance service performed by skilled employees of the manufacturer's designated service organization. Provide OEM parts and supplies to complete all service to support all factory warranty requirements with written reports to the Owner upon completion of visits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

All automatic transfer switches shall be provided by the supplier of the generator set such that the supplier of the generator in Specification Section 16230 shall be a single source of responsibility for products provided, for warranty, startup and service purposes. The generator and automatic transfer switches may be different brands.

A. MANUFACTURERS

Subject to compliance with requirements, provide products by the following:

1. General Electric Co.; Electrical Distribution & Control Div.

2. Eaton, Cutler-Hammer.

3. ASCO

4. Kohler

5. Cummins Power Generation/Onan

6. Square D

7. MTU

2.2 AUTOMATIC TRANSFER SWITCHES

A. RATINGS

1. Phases: As shown on the Plans.

2. Poles: As shown on the Plans.

3. Voltage Rating: As shown on the Plans.

4. Current Rating: As shown on the Plans.

5. Fault Current Rating: As shown on the Plans.

6. Neutral

   With neutral bus unless indicated otherwise on the Plans.

7. Enclosure: As shown on the Plans.

B. FEATURES

Reference "DEFINITIONS" in this specification.

1. UL 1008/CSA certification.

2. Open Transition.

3. Delayed transfer (3-position) switch, capable of transferring the connected load from its “normal” power source to a “neutral” (disconnected) position for a programmable period of time, then from the “neutral” position to its “standby” power source, and

capable of retransferring back to its "normal" power source with mirrored positions and delays.

4. Switch transfer control sensing shall be provided on all phases.

5. Switching mechanism shall be a discrete purpose device specifically designed for Automatic Transfer Switches.

6. Electrically operated by solenoid mechanisms and held by mechanical latches.

7. High current-breaking capacity with silver-surfaced contacts equipped with arc barriers and magnetic blow-out coils.

8. Contacts rated in accordance with UL 1008 for current carrying and switching capabilities.

9. Suitable for repetitive load transfer switching. Minimum 1,000 transfer cycles under full load conditions and minimum 2,000 cycles under no load conditions.

10. Interlocked to prevent supplying the load from more than one source at a time.

11. Adjustable close differential voltage monitoring relays provided on all three phases to sense voltage on the “NORMAL” and “STANDBY” sources.

12. Auxiliary Contacts

    a. All auxiliary contacts shall be isolated, dry, Form C, suitable for 120V, 10A inductive loads, NEMA B10 rated, wired to easily-accessible terminals in the low voltage control area.

    b. Provide, as a minimum, the following status outputs:

        i. Switch in utility power position.

        ii. Switch in generator position.

        iii. Switch fault.

13. Molded case breakers are not acceptable.

14. Intelligent display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The display panel shall be capable of providing the following functions and capabilities:

    a. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance. Line to neutral voltages shall be displayed for 4-wire systems.

    b. Display source status, to indicate source is connected or not connected.

    c. Display load data, including 3-phase AC voltage, 3-phase, frequency, kW, and kVA. Voltage and current data for all phases shall be displayed on a single screen.

    d. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:

        i. Set nominal voltage and frequency for the transfer switch.

        ii. Adjust voltage and frequency sensor operation set points.

        iii. Set up time clock functions.

        iv. Set up load sequence functions.

        v. Enable or disable control functions in the transfer switch, including program transition.

        vi. Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.

    e. Display real time clock data, including date, and time in hours, minutes, and seconds. The real time clock shall

incorporate provisions for automatic daylight saving time and leap year adjustments. The control shall also log total operating hours for the control system.

f. Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.

g. Display information for other transfer switches in the system, including transfer switch name, real time load in kW on the transfer switch, current source condition, and current operating mode.

h. Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, and network communications error.

C. OPERATION

1. When “normal” voltage falls below invalid UVTL, then

   a. The ATS starts the generator.

2. When the “standby” voltage is above valid GVTL, then

   a. After a programmable delay in the “normal” position, the switch transfers from the “normal” position to the “neutral” position.

   b. After a programmable delay in the “neutral” position, the switch transfers from the “neutral” position to the “standby” position.

3. When “normal” voltage is above valid UVTL, then

   a. After a programmable delay in the “standby” position, the switch transfers from the “standby” position to the “neutral” position.

b. After a programmable delay in the “neutral” position, the switch transfers from the “neutral” position to the “normal” position.

c. After the switch returns to the “normal” position, the transfer switch shuts off the generator after a programmable cool down delay.

4. Two separately adjustable time delays prevent transfer and retransfer on voltage dips.

5. Seven day exercise timer provides periodic exercising of generator.

   a. Timer is programmable as to day of week, time of day, and duration for exercising.

   b. Programmable as to whether generator is exercised with or without load being transferred

6. Initially preset the UVTL at:

   a. Valid >= 90 percent nominal system voltage

   b. Invalid <= 80 percent nominal system voltage

   c. Relay will pull in at the “valid” level and drop out at the “invalid” level.

7. Initially preset the GVTL at:

   a. Valid >= 90 percent nominal system voltage

   b. Invalid <= 75 percent nominal system voltage

   c. Relay will pull in at the “valid” level and drop out at the “invalid” level.

8. Initially preset the utility and generator frequency transition levels at:

   a. Valid >= 95 percent of system frequency

   b. Invalid >= 90 percent of system frequency

2.3 MANUAL TRANSFER SWITCHES

A. RATINGS

1. Phases: As shown on the Plans.

2. Poles: As shown on the Plans.

3. Voltage Rating: 600V.

4. Current Rating: As shown on the Plans.

5. Fault Current Rating: As shown on the Plans.

6. Neutral

   With neutral bus where indicated on the Plans.

7. Enclosure

   a. Mounted Inside a Closed Room

      NEMA 12 unless indicated otherwise on the Plans.

   b. Not Mounted Inside a Closed Room

      NEMA 4X stainless steel unless indicated otherwise on the Plans.

B. FEATURES

1. UL 508, UL 98 certification and in accordance with article 702 of the NEC, ANSI/NFPA 70.

2. Switches shall include pad lockable handles, lockable in the "NORMAL," "OFF," and "STANDBY" positions.

3. Switches shall include two auxiliary contacts:

   a. One contact closed when in "NORMAL" position.

   b. The other contact closed when in "STANDBY" position.

   c. Both contacts open in "OFF" position.

Both contacts shall be rated at 10 A, 250 V.

4. Capable of transferring the connected load from “NORMAL” to “OFF”, from “OFF” to “STANDBY,” from “STANDBY” to “OFF,” and from “OFF” to “NORMAL.”

5. Manual mechanical switch movement.

C. OPERATION

1. Transfers from “NORMAL” to “OFF” on manual movement of switch handle.

2. Transfers from “OFF” to “STANDBY” on manual movement of switch handle.

3. Transfers from “STANDBY” to “OFF” on manual movement of switch handle.

4. Transfers from “OFF” to “NORMAL” on manual movement of switch handle.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

Deliver transfer switch components to their final locations in protective wrappings, containers, and other means of protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is safe from such hazards. Field repair of material or equipment made defective by improper storage or site construction damage by other trades may be cause for rejection of installation.

3.2 INSTALLATION

A. Install transfer switch per the manufacturer’s installation instructions.

B. Maintain minimum workspace around unit and components per manufacturer’s installation shop drawings and NFPA 70 NEC.

3.3 IDENTIFICATION

Identify field-installed wiring, components, and provide warning signs as specified in Section 16050.

3.4 GROUNDING

Provide ground continuity to facility electrical ground system as indicated in the Contract Provisions.

3.5 FIELD QUALITY CONTROL

A. Provide a factory-authorized service representative to supervise installation and connections to the unit. Provide the inspection results of field visit and field testing in writing.

B. SUPERVISED ADJUSTING AND PRETESTING

Under supervision of a factory authorized service representative pretest all system functions, operations, and protective features. Provide all instruments and equipment required for testing. Adjust the time delays, and trip point settings to ensure operation is within accordance to the specifications.

C. FIELD TEST

Test the transfer switch after installation is complete.

1. Advise the Engineer of the test date well in advance so that the test may be witnessed if desired.

2. Perform manufacturer's standard field tests.

3. Provide documented field test results to Owner and Engineer.

4. Provide trip set points and time delays in the O&M manual.

***** END OF SECTION *****

SECTION 16420

MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes AC motor controllers rated 600 volts and less that are supplied as enclosed units within motor control centers or as individual units mounted in equipment specified under other sections. Reference the Plans for description of modifications to existing Area 07 starters.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Items
16910	PLC Hardware and Software
16050	Basic Electrical Materials and Methods
16120	Conductors and Cables
16410	Enclosed Switches, Fuses, and Circuit Breakers
16442	Motor Control Equipment
16940	Control Panels

1.3 DEFINITIONS

A. ANALOG AMMETER

A dial-type, d'Arsenval movement, analog meter measuring motor ampacity, either directly or indirectly from a current transformer connected to one of the motor leads.

B. COMPLETE COMBINATION STARTER

The terms STARTER, MOTOR STARTER, COMBINATION MOTOR STARTER, and COMBINATION STARTER are all equivalent to COMPLETE COMBINATION STARTER as described here.

A Complete Combination Starter consists of all power, control, and communication devices required to completely and safely operate a motor in HAND control. It consists of a lockable Overcurrent Protective Device (OCPD) such as a circuit breaker or a fused disconnect, a Power Module (RVSS, VFD, or Magnetic) for controlling/applying power to the motor, Motor Overload Protection (MOP) circuits, and other ancillary circuits for complete control and protection of the motor and starter power devices. It

includes an enclosure with operator interface control and monitoring devices.

C. FVNR (Full Voltage Non Reversing) STARTER

FVNR starters operate motors in only one direction. These starters instantly apply full line voltage to the motor terminals through a contactor relay.

See MAGNETIC STARTER.

D. FVR (Full Voltage Reversing) STARTER

FVR starters operate motors in both forward and reverse directions. These starters instantly apply full line voltage to the motor terminals through two separate (one forward and one reverse) contactor relays.

See MAGNETIC STARTER.

E. MAGNETIC MOTOR STARTER

Because FVNR and FVR starters use an electromagnetic contactor relay to transfer power to the motor, these devices are a part of the MAGNETIC STARTER family of motor starters.

See FVNR, FVR.

1.4 SUBMITTALS

Submit under the provisions of Section 01300.

Manufacturer's product data for motor controllers and accessories specified in this Section.

Maintenance data for tripping devices to include in the operation and maintenance manual specified in Section 16050.

Compile load current and overload relay list after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.5 QUALITY ASSURANCE

See Section 16050.

1.6 COORDINATION

Coordinate the sizing and settings of each starter's Overcurrent Protective Device (OCPD) and Motor Overload Protection (MOP) device with associated motor's nameplate data.

The Contractor shall acquire the full and complete nameplate data for each motor and document this data for insertion into the O&M Manual. This data shall be made available during FIELD TESTING AND COMMISSIONING work as described in Section 3.5.

1.7 EXTRA MATERIALS

Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

A. SPARE FUSES

1. Provide one spare control fuse of each size for every installed unit.

2. Provide three spare power fuses of each type and size.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. AVAILABLE MANUFACTURERS

Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include the following:

1. Allen-Bradley Co.; Industrial Control Group.

2. Eaton Corp.; Westinghouse & Cutler-Hammer Products.

3. General Electric Co.; Electrical Distribution & Control Div.

4. Square-D.

When motor starters are integrated into Motor Control Centers (MCCs), the starters shall be fabricated, tested, and UL labeled by the MCC manufacturer.

2.2 PRODUCT SHIPMENT AND STORAGE

A. PRODUCT SHIPMENT

Equipment shall be delivered directly to the jobsite or to the System Integrator .

B. PRODUCT STORAGE

Motor starters, whether in MCCs or stand alone, shall be packaged, covered, and protected from weather and physical damage during storage before final installation.

2.3 COMBINATION MOTOR STARTERS, GENERAL

A. ENCLOSURES

1. For Starters Internal to MCCs

For starters internal to MCCs, reference Section 16442 (Control Centers) and reference the MCC NEMA rating(s) on the Plans.

2. For Starters Not Internal to MCCs

Flush- or surface-mounted cabinets as indicated. NEMA 250, Type 12, unless otherwise indicated to meet environmental conditions at installed location.

Exceptions to 2:

- *Unless specifically stated otherwise on the Plans.*

B. COMPLIANCE

1. Standards

Motor starters shall be Underwriter's Laboratory (UL) listed and labeled, and comply with the latest applicable standards of ANSI, IEEE, and the National Electrical Code.

C. GENERAL DEVICES AND COMPONENTS

All combination motor starters shall include the following devices:

1. Overcurrent Protective Device (OCPD).

a. The OCPD shall be a NEMA AB 1, motor circuit breaker protector, magnetic only, with field-adjustable short-circuit trip-coordinated with motor locked-rotor amperes for the specific motor being powered.

b. The OCPD shall be lockable in the OPEN position and shall include an auxiliary Form A contact that is open when the OCPD is electrically tripped or manually opened.

c. The OCPD shall be lockable from the front panel, without the operator having to open the panel door.

d. The OCPD shall be sized by the motor controller manufacturer for the motor being served and shall be selectively coordinated with OCPDs upstream as per Section 16410.

2. Control Devices (reference Section 16940)

The following minimum requirements apply:

a. Provide surge protective devices across each AC and DC relay coil.

b. Provide control and timing relays per Section 16940.

c. Provide LED "push-to-test" indicating lights.

d. Provide combination electromechanical motor start counter and motor run time (elapsed time) meters per

Section 16940. Battery backed LCD displays will not be accepted.

e. Provide Phase Monitor Relays that monitor phase loss, phase imbalance, phase reversal, under-voltage, and over-voltage, with a Form A contact that is active on any of these conditions.

f. Door-Mounted Devices

Provide door-mounted devices as specifically shown on the Plans.

Door-mounted devices, such as elapsed time meters, motor start counters, indicating lights, ammeters, selector switches, reset pushbuttons, etc., shall not be replaced with electronic panel functions.

g. Devices Mounted Internal to the Enclosure

Motor starters shall include all components and devices necessary to provide the electrical control functionality shown on the Motor Starter Elementary Wiring Diagrams on the Plans.

Electromechanical relays and timers shall not be replaced with electronic logic functions.

Exceptions to 2:

- *Unless shown otherwise on the Plans.*

3. Control Circuit Requirements

a. Control functions shall match those shown on the Motor Starter Elementary Diagrams including manual requirements by the operators.

Provide additional circuits and devices as required by the starter manufacturer for power circuit isolation; however, these additions shall not change the features or functionality of the intended design.

b. Provide additional fusing or device protection as required to protect the drive's electronic power and control circuits and to comply with UL requirements.

c. Motor starters shall be provided with independent fused "control power" circuits. A fault in one motor control circuit shall only disable that associated motor.

i. Motor starter control circuits shall be 120 volts AC.

ii. If motor power is derived from voltage configurations that directly provide 120 volts AC line-to-neutral (240/120 volts AC or 208/120 volts AC systems), then each control circuit shall be provided with an individual fuse protective device at 120 volts AC.

NOTE:
Motor starters operating from a 240/120 Vac, 3-phase power source shall be provided with an internal label as shown here:

CAUTION: B PHASE HAS 208 VOLTS TO GROUND

Motor starters operating from a 240/120 Vac, 3-phase power source shall not have their motor starter control power be derived from Phase B and neutral.

iii. If motor power is derived from 480 Vac, then each control circuit shall be provided with an independent control transformer with a 120-volt AC fused secondary. The fuse shall be factory mounted to the top of the transformer.

iv. Motor starter control circuits may include remote panel heaters, motorized dampers, blower enclosure cooling fans, or other small power devices. Size the control transformers and fuses to handle all connected loads shown on the Plans plus an additional 25 percent.

2.4 MAGNETIC MOTOR STARTERS

NEMA ICS 2, Class A, full voltage, reversing or non-reversing (FVR or FVNR respectively), across the line.

Reference section COMBINATION MOTOR STARTERS, GENERAL

A. THE POWER CIRCUIT

1. Overcurrent Protective Device (OCPD).

   Reference GENERAL DEVICES AND COMPONENTS, Section 2.3C.

2. Magnetic Contactor.

   The magnetic contactor shall be NEMA rated, Size 1 minimum. IEC contactors will not be permitted.

3. Motor Overload Protection (MOP).

   a. Bimetallic Overload Protection

      Three overload elements of melting alloy or bimetal type selected to provide Class 10 protection for the actual motor furnished. Units are manual reset type with an external reset mechanism provided in the starter enclosure front and a minimum of one NO and one NC isolated dry contact rated at 1.5 amps at 240 volts AC minimum.

Exceptions to A:

- *Unless specifically shown otherwise on the Plans or unless specifically approved by the Engineer.*

B. THE CONTROL CIRCUIT

Reference GENERAL DEVICES AND COMPONENTS, Section 2.3C.

2.5 EXTRA MATERIALS

Reference Specification 16050 for spare parts.

PART 3 EXECUTION

3.1 APPLICATION

Apply motor starters as described on the Plans.

3.2 INSTALLATION

Install independently mounted motor control devices according to manufacturer's written instructions and the NEC.

A. IDENTIFICATION

Identify motor control components and control wiring according to Section 16050.

B. LOCATION AND MOUNTING

Locate controllers as shown on the Plans. Provide the mounting methods for each separate starter enclosure as shown on the Plans. Reference Section 16050.

3.3 WIRING INSTALLATION

A. Install wiring between motor control devices according to Section 16120.

B. Bundle, train, and support wiring in enclosures.

C. Make all control wiring connections to provide a complete and operational system. Provide additional terminals, wire guides, and gutters as required for a safe and protected system.

3.4 CONNECTIONS

Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals including screws and bolts according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD TESTING AND COMMISSIONING

A. GENERAL TESTING REQUIREMENTS

1. Testing procedures described herein shall apply to all starters associated with the project.

2. Complete testing of motor starters shall be provided and shall include:

   a. The services of a qualified independent testing agency to perform breaker testing as described below.

3. Motor starter tests shall also be coordinated with the following representatives:

   a. The System Integrator,

   b. The motor/pump Manufacturer,

   c. The Engineer,

   d. The Owner.

B. TESTING PROCEDURES BEFORE MAKING ELECTRICAL CONNECTIONS TO THE STARTER

1. Megger the motor leads per Specification 16120.

2. If the starter is powered from a separate feeder, then megger the feeder per Section 16120.

3. For molded case circuit breakers 100 amps and larger, provide independent testing agency to perform circuit breaker tests as stated in NETA ATS, Section 7.6. Certify compliance with test parameters. Provide the Engineer a copy of the test results signed by testing agency.

4. Perform visual and mechanical inspection of enclosure and devices. Remove and replace damaged units with new.

5. Connect power, control, instrumentation, and communication conductors to the motor starter. Verify the integrity of all connections.

6. Remove any burrs, filings, or other foreign materials from enclosure.

7. Completely wipe down and vacuum enclosure.

8. Check connections and device mounting for proper torque.

9. Check alignment of plug-in devices with stationary parts.

10. Check operating mechanisms for binding, lubrication, etc.

11. Verify that all pilot lights are LED type. Replace if not.

12. Verify that analog meters are scaled roughly two times the motor's FLA.

13. Test the validity of the control, instrumentation, and communication circuits.

14. Test all breakers for proper physical movement and door interlocking. Repair or replace as required.

15. Set the motor protection values for the specific motors being controlled.

C. AFTER ENERGIZATION

1. Verify motor rotation and direction. Coordinate this work with the pump/motor manufacturer.

2. Test the starter protection circuits.

3. Test the starter RESET control.

4. Test the starter for proper operation and functionality per design. Verify manual and automatic speed controls and transfers.

5. Test the starter network communications and functionality with associated PLC or network controller. Coordinate this work with the System Integrator.

6. Test all starter digital and analog I/O connectivity, functionality, and scaling with the PLC, whether hardwired or networked. Coordinate this work with the System Integrator.

7. Correct malfunctioning units on site where possible and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

D. ADJUSTMENTS AND STARTER PERFORMANCE

1. Make all necessary adjustments and calibrations as required to provide acceptable motor starting and operational performance. Set motor protection circuits against the motor nameplate data.

2. Make the final OCPD breaker trip setting for the motor circuit being protected.

3.6 DEMONSTRATION

A. DEMONSTRATION OF FULLY FUNCTIONAL MOTOR CONTROLLERS

1. Provide all testing required to demonstrate complete functionality for all motor/motor starter systems including speed control, speed notching, manual and auto control, motor acceleration and deceleration, upper and lower speed limits (in manual and auto modes), and motor protection.

2. Provide all testing required to demonstrate complete functionality for all motor/motor starter systems including manual and auto control and motor protection.

3. Cycle power to each starter while their motors are running. Provide a minimum of two cycle tests per motor/starter.

B. TRAINING

1. Provide basic starter operation training immediately following commissioning.

2. Provide a minimum of 4 hours of training 30 to 90 days after commissioning (time defined by Owner). The training shall demonstrate starter controller operation and troubleshooting to the Owner's operators and maintenance personnel as specified in

Section 01770. Include training related to equipment operation and maintenance procedures.

3. Schedule training with at least 7 days' advance notice.

3.7 CLEANING

Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

***** END OF SECTION *****

SECTION 16440

PANELBOARDS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of lighting, power, and distribution panelboards, and associated auxiliary equipment rated 600 V and less.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
16050	Basic Electrical Materials and Methods
16060	Grounding and Bonding

1.3 SUBMITTALS

Submit under the provisions of Section 01300.

A. PRODUCT DATA

For each type of panelboard, accessory item, and component specified.

B. SHOP DRAWINGS

For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type and mounting.

2. Bus configuration and current ratings.

3. Short-circuit current rating of panelboard.

4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

C. PANELBOARD SCHEDULES

For installation in panelboards and inclusion in the maintenance manuals specified in Division 1. Submit final versions prior to closeout of project.

D. MAINTENANCE DATA

For panelboard components to include in the maintenance manuals specified in Division 1. Include manufacturer's written instructions for testing circuit breakers.

1.4 QUALITY ASSURANCE

See Section 16050.

Subject to compliance with requirements, provide products by the following:

A. REFERENCED STANDARDS

1. National Electrical Manufacturers Association (NEMA):

   a. NEMA 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

   b. NEMA PB 1, Panelboards.

2. National Fire Protection Association (NFPA):

   a. 70, National Electrical Code (NEC).

3. Underwriters Laboratories, Inc. (UL):

   a. 50, Standard for Safety Cabinets and Boxes.

   b. 67, Standard for Safety Panelboards.

1.5 EXTRA MATERIALS

A. SPARES

Provide three spares of each type of key for panelboard cabinet lock.

B. UNUSED CIRCUITS

Unless specifically noted otherwise on the Plans, provide a 20 A trip, 1 pole, breaker matching the specifications as defined herein for each uncommitted circuit in the panelboard.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. MANUFACTURERS

Subject to compliance with requirements, provide products by the following:

1. General Electric Co.; Electrical Distribution & Control Div.

2. Eaton, Cutler-Hammer.

3. Square D Co.

2.2 PANELBOARD FABRICATION

A. MANUFACTURED UNITS

Standards: NEMA PB 1, NFPA 70, UL 50, UL 67.

B. RATINGS

1. Bus current, voltage, number of phases, and number of wires as shown on the Plans.

2. Short Circuit Fault Rating

a. 250 Vac or Less

10 kAIC minimum short circuit rating or as indicated on the Plans, whichever is the greater.

b. 600 Vac or Less

14 kAIC minimum short circuit rating or as indicated on the Plans, whichever is the greater.

3. Service Entry Equipment rated when indicated on the Plans.

C. BUS BARS

1. Main Bus Bars

a. Plated drawn copper of 98 percent conductivity sized to limit temperature rise to a maximum of 65 degrees C above an ambient temperature of 40 degrees C.

b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.

2. Ground Bus

a. Ground bus shall be full size (100 percent) rated unless shown otherwise on the Plans.

b. Ground bus shall be bonded to the box.

c. Provide additional isolated ground bus when indicated on the Plans.

d. Compression type connectors.

3. Neutral Bus Bars

a. Insulated, full size (100 percent) rated unless shown otherwise on the Plans.

b. Compression type connectors.

D. CONSTRUCTION

1. Interiors shall be factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent unit and without removing the main bus connectors.

2. Multi-Section Panelboards

Feed-through or sub-feed lugs.

3. Main Lugs

Compression type approved for copper and aluminum.

E. ENCLOSURES

1. Boxes

Code gauge galvanized steel, furnished without knockouts.

2. Trim Assembly

Code gauge galvanized steel, finished with rust-inhibited primer and manufacturer's standard paint inside and out.

3. Panelboard Mounted Integral to MCC

a. Trims supplied with hinged door over all circuit breaker handles.

b. Doors on panelboard front, with concealed hinges, secured with corrosion resistant chrome-plated flush catch and tumbler lock, all keyed alike.

c. Nominal 20-inch wide by 5-3/4-inch deep with gutter space in accordance with NEC.

d. Clear plastic cover for directory card on the inside of each door.

e. Rated NEMA 1.

4. Distribution, Lighting and Appliance Panelboard

a. Trims supplied with hinged door over all circuit breaker handles.

b. Trims for surface mounted panelboards shall be the same size as the box.

c. Trims for flush mounted panelboards shall overlap the box by 3/4 inch on all sides.

d. Doors on panelboard front, with concealed hinges, secured with corrosion resistant chrome-plated flush catch and tumbler lock, all keyed alike.

e. Nominal 20-inch wide by 5-3/4-inch deep with gutter space in accordance with NEC.

f. Clear plastic cover for directory card on the inside of each door.

g. Enclosure

NEMA 1 unless stated otherwise on the Plans.

5. Power Distribution Panelboard

a. Trims cover all live parts with switching device handles accessible.

b. Less than or equal to 12-inches deep with gutter space in accordance with NEC.

c. Doors on panelboard front, with concealed hinges, secured with corrosion resistant chrome-plated flush catch and tumbler lock, all keyed alike.

d. Clear plastic cover for directory card on the inside of each door.

e. Enclosure

NEMA 1 unless stated otherwise on the Plans.

F. SERVICE EQUIPMENT APPROVAL

Listed for use as service equipment for panelboards with main service disconnect.

1. Future Devices

Equip with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices.

G. SPECIAL FEATURES

Include the following features for panelboards:

1. Skirt for Surface-Mounted Panelboards

   Same gage and finish as panelboard front, removable, with flanges for attachment to panelboard, wall, and floor.

2.3 OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES

A. MAIN OVERCURRENT PROTECTIVE DEVICE

1. Molded-Case Circuit Breaker, NEMA AB 1, handle lockable.

2. Vertical mounting unless stated otherwise in the Plans.

B. BRANCH OVERCURRENT PROTECTIVE DEVICES

1. Shall be bolt-on molded case circuit breakers

2. The minimum breaker size shall be 15 Amp unless stated otherwise on the Plans.

3. Characteristics

   a. Frame size, trip rating, number of poles, and auxiliary devices as indicated on the Plans.

   b. Fault current rating as defined herein and as indicated on the Plans.

4. Application Listing

   Appropriate for application, including Type SWD for switching fluorescent lighting loads and Type HACR for heating, air-conditioning, and refrigerating equipment.

5. Circuit Breakers, 200 A and Larger

   Trip units shall be interchangeable within frame size.

6. Circuit Breakers, 400 A and Larger

Field-adjustable short-time and continuous current settings.

7. Circuit breakers, under 200 A

Thermal-magnetic, trip-free, non-interchangeable, non-adjustable.

8. Lugs

Mechanical lugs and power-distribution connectors for copper conductors of number and size indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Install panelboards and accessory items according to NEMA PB 1.1.

Setup, adjust and fasten in place flush trim and interiors.

Install circuit breakers as shown on the "Panelboard Schedule" for each panelboard. Record all circuit breaker installation deviations from the "Panelboard Schedule" and show on the Record Drawings the actual size and pole position of all circuit breakers installed.

Do not remove knockouts for breaker positions unless a breaker is to be installed (reference EXTRA MATERIALS, UNUSED CIRCUITS in this Section). Where twistouts or knockouts are removed in error, provide a circuit breaker (one pole, 20-ampere) to fill each position removed.

A. MOUNTING HEIGHTS

Top of trim 74 inches above finished floor, unless otherwise indicated.

B. MOUNTING

Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish. Provide spacers of neoprene or fiberglass to shim out from irregular surfaces or from damp surfaces.

C. CIRCUIT DIRECTORY

Prepare neatly typewritten panelboards directories in the same pole sequence as the panelboard stamping. Send a copy to the Owner for his records. Prior to typing the final directories, verify room and equipment names and numbers with the Owner and modify circuit descriptions of areas/spaces to conform with the Owner's desires. Obtain approval before installing.

D. PROVISION FOR FUTURE CIRCUITS

Install panelboards in such a manner as to leave access to the box, building chases, knockouts, etc., for future circuit additions. Place conduit in the rear line of knockouts where possible. Install spare conduits from flush-mounted panels up to accessible spaces.

E. WIRING IN PANELBOARD GUTTERS

Run neatly parallel and perpendicular to enclosure. Arrange conductors into groups, and bundle and wrap with wire ties.

3.2 IDENTIFICATION

Identify field-installed wiring and components and provide warning signs as specified in Section 16050.

Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.

3.3 GROUNDING

Connect equipment grounding conductors to ground bus, except for circuits requiring isolated grounding.

Provide ground continuity to main electrical ground bus as indicated.

3.4 CONNECTIONS

Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuits.

2. Make continuity tests of each circuit.

B. TESTING AGENCY

Provide services of a qualified independent testing agency to perform specified testing.

C. TESTING

1. Prior to Energization

Perform visual and mechanical inspection of panelboard, bus, and breakers.

Check connections and mounting for proper torque.

For molded case circuit breakers 100 Amps and larger, provide independent testing agency to perform circuit breaker tests as stated in NETA ATS, Section 7.6. Certify compliance with test parameters.

Provide to the Engineer separate copies of test results signed by testing agency. Include the manufacturer's circuit breaker curve for each breaker tested.

Correct or replace malfunctioning units and retest.

Remove any burrs, filings, or other foreign materials. Completely wipe down and vacuum panelboard.

2. After Energization

After electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

Correct malfunctioning units on site where possible and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.6 ADJUSTING

Set field-adjustable switches and circuit-breaker trip ranges as indicated.

***** END OF SECTION *****

SECTION 16442

MOTOR CONTROL EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of motor control equipment rated 600 V and less.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
03300	Cast-in-Place Concrete
16910	PLC Hardware and Software
16050	Basic Electrical Materials and Methods
16420	Motor Controllers
16940	Control Panels

1.3 SUBMITTALS

A. PRODUCT DATA

For each type of motor control center, accessory item, and component specified.

B. SHOP DRAWINGS

Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type, wiring type.

2. Bus configuration, voltage and current ratings for horizontal bus and each separate vertical bus.

3. Short-circuit current ratings.

4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

5. Elevation drawing with dimensions.

6. Identification of units and their location in the MCC.

7. Bill of Materials for each control unit.

8. Wiring diagrams for power distribution circuits.

9. Elementary wiring diagrams for each motor starter including wire numbers, terminal connectivity to contactors, relays, and drive modules. Clearly show field wiring termination points and numbering.

10. Nameplate schedules.

C. FIELD TEST REPORTS

Indicate and interpret test results for compliance with performance requirements.

D. MAINTENANCE DATA

For components to include in the maintenance manuals specified in Division 1.

E. LOAD-CURRENT AND OVERLOAD-RELAY HEATER LIST

Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

See Section 16050. Motor control centers must be factory assembled and wired as completed units by the manufacturer, except where shipping splits are required for shipping of the units. This requirement pertains to control wiring, PLC wiring, and similar wiring within the centers and/or to the "MCC side" of terminal blocks or terminal strips within the centers. Use of a third party to assembly and/or wire is not permitted.

A. SOURCE LIMITATIONS

Obtain similar motor-control devices through one source from a single manufacturer.

B. PRODUCT SELECTION FOR RESTRICTED SPACE

Plans indicate maximum dimensions for motor-control centers, including clearances between motor-control centers and adjacent surfaces and items, and are based on types and models indicated. Other manufacturers' motor-control centers with equal performance characteristics and complying with indicated maximum dimensions may be considered. Refer to Division 1 Section "Substitutions."

1.5 DELIVERY, STORAGE, AND HANDLING

Protect motor control center during construction from moisture, dust, abrasion, or other damage or disfigurement, using plastic sheeting, kraft paper, space heaters, or other appropriate means. Field repair of material or equipment made defective by improper storage is not acceptable.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. MANUFACTURERS

Subject to compliance with requirements, provide products by the following:

1. Allen-Bradley
2. General Electric Co.; Electrical Distribution & Control Div.
3. Eaton; Cutler Hammer
4. Square D Co.

2.2 MOTOR CONTROL CENTER FABRICATION

A. RATINGS

1. 600 V class, 3-phase, 60 hertz with operating voltage and number of wires as indicated on the Plans.
2. Bus bracing short circuit fault current rating: as indicated on the Plans.

B. ENCLOSURES

1. Free-standing, totally enclosed, metal-clad structure.

2. Sections nominally 20 inches wide by 20 inches deep by 90 inches high, bolted together to form a continuous assembly.

3. Suitable for mounting against a wall or back-to-back with other electrical units and not requiring rear or side access.

4. Designed to easily extend at either end with similar vertical structures.

5. Provide channel sills where indicated.

6. Enclosure

   NEMA 250, Type as indicated on the Plans.

C. WIRING

NEMA ICS 3, Class II, Type B.

1. Class C stranded, single copper conductor; No. 14 AWG minimum size for control wiring, No. 12 AWG minimum size for power wiring.

2. 600 volt rated MTW thermoplastic insulation. Insulation color as follows:

   a. Red for control circuits internally energized

   b. Yellow for control circuits externally energized

   c. Black for power wiring

   d. White for all grounded conductors

   e. Blue for dc conductors.

D. WIREWAYS

Continuous both vertically and horizontally.

1. Accessible from the front of the center.

2. Completely isolated from bus compartments and adjacent sections.

3. Vertical wireways adjacent to the slide-in units in each section, but accessible through a separate hinged door running the full height of each section between horizontal wireways.

4. Horizontal wireways at both top and bottom, each intersecting the vertical wireways of every section.

E. BUSING

1. Material

Tin plated copper.

2. Main Horizontal Bus

a. Ampacity

600 amperes RMS tin plated copper unless otherwise indicated on the Plans.

b. The main horizontal bus shall be at the top or the center, continuous without splices, except where shipping splits are required. Provide splice bars and hardware for shipping splits. Access to the horizontal bus is by removable barriers.

c. Extend the main horizontal bus the full length of the MCC with provisions for splicing additional sections to either end.

d. Lug connections to the bus are bolted.

3. Vertical Buses

a. Ampacity

Sized for maximum load on vertical section. 300 amperes RMS tin plated copper minimum.

b. Securely bolted to the main horizontal bus with connections easily accessible for maintenance.

c. Completely isolated and insulated by means of a barrier.

d. Continuous from the top of the section to the lowest unit opening possible in the section.

e. Lug connections to the bus are bolted.

4. Ground Bus

a. Ampacity

Tin plated copper, 50 percent of the RMS ampacity of the main horizontal bus. 300 amperes RMS minimum.

b. Extend the full length of the MCC with provisions for splicing additional sections to either end.

c. Copper ground bus at the bottom of the center, mechanically and electrically connected to each vertical structure.

d. Provide ground lug connections.

e. Lug connections to the bus are bolted.

5. Bracing

a. Short circuit fault current rating: as indicated on the Plans.

b. Bracing designed to avoid accumulation of dirt, lint, etc., on supports between phases.

c. Supports are moisture-resistant, non-carbonizing and non-tracking.

d. Bracing designed to avoid accumulation of dirt, lint, etc. on supports between phases.

6. Barriers

Insulated horizontal and vertical bus barriers and a barrier cover below the vertical bus to protect the ends of the bus from contact with items entering the bottom of the enclosure.

F. SECTION UNITS FOR MOTOR CONTROL

1. Units consist of protective/disconnect devices, magnetic starters, control power transformers, control units, pilot lights, relays, terminal blocks and associated wiring mounted on a metal slide-in structure of a modular size.

2. Units of equal rating are interchangeable within the center structure and from center to center.

3. Unit components do not protrude into or restrict wireways.

4. Unit barriers isolate each unit from adjacent units, vertical bus and horizontal bus.

5. Pushbuttons, selector switches, and pilot lights are mounted on the draw-out compartment; but they are visible and operable externally through gasketed, die-cut openings in the unit door. Provide an external reset mechanism for overload relays on the unit door.

6. Plug-in contacts for bus connection of the units are silver plated, free-floating but captive in an insulating block and easily replaceable. The unit plug-in arrangement is completely self-aligning and fail-safe against accidental short or ground. Each plug-in control unit is retained in the structure.

7. Short-circuit protective devices in combination starters and branch circuit protective devices have an external operator. This operator is interlocked with the door so that the circuit must be de-energized before the door can be opened and the device cannot be closed with the door open. A semi-concealed interlock defeat mechanism is provided.

8. The lugs compartment does not interfere with routing of control or power wiring nor interrupt the vertical wireway in the vertical section where it is installed.

9. Locate units as indicated on Plans. Do not revise locations, layout, or number of sections of center from that shown on Plans.

G. IDENTIFICATION

1. Provide a main nameplate for each center, 2" x 10" minimum size with 1/2-inch engraved letters. Nameplate is Lamacoid or equal plastic laminate or engraved metal plate. Lettering is white; backgrounds are black. No abbreviations are permitted unless approved by the Owner. Engraving is subject to the Owner's approval.

2. Lugs [Main Breaker] compartment is identified by a 1" x 4" nameplate engraved "MAIN LUGS [BREAKER] COMPARTMENT."

3. Each unit door and each slide-in unit shall has a permanently attached, engraved nameplate: 3/8 of an inch letter unless otherwise shown.

4. Provide legend plates for all cover-mounted control devices, including pilot lights, selector switches and pushbuttons. Engraving is subject to the Owner's approval.

5. Provide nameplates for all relays, timers, transformers, fuses, terminal blocks, and switches mounted internally to the unit. Nameplates are Lamacoid sized to the scale of device to which they refer. Engrave as indicated for the device on the elementary wiring diagrams.

6. Identify conductors at each termination by yellow sleeve wire markers of the heat-shrink or stretch-on type with indelible black letters and numbers at each termination or splice.

   a. The manufacturer's standard internal wiring may be numbered per NEMA or manufacturer's standard.

H. FINISH

Ferrous parts are cleaned, rustproofed and finished with light gray baked enamel. Manufacturer's standard gray colors or accents are acceptable.

2.3 PROTECTIVE AND CONTROL DEVICES

A. CIRCUIT BREAKERS MEET NEMA STANDARD AB-1

1. Main breakers: molded case units with solid-state long- and short-time trip circuits individually and separately adjustable for both time and pickup. Four wire systems have ground trip units. Provide two normally open individual dry auxiliary contacts, rated 10 A at 250 Vac, that open when the breaker is tripped or manually opened; closed when the breaker is closed.

2. Feeder breakers: molded case breakers with thermal magnetic trip, adjustable for magnetic pickup. Provide two normally open individual dry auxiliary contacts, rated 10 A at 250 Vac, that open when the breaker is tripped or manually opened; closed when the breaker is closed.

3. Motor circuit breakers: magnetic only trip with adjustable trip setting. Provide two normally open individual dry auxiliary contacts, rated 10 A at 250 Vac, that open when the breaker is tripped or manually opened; closed when the breaker is closed.

4. Branch circuit breakers: molded case, thermal-magnetic trip, trip-free with non-interchangeable, non-adjustable trip unless otherwise noted.

5. Breakers meet the integrated equipment rating required for the available short circuit current at the equipment in which they are used.

6. All breakers provided in MCC shall be coordinated with respect to their trip points by the MCC manufacturer.

B. MOTOR STARTERS MEET NEMA STANDARD ICS

1. Motor starters shall not include intrinsically safe areas or circuits. Intrinsically safe areas shall be located in electrical enclosures other than the MCC.

   Where a field device directly associated with the starter requires an intrinsically safe interface, provide the power to the intrinsically safe circuit from the starter. In this manner, if power is lost to the control panel but the starter is still operable, then the field device and its associated intrinsic interface shall also remain operable.

2. Complete with three overload units of the melting alloy or bimetal type. The overload units are manual reset type.

3. Starter sizes as stated by NEMA, no half or third sizes or IEC devices or ratings are allowed. Minimum size NEMA 1.

4. 600 volt rated, three-pole with 120 Vac control power and 120 Vac coils.

5. Provide three normally open/normally closed (Form C) dry auxiliary contact sets, rated 10 A at 250 Vac, on each starter as a minimum.

   a. Provide a means of mounting up to two additional auxiliary contact sets on each starter.

   b. Provide additional auxiliary contact sets as required or indicated for specified functionality and interface with control systems.

C. MISCELLANEOUS PROTECTION AND CONTROL DEVICES

1. Fuses

   Power fuses, Class RK-5 silver element. Control fuses, Busman FNQ or equal.

2. Power Monitor Metering

   Reference Section 16940, Control Panels.

3. Surge Protection

   The main bus of the MCC shall be protected with a Surge Protective Device (SPD). Reference Section 16280.

4. Pilot Devices: Reference Section 16940.

5. Control Relays: Reference Section 16940.

6. Time Delay Relays: Reference Section 16940.

7. Intrinsically Safe Relays: Reference Section 16940.

8. Interval Timers: Reference Section 16940.

9. Running Time Meters

   Eagle Signal six digit non-reset or equal.

10. Ammeters

    Sized for approximately two times the Full Load motor Amps (FLA), ±2 percent accuracy, 3-1/2 to 4 inch size, GE "Big Look" or equal, Simpson, Weston, or Crompton.

11. Current Transformers

    One percent accuracy at burden and lead length as installed. G.E., Midwest, or Westinghouse.

12. Current Monitor

    Loop powered 4-20 mA solid core current transducer for currents up to 200 A. Hawkeye H721 Series or equal.

2.4 OTHER MOTOR CONTROL CENTER MOUNTED EQUIPMENT

Sections may contain units, equipment or devices other than motor starters such as transformers, panelboards, power factor correction capacitors, metering equipment, programmable logic controllers, or similar devices or equipment. These items are standard products of the same manufacturer as the center and meet the requirements of the specification sections for those items.

Units, equipment, and devices are factory mounted in the center. Locate units, equipment and devices as indicated on Plans. Do not revise locations or layout of center from that shown on Plans.

PART 3 EXECUTION

3.1 INSTALLATION

Install motor control centers and accessory items according to NEMA ICS.

A. MOUNTING

1. Level, plumb and rigid without distortion of enclosure.

2. Install on floor or pad level within ±1/8 of an inch in a square yard.

3. Shim with stainless steel shims where necessary.

4. Bolt units to the floor with 3/8 of an inch stainless steel expansion anchors and bolts or weld to embedded steel channels.

5. Grout or caulk enclosure to floor or pad.

B. CONDUIT CONNECTIONS

1. Provide bushings on conduits entering from above or at the sides.

2. Provide grounded insulating bushings bonded to the ground bus or pad on conduits entering from below.

C. WIRING IN WIREWAYS

Arrange conductors into groups, and bundle and wrap with wire ties.

D. Prior to energization, remove bracing, packing materials, tape on movable parts, etc. as necessary. Check for damage to enclosure, cracked porcelain, chipped bushings, etc.

3.2 IDENTIFICATION

Identify field-installed wiring and components and provide warning signs as specified in Section 16050.

3.3 GROUNDING

Connect equipment grounding conductors to ground bus, except for circuits requiring isolated grounding.

Provide ground continuity to facility electrical ground system as indicated.

3.4 CONNECTIONS

Clean splice plates with Stoddard's Solvent before assembling.

Assemble all shipping splits.

Tighten bus splices, electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

Check factory connections for proper torque.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. The manufacturer shall make insulation-resistance tests of each motor control center bus, component, and connecting supply, feeder, and control circuits.

2. The manufacturer shall make continuity tests of each circuit.

B. TESTING AGENCY

Provide the services of a qualified independent testing agency to perform specified field quality-control testing.

C. TESTING

1. Prior to Energization

After installing disconnect switches and circuit breakers, perform visual and mechanical inspection of enclosure and devices.

Check connections and mounting for proper torque.

For molded case circuit breakers 100 Amps and larger, provide independent testing agency to perform switch tests as stated in NETA ATS, Section 7.5 and circuit breaker tests as stated in NETA ATS, Section 7.6. Certify compliance with test parameters. Provide the Engineer a copy of the test results signed by testing agency.

Correct or replace malfunctioning units and retest.

Remove any burrs, filings, or other foreign materials from enclosure. Completely wipe down and vacuum enclosure.

2. After Energization

After electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

Correct malfunctioning units on site where possible and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.6 ADJUSTING

Tighten all structural connections, barriers, racking mechanisms, etc.

Check alignment of plug-in devices with stationary parts.

Check operating mechanisms for binding, lubrication, etc.

Set field-adjustable switches and circuit-breaker trip ranges as indicated.

Check continuity and phase uniformity from unit to unit and for all control or metering circuits.

3.7 CLEANING

Vacuum equipment clean after installation; remove metal cuttings with a magnet or suitable means before assembling equipment; wipe insulating supports, bushings, etc., with a clean lint-free cloth; clean debris, shavings, etc., from breakers, bus, switches, relays, and similar components before startup.

***** END OF SECTION *****

SECTION 16460

LOW VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of dry-type distribution and specialty transformers rated 1000 V and less.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
16050	Basic Electrical Materials and Methods

1.3 SUBMITTALS

Submit under the provisions of Section 01300.

A. PRODUCT DATA

Submit the following:

1. Nameplate ratings
2. Mounting methods
3. Dimensioned plans, sections, elevation views and minimum clearances

B. WIRING DIAGRAMS

Submit manufacturer's wiring diagrams and clearly identify terminals for tap changing and connecting field-installed wiring.

C. FIELD TEST REPORTS

Indicate and interpret test results for tests specified in Part 3.

D. MAINTENANCE DATA

Include in the maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

See Section 16050

1.5 DELIVERY, STORAGE, AND HANDLING

Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Subject to compliance with requirements, provide transformers by one the following:

A. Cutler-Hammer/Eaton Corp.

B. GE Electrical Distribution & Control.

C. Siemens Energy & Automation, Inc.

D. Square D; Groupe Schneider.

2.2 TRANSFORMERS, GENERAL

A. DESCRIPTION

Factory-assembled and -tested, air-cooled units of types and sizes specified, designed for 60-Hz service.

B. CORES

Grain-oriented, nonaging silicon steel.

C. COILS

Continuous copper windings without splices, except for taps.

D. INTERNAL COIL CONNECTIONS

Brazed or pressure type.

E. ENCLOSURE

Class complies with NEMA 250 for the environment in which installed.

F. SOUND LEVELS

Manufacturer shall guarantee not to exceed the following:

1. Up to 9 kVA: 40 dB.

2. 10 to 50 kVA: 45 dB.

G. EFFICIENCY

Ventilated, 15 kVA and larger: Energy efficient meeting NEMA TP-1 requirements.

2.3 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

Comply with NEMA ST 20 and list and label as complying with UL 1561.

A. CORES

One leg per phase.

B. WINDINGS

One coil per phase in primary and secondary.

C. ENCLOSURE

As follows unless otherwise indicated.

1. Indoor, ventilated.

D. INSULATION CLASS

185 or 220 degrees C class for transformers 15 kVA or smaller;
220 degrees C class for transformers larger than 15 kVA.

1. Rated Temperature Rise

150 degrees C maximum rise above 40 degrees C for 220 degrees C class insulation; 115 degrees C maximum rise for 185 degrees C class insulation.

E. TAPS

For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:

1. Taps, 3 through 25 kVA

Two 5-percent taps below rated high voltage.

2. Taps, 25 through 500 kVA

Six 2.5-percent taps, 2 above and 4 below rated high voltage.

F. WALL-MOUNTING BRACKETS

Manufacturer's standard brackets for wall mounted transformers up to 75 kVA.

2.4 CONTROL AND SIGNAL TRANSFORMERS

A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506.

B. RATINGS

Continuous duty. If rating is not indicated, provide capacity exceeding peak load by 50 percent minimum.

C. DESCRIPTION

Self-cooled, 2 windings.

2.5 FINISHES

A. INDOOR UNITS

Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

B. OUTDOOR UNITS

Comply with ANSI C57.12.28.

2.6 SOURCE QUALITY CONTROL

Design and routine factory tests comply with referenced standards.

PART 3 EXECUTION

3.1 INSTALLATION

Comply with safety requirements of IEEE C2.

Arrange equipment to provide adequate spacing for access and for circulation of cooling air.

Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.2 GROUNDING

Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer.

Comply with Division 16 Section "Grounding and Bonding" for materials and installation requirements.

3.3 FIELD QUALITY CONTROL

Test to ensure transformer is operational within industry and manufacturer's tolerances, is installed according to the Contract Documents, and is suitable for energizing.

A. REPORT

Submit a written report of observations and tests. Report defective materials and installation.

B. TESTS

Include the following minimum inspections and tests according to manufacturer's written instructions.

1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.

2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.

3. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.

C. TEST FAILURES

Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

3.4 CLEANING

On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5 ADJUSTING

After installing and cleaning, touch up scratches and mars on finish to match original finish.

Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.

***** END OF SECTION *****

SECTION 16910

PROGRAMMABLE LOGIC CONTROLLER (PLC) HARDWARE AND SOFTWARE

PART 1 GENERAL

1.1 SCOPE

The work provided in this Section Includes Programmable Logic Controller (PLC) hardware and development software procurement.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
13451	PLC Programming - Process Control Description
16050	Basic Electrical Materials and Methods

1.3 REFERENCES

Reference	Title
NEMA	National Electrical Manufacturers Association
ICS-1	General Standards for Industrial Control and Systems
ICS-1.1	Safety Guidelines for the Application, Installation and Maintenance of Solid State Control
ICS-4	Terminal Blocks for Industrial Use
ICS-6	Enclosures for Industrial Controls and Systems
Publication NO 250	Enclosures for Electrical Equipment (1000 V maximum)
NFPA	National Fire Protection Association
NEC	National Electric Code

1.4 SYSTEM DESCRIPTION

A. DESIGN REQUIREMENTS

1. The system includes racks, central processing units (CPUs), input/output (I/O) modules, communication modules, power supplies, and associated accessory items to provide a complete and functional process control system for the facility.

2. The system includes development and application software which run on the PLC hardware to provide a complete and functional process control system for the facility.

3. Reference Section 13451 for PLC Programming and Process Control Description.

B. PERFORMANCE REQUIREMENTS

The installed system performs the functional and operational algorithms required for control of the process.

1.5 DEFINITIONS

B. ANALOG I/O

Analog I/O are PLC input/output electronic signals that are contiguous over time. Analog signals represent a large number of values within a specific range.

C. DIGITAL I/O

A single digital binary bit with one of a possible two states which may be represented as 1's or 0's, ON or OFF, YES or NO, TRUE or FALSE, etc. Digital I/O may also be called "discrete" I/O. Within this specification, both terms are synonymous.

D. HIM

Human Interface Module – A programmable operator interface directly associated with, or integral to, an electrical control device (such as a VFD or Soft Start drive). This interface displays device setpoints and status with a keypad for data entry.

E. I/O

Inputs/Outputs – Input and output signals into and out of a PLC or RTU.

F. OIU

Operator Interface Unit – A graphical display of industrial plant system variables and status. It may also allow for process control. Navigation of its programming may be via keypad, touch screen, or a combination of both. An OIU is typically located on a field control panel or control panel in an electrical equipment room.

G. PLC

Programmable Logic Controller – A device used to monitor and control system process. It can be used stand-alone or in conjunction with other systems such as SCADA. It may provide telemetric functions or interface with telemetric equipment.

H. RTU

Remote Telemetry Unit/Remote Terminal Unit – A device that reads the status of process devices and transmits them to another telemetric unit. RTUs may transmit a command from another source but will not alter or interpret the command. RTUs do not control the process.

I. SCADA

Supervisory Control and Data Acquisition (SCADA) systems are data monitoring and control stations that allow operators to visualize and adjust live process conditions at a centralized HMI. These systems often include process historical data tracking and alarming capabilities. SCADA systems can be used for data monitoring locally, remotely, or both.

J. TELEMETRY

Telemetry is the transfer of data between remote sites. Typical methods of data transfer are utility phone lines, radio transmission, and fiber optics.

1.6 SUBMITTALS

A. Submit under the provisions of Section 01300.

B. PRODUCT DATA

1. Submit an electronic version of the manufacturer's data sheets for hardware components including specific model numbers for each device, and size of memory provided in each CPU.

2. Submit an electronic version of the manufacturer's installation manual, operation and maintenance manual.

3. If providing a development-level software package for the owner, then submit on the package's manufacturer, title, part number, version number, serial number, and publication date.

C. OPERATION AND MAINTENANCE MANUALS

1. See Section 01300.

2. Provide specific information including:

a. An electronic version of the manufacturer's published operation and maintenance manual, and troubleshooting guide.

b. Information for obtaining assistance and troubleshooting, parts ordering information, and field service personnel requests.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the requirements, provide products by the following manufacturers:

1. Allen Bradley Company.

B. Procure and provide to the owner any and all "runtime" licenses that may be required for day to day operation. Do NOT provide the Owner a development license. The PLC software must be the latest version and must be of the same manufacturer and family as the PLC hardware. It is assumed that the programmer has his/her own development-level software.

C. The PLC CPU, I/O, and communication cards shall be provided with the latest version of firmware.

2.2 EQUIPMENT

A. Conform to NEMA ICS 1.1 for installation and application of the PLC system.

B. All PLCs provided for the project shall be from the same manufacturer.

2.3 COMPONENTS

Hardware is referenced against Allen Bradley PLC products. Other manufacturers may be selected as comparable substitutions as listed below.

A. CENTRAL PROCESSOR UNIT (CPU)

1. Area 01 – South Well Field Reservoirs
   Allen Bradley: L24E CompactLogix family

2. Area 04 – South Well Field Treatment Building
   Allen Bradley: L33E CompactLogix family

3. Area 05 – North Well Field Water Treatment Plant
   Allen Bradley: L33E CompactLogix family

B. ANALOG INPUT/OUTPUT (I/O) MODULES (DOES NOT APPLY TO EMBEDDED, EXTRA CARDS ONLY)

Provide modules as defined in the PLC I/O tables in the Plans. Manufacturers other than Allen Bradley shall match the features and performance criteria of the Allen Bradley products listed below:

1. Analog Input Cards

   Allen Bradley P/N 1769-IF4I:

Channels:	4
Input Type:	4-20 mA
Resolution:	16 bit or +/-15 bit
Differential?	Yes
Isolated?	Yes

2. Analog Output Cards

   Allen Bradley P/N 1769-OF4CI:

Channels:	4
Input Type:	4-20 mA
Resolution:	16 bit
Differential?	Yes
Isolated?	Yes

C. DIGITAL INPUT/OUTPUT (I/O) MODULES (DOES NOT APPLY TO EMBEDDED, EXTRA CARDS ONLY)

Provide modules as defined in the PLC I/O tables in the Plans. Manufacturers other than Allen Bradley shall match the features and performance criteria of the Allen Bradley products listed below:

1. Digital Input Cards

Allen Bradley P/N 1769-IQ16

Input Channels:	16
Input Voltage:	24 Vdc
Signal Polarity:	Sinking/Sourcing

Allen Bradley P/N 1769-IQ32

Input Channels:	32
Input Voltage:	24 Vdc
Signal Polarity:	Sinking/Sourcing

2. Digital Output Cards

Allen Bradley P/N 1769-OB16

Output Channels:	16
Output Voltage:	24 Vdc
Signal Polarity:	Sourcing

Allen Bradley P/N 1769-OB32

Output Channels:	32
Output Voltage:	24 Vdc
Signal Polarity:	Sourcing

Allen Bradley P/N 1769-OW16

Output Channels:	16
Output Voltage:	Relay, Form A

D. POWER SUPPLY UNITS

For racks using separate power supplies, use the largest power supply available for that specific rack.

Input Voltage:	24 Vdc

2.4 ACCESSORIES

Provide all accessories required, whether indicated or not, for a complete PLC control system to accomplish the requirements of the Plans and Specifications.

2.5 SOURCE QUALITY CONTROL

A. SHOP TEST

1. Submit a shop test plan indicating how the test will be conducted, and how system operation will be verified.

2. Provide a shop test after factory assembly of the PLC control panel and prior to shipment.

   a. Conduct a burn-in period (minimum of 2 days) where the system is powered continuously and checked for proper operation.

   b. Provide sufficient PLC programming to demonstrate PLC I/O testing. Include a PC with sufficient software tools to allow visual demonstration of each digital/analog input status/value and be capable of forcing digital and analog outputs. Coordinate effort with PLC programmer if required (reference Specification 13451).

   c. Utilize dummy I/Os to verify proper operation.

   d. Demonstrate that all PLC hardware is fully functional.

   e. Allow for Owner and/or Engineer representatives to witness the shop test. Provide a minimum of 15 days notice prior to test.

   f. Do not ship the system prior to successful completion of this testing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install PLC control system in accordance with manufacturer's written instructions.

B. Test, verify and demonstrate access to and functionality of PLC system.

***** END OF SECTION *****

SECTION 16940

CONTROL PANELS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes control panels not provided as part of a manufacturer's package (skid) system.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section	Item
01300	Submittals
13450	Programmable Logic Controller (PLC) Hardware
Division 16	Electrical

1.3 DEFINITIONS

A. CONTROL PANELS

Reference Section 16050.

B. CONTROL POWER

Control power is considered electrical power at either 120 VAC or 24 VDC that powers control or instrumentation devices. Control power circuits are less than 150 VAC and less than or equal to 20 Amps.

Examples:

1. 120 VAC or 24 VDC device power to instruments such as flow meters, chlorine analyzers, dissolved oxygen transmitters, and etc.

2. 120 VAC or 24 VDC device power to control devices such as PLCs, radios, network switches, and etc.

3. 120 VAC power to control devices such as motor operated valves, metering pumps (even when through dedicated receptacles), lighting circuits (controlled within a lighting control panel), and etc.

1.4 REFERENCES

Reference	Title
NEMA	National Electrical Manufacturers Association
ICS-1	General Standards for Industrial Control and Systems
ICS-4	Terminal Blocks for Industrial Use
ICS-6	Enclosures for Industrial Controls and Systems
Publication No. 250	Enclosures for Electrical Equipment (1000 V maximum)
NFPA	National Fire Protection Association
NEC	National Electric Code
JIC-EMP-1	Joint Industrial Council

1.5 SYSTEM DESCRIPTION

A. CONTROL PANELS

1. Reference Section 16050, Definitions.

2. Control panels shall be fabricated similar to those shown on the Plans. With the exception of the discrete and analog I/O terminal blocks, the exact dimensions and component layout is not critical.

3. The system includes new control panels for control of process equipment. Some of the control panels are provided under Division 16. Some panels are provided under other Divisions with equipment specified in those Divisions. Control panels, whether provided under Division 16 or other Divisions, shall meet the requirements of this Section.

1.6 SUBMITTALS

A. SHOP DRAWINGS

1. See Section 01300.

2. Dimensioned or to-scale panel layout drawings.

3. Materials of construction.

4. Drawings showing conduit and wiring access locations.

5. Elementary wiring diagrams and terminal block drawings, differentiating between panel and field wiring.

6. Bill of Materials describing the reference name or number, quantity, complete English language description, manufacturer, model number, local supplier, and wiring or piping reference. Information shall include manufacturer name, catalog descriptions, wiring and piping diagrams, dimensional plans, anchoring details, installation instruction, and test results.

7. Loop diagrams with all components connected per ISA standards.

8. Nameplate text.

9. Heat calculations and relationship to enclosure fan, heater, air conditioner.

10. UPS system loading and resulting back-up run time.

B. OPERATION AND MAINTENANCE MANUALS

1. See Section 01300.

2. Provide manufacturer's operating and maintenance manuals for each device or item provided.

3. Recommended spare parts stocking list.

C. CONTRACTOR CERTIFICATION

The Contractor fabricating panels shall submit proof of certification as a UL 508 panel shop.

1.7 QUALITY ASSURANCE

A. Make shop drawings available prior to placement of conduits in slabs to ensure placement is coordinated with panel access locations.

B. Test panels prior to shipment to project site.

1. The entire assembled panel shall be tested to be free from grounds and shorts.

2. Controllers, circuits, and interlocks shall be rung out and tested to assure that they function correctly before the panel is shipped. Prior to placement of conduit feeds, assure approved control panel layouts are available.

C. Panels supplied under this Section are provided by a single manufacturer.

D. Provide panels labeled by a recognized testing laboratory or otherwise acceptable to the State of Washington Department of Labor and Industries meeting the requirements of Article 409 of the NEC. In addition, all completed panels shall be UL listed.

E. Revise all drawings upon completion of the work to show "as shipped" condition of the panel.

1.8 STORAGE AND HANDLING

A. After completion of shop assembly and testing, enclose panels in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from dust and moisture. Place dehumidifiers inside the polyethylene covering.

B. Skid-mount the equipment for final transport. Show shipping weight on shipping tags, together with instructions for unloading, transporting, storing, and handling on job site.

PART 2 PRODUCTS, MATERIALS

2.1 CONTROL PANEL ENCLOSURES

A. ENCLOSURE BODIES

Control panel enclosures are factory UL labeled enclosures fabricated of stretcher leveled steel welded into a rigid, self-supporting structure. Control panels shall be completely enclosed, welded construction, self-supporting, and gasketed dust-tight.

1. Panels mounted outdoors or in below-ground vaults shall be NEMA 4X 316L stainless steel.

Exception:

- *Unless indicated otherwise in the Plans.*

2. Panels mounted indoors shall be NEMA 1 gasketed.

Exception:

- *Unless indicated otherwise in the Plans.*

B. HINGES AND HINGE PINS

1. Provide full length (continuous) piano hinges rated for 1.5 times the weight of the door plus all door-mounted instruments.

2. Hinges shall be welded to all surfaces and shall match the metallurgy of the enclosure.

3. Hinge pins shall be 316L stainless steel on all panels.

C. MOUNTING FEET

If called for, mounting feet shall be the height indicated on the Plans and shall be made of the same material as the enclosure body that it supports.

2.2 CONTROL PANEL POWER DEVICES

A. FUSES

1. Power Circuit Fusing

Reference Specification 16410, Enclosed Switches, Fuses, and Circuit Breakers.

2. Control Power Fusing

Control power fuses are FRN for ratings above 10 amperes and FNQ for 10 amperes and below. FRN fuses are mounted in phenolic blocks with a fuse puller mounted adjacent to them. FNQ fuse holders are DIN-rail mounted type, 12A, 300 V minimum, hinged to disconnect and replace fuse, with blown fuse indicating light. Label all fuseholders with fuse identification number and fuse size and type. Provide five spare fuses of each type and size in each panel. Provide box mounted on panel interior marked "SPARE FUSES" to hold the spares.

3. PLC I/O Field Connection Fusing

a. 24 Vdc Fusing

i. Fuses for 24 Vdc circuits shall be 5 x 20 mm, glass body, fast acting, 250 Vac, sized by the integrator unless specifically called in the Plans or Specifications.

ii. Fuse holders for 24 Vdc circuits shall be DIN-rail mounted type, provided in fusible terminal blocks, for 5 x 20 mm fuses, black, hinged to open, 10-57 Vac/Vdc, with red LED blown fuse indicators, #30 AWG - #12 AWG, 15A.

b. 120 Vac Fusing

i. Fuses for 120 Vac circuits shall be 1/4" x 1-1/4", glass body, time-delay, 250 Vac, sized by the integrator unless specifically called in the Plans or Specifications.

ii. Fuse holders for 120 Vac circuits shall be DIN-rail mounted type, provided in fusible terminal blocks, for 1/4" x 1-1/4" fuses, black, 100-300 Vac, with neon blown fuse indicators, #30 AWG - #12 AWG, 15A.

B. CIRCUIT BREAKERS

1. Power Circuit Breakers

Reference Section 16410, Enclosed Switches, Fuses, and Circuit Breakers.

2. Control Power Circuit Breakers

Control power circuit breakers shall be DIN-rail mounted type, miniature, 240 Vac, single pole, 10 kAIC (minimum) @ 240 Vac, “C” curve (inductive) trip characteristics, 1,500 Vac dielectric strength (minimum), #14 to #12 AWG 75 degrees C line and load screw terminals, UL 489, CSA 22.2 No. 5.1; Allen Bradley Bulletin 1492-SPU Series A or equal.

C. DISCONNECT SWITCHES AND ACTUATORS

1. For Power Circuits > 30 Amps

Reference Section 16410, Enclosed Switches, Fuses, and Circuit Breakers.

2. For Power Circuits <= 30 Amps

Disconnect load switches shall be OFF-ON, 90 degree, 20 A rating, single pole, front door installation; Allen Bradley 194L-HC4L-1751 or equal.

Disconnect load switch actuators shall be OFF-ON, 90 degree, front/door installation, 22.5 mm central hole mount, red/yellow handle with padlock provision, 48 mm x 48 mm; Allen Bradley 194L-E20-1751 or equal.

D. SURGE PROTECTIVE DEVICES

1. For Power Circuits > 150 VAC and > 30 A

Reference Specification 16280, Surge Protective Devices.

2. For Control Power Circuits

Control power SPDs shall protect L-N, L-G and N-G and have a minimum peak surge current of 40kA, shall have terminals that accept a #12 AWG conductor, shall be rated for the voltage shown in the Plans, shall be UL listed, and shall have a terminal configuration with separate Line, Neutral, and Ground connections.

Control power SPDs shall meet Mil-Std-220 for maximum EMI/RFI attenuation.

Control power SPDs shall be DIN-rail mounted, 1-inch wide maximum.

Control power SPDs shall be Innovative Technology HS-DIN-120 series or equal.

3. For Telecommunications

All incoming phone and internet services shall be provided with surge protection.

a. Intermatic IG2TM or equal for twisted pair copper.

b. Intermatic IG4TM or equal for coaxial cable.

E. UPS SYSTEMS

1. 24 Vdc UPS Systems

24 Vdc UPS Systems shall include the 24 Vdc power supplies, the converters, batteries, and redundancy modules as described herein. Each of these devices shall be DIN-rail mounted, industrial rated, packaged, and UL-Listed. Custom built circuits boards and loose electronic devices shall not be allowed. Provide a minimum of 30 minutes of backup time or that shown on the Plans, whichever is the greater.

A single 24 Vdc UPS system shall include, as a minimum, the following devices: 1 x 24 Vdc Power Supply, 1 x 24 Vdc UPS Controller, 1 x 12 Vdc Backup Battery.

A dual (paralleled) 24 Vdc UPS systems shall include, as a minimum, the following devices: 2 x 24 Vdc Power Supplies, 2 x 24 Vdc UPS Controllers, 2 x 12 Vdc Backup Batteries, 1 x 24 Vdc DC Redundancy Module.

The minimum DC UPS system shall be capable of providing 10 amps at 24 Vdc continuously. The specifications listed below are for a minimum system. Increase the system ampacity as called on the Plans.

a. 24 VDC Power Supplies

24 Vdc power supplies shall be 120 Vac input, 24 Vdc output, 10 A minimum, with +/- 1 percent voltage regulation from no-load to full-load. Process power supplies shall be sized by the integrator and increased in size as required. Provide the power supply sizing calculations with the product submittal. PULS #QS10.241 or equal.

b. 24 Vdc UPS Controller

DC UPS controller shall be 24 Vdc/24 Vdc, 10 A, with indicating LEDs. The unit shall monitor the battery and provide a dry contact output to indicate that the battery should be replaced. PULS #UB10.241 or equal.

c. 12 Vdc Backup Batteries

Batteries shall be fully sealed gel type. Batteries shall be rated for 12 Ah (minimum) and rated to operate between -40 degrees C and 60 degrees C.

d. DC Redundancy Module

DC Redundancy Modules provide parallel connectivity of two separate 24 Vdc systems and are required on all dual 24 Vdc supply systems.

Provide DC Redundancy module, 24 Vdc/24 Vdc input, 24 Vdc output, 20 amp; PULS YR2.DIODE or equal.

F. PHASE MONITOR RELAYS (PMRS)

1. PMRs shall only be used on 3-phase power systems and shall be compatible with the voltage configuration as shown on the Plans. For 240 Vac 3 phase systems, the high leg shall be phase B.

2. PMRs shall monitor the following conditions and provide the ability to adjust trip values and time delays as described below:

a. Phase Loss

i. Trip not adjustable

ii. Time delay not adjustable, fixed at 100 msec.

b. Phase Reversal

i. Trip not adjustable

ii. Time delay not adjustable, fixed at 100 msec.

c. Phase Unbalance

i. Trip adjustable, set at 10 percent

ii. Time delay not adjustable, fixed at 2 seconds.

d. Under voltage

i. Trip adjustable, set at 80 percent of nominal voltage

ii. Time delay adjustable, set at 5 seconds.

e. Overvoltage

i. Trip not adjustable, fixed at 110 percent of nominal voltage

ii. Time delay not adjustable, fixed based on inverse time.

3. PMRs shall be provided with 1 x SPDT (Form C) dry isolated contact that transitions when thresholds are exceeded for time delays described above.

4. PMRs shall be: Automation Direct, Prosense, PMRU-1C-480A or equal.

G. MOTOR START COUNTERS/MOTOR RUN TIME (ELAPSED TIME) METERS

When the control panel contains motor starters, start counter and run time meter shall be a combination electromechanical device.
Eaton CEC-55PM-406 or equal. Battery backed LCD displays shall not be used. Refer to Section 16420, Motor Controllers.

H. CURRENT TRANSFORMERS

Current transformers are 1 percent accuracy at burden and lead length as installed; G.E., Midwest, Westinghouse or Hawkeye.

I. AMMETERS

Ammeters are ±2 percent accuracy, 2-1/2 -inch size GE, Simpson, Weston, or Crompton.

J. ANALOG CURRENT TRANSMITTERS

Loop powered 4-20 mA solid core current transducer for currents up to 200 A. Hawkeye H721 Series or equal.

2.3 CONTROL PANEL CONTROL DEVICES

A. PILOT LIGHTS

Pilot lights shall be heavy duty, Class 9001, Type J, NEMA 4 (watertight) and NEMA 13 (oil-tight), push-to-test, multi-segmented LED with red, green, amber, blue, clear, white, or yellow colored caps as shown on the Plans.

1. Allen-Bradley
2. Cutler-Hammer
3. General Electric
4. Siemens
5. Square D

B. PUSH BUTTONS

Push buttons shall be heavy duty, Class 9001, Type K, UL types 4 and 13, NEMA 4 (watertight) and NEMA 13 (oil-tight), non-illuminating, with full button guard. Contact block shall be provided with 1 N.O. and 1 N.C. contacts minimum with the ability to stack additional blocks. Provide additional blocks as required.

Pushbutton actuators may be standard, mushroom head, recessed (flush collar), or deep recessed (deep collar) as required.

1. Allen-Bradley
2. Cutler-Hammer
3. General Electric
4. Siemens
5. Square D

C. SELECTOR SWITCHES

1. On-Off Selector Switches

ON-OFF selector switches shall be Class 9001, Type K, UL types 4 and 13, NEMA 4 (watertight) and NEMA 13 (oil-tight), non-illuminating push button contact blocks with 2-position operators and standard knob. Contact block shall be provided with 2 N.O. and 2 N.C. contacts minimum with the ability to stack additional blocks. Provide additional blocks as required.

The 2-position operator shall be manual rotation to left and manual rotation to right. Two contact block stacks shall be provided. In both contact block stacks, one set of contacts is closed in the left position and open in the right position. In both contact block stacks, one set of contacts is closed in the right position and open in the left position.

a. Allen-Bradley

b. Cutler-Hammer

c. General Electric

d. Siemens

e. Square D

2. Hand-Off-Auto (HOA) Selector Switches

HOA selector switches shall be Class 9001, Type K, UL types 4 and 13, NEMA 4 (watertight) and NEMA 13 (oil-tight), non-illuminating push button contact blocks with 3-position operators and standard knob. Contact block shall be provided with 2 N.O. and 2 N.C. contacts minimum with the ability to stack additional blocks. Provide additional blocks as required.

The 3-position operator shall be manual rotation to left and right from center and manual return back to center. Two contact block stacks shall be provided. In both contact block stacks, one set of contacts is closed in the left position and open in the center and right positions. In both contact block stacks, one set of contacts is closed in the right position and open in the center and left positions.

a. Allen-Bradley

b. Cutler-Hammer

c. General Electric

d. Siemens

e. Square D

3. Reset-Off-On Selector Switches

RESET-OFF-ON selector switches shall be Class 9001, Type K, UL types 4 and 13, NEMA 4 (watertight) and NEMA 13 (oil-tight), non-illuminating push button contact blocks with 3-position operators and standard knob. Contact block shall be provided with 2 N.O. and 2 N.C. contacts minimum with the ability to stack additional blocks. Provide additional blocks as required.

The 3-position operator shall be manual rotation to left and right from center, spring return from left to center and manual return from right to center. Two contact block stacks shall be provided. In both contact block stacks, one set of contacts is closed in the left position and open in the center and right positions. In both contact block stacks, one set of contacts is closed in the right position and open in the center and left positions.

a. Allen-Bradley

b. Cutler-Hammer

c. General Electric

d. Siemens

e. Square D

D. RELAYS

1. Contactor Relays

Contactor relays for switching 120 Vac power circuits including, but not limited to, lighting, solenoid valves, and small motors shall be electro-mechanical machine tool, heavy-duty type, NEMA

rated, with 120 Vac/24 Vdc coils and double-break contacts rated at 20 A at 250 Vac. Equip relays with surge suppressers. IEC rated relays are not permitted.

2. Control relays

Control relays for logic control circuits shall be permitted to be miniature "ice cube" type DPDT or 4PDT with 24 V or 110-120 V AC/DC coils with a mechanical life of 20 million operations minimum and an electrical life of 1 million operations minimum at 1 amp. The dielectric strength between the coil and contacts shall be 2,000 Vac for 1 minute. Contacts shall be rated at 10 A at 250 Vac, 10 A at 30 Vdc. Relays shall have a maximum pickup and release time of 25 milliseconds and a minimum drop voltage of 30 percent of the rated voltage. Relays shall include non-polarized LED coil indictors. Relays shall be IDEC, P&B/Tyco or equal.

3. Alternating Relays

Alternating relays shall have 24 Vdc or 120 Vac coils as required for the application.

a. Duplex Alternating Relays

2-state alternating relays shall be DPDT with the transition between states occurring on loss of power to the coil.

b. Triplex Alternating Relays

Triplex alternating relays shall operate on 3 switch inputs, with the loads falling out in the reverse order of their pull-up. Relays shall be octal socket type with 120 Vac or 24 Vdc coils. Contacts shall be rated at 3 A at 24/120 Vac with a full load electrical life of 100,000 operations and a mechanical life of 10,000,000 operations.

Relays that operate with a first-on, first-off control sequence shall not be allowed.

Macromatic (Triplexor Only), #ATP120A1 (120 Vac coil) or #APT024A1 (24 Vdc coil) or equal.

4. Time Delay Relays

Time delay relays shall be electronic, programmable, multifunction type with a minimum of two (2) Form C time-delay contacts; Crouzet Chronos 2 or equal.

Time delay relays shall be capable of TDAE and TDAD functions as a minimum.

Time delay relays shall be provided with selectable time ranges in seconds, minutes, and hours and adjustable settings within the range.

5. PLC 24 Vdc Output Buffer Relays

PLC 24 Vdc output buffer relays shall be miniature DIN-rail DPDT type with silver-nickel alloy contacts rated at 8 amps @ 250 Vac/30 Vdc (resistive load), 4 amps @ 250 Vac/30 Vdc (inductive load), and 100,000 operations at full rated load with a dielectric strength between contacts of 1,000 Vac for 1 minute.

The relay coil shall be 24 Vdc, with a mechanical life of 50 million operations and a dielectric strength between the coil and contacts of 5,000 Vac for 1 minute. Relays shall have a maximum pickup time of 15 milliseconds and release time of 10 milliseconds and a minimum drop voltage of 10 percent of the rated voltage.

Relays shall include a non-polarized LED coil indicator.

Relays shall include a DIN-rail mounting socket, 0.625 inch wide maximum with finger-safe screw terminals and replacement locking lever. DPDT relays and sockets shall be stackable at 0.625 inch.

Relays shall be IDEC RJ2S-CL-D24 or exact equal.

6. PLC 120 Vac - to - 24 Vdc Input Buffer Relays

PLC 120 Vac input buffer relays shall be miniature DIN-rail DPDT type with silver-nickel alloy contacts rated at 8 amps @ 250 Vac/30 Vdc (resistive load), 4 amps @ 250 Vac/30 Vdc (inductive load), and 200,000 operations at full rated load with a dielectric strength between contacts of 1,000 Vac for 1 minute.

The relay coil shall be 120 Vac, with a mechanical life of 30 million operations and a dielectric strength between the coil and contacts of 5,000 Vac for 1 minute. Relays shall have a maximum pickup time of 15 milliseconds and release time of 10 milliseconds and a minimum drop voltage of 30 percent of the rated voltage.

Relays shall include a non-polarized LED coil indicator.

Relays shall include a DIN-rail mounting socket, 0.625 inch wide maximum with finger-safe screw terminals and replacement locking lever. DPDT relays and sockets shall be stackable at 0.625 inch.

Relays shall be IDEC RJ2S-CL-A120 or exact equal.

E. LEVEL INDICATOR/SET POINT CONTROLLERS (LICs)

For processes using set point controllers for level control, such as wet wells and reservoirs, the following specifications shall apply.

1. 120 Vac or 24 Vdc power (as shown on the Plans).

2. 4-20 mA or 0-10 Vdc analog input (as shown on the Plans).

3. 16-point scaling for non-linear processes.

4. Four set point outputs, each with its own separate "SET" and "RESET" set points.

5. Panel mount configuration.

6. LICs shall be Red Lion PAXP Process Input Panel Meters with PAXCDS Quad Set Point Relay Output Card or equivalent.

F. ETHERNET SWITCHES

Ethernet switches shall be industrial grade, 10/100 MB, DIN-rail mounted type, 24 Vdc powered, 8-port; N-Tron 300 series or equal.

Exception:

- *If the requirement shown on the Plans is greater than 8 ports, then provide the higher value.*

- *Non-DIN-rail acceptable if over 16 channels.*

G. AUTODIALERS

Autodialers shall be 8 channel, 8 phone number, with dial-out capability for power failure and low battery and shall include 20-hour internal backup batteries. The device shall operate at 12 Vdc and include a 120 Vac to 12 Vdc wall plug power supply.

Exception:

- *Provide 8 channel input or the number of channels as shown on the Plans, whichever is the greater.*

Antx Dialog Scout, or equal.

H. SPREAD SPECTRUM ETHERNET RADIOS AND ACCESSORIES

The following materials may be replaced with or equal, however if another manufacturer is submitted a radio study must also be submitted showing the proposed devices are capable of communicating between the sites as shown in the Plans.

1. 24 Vdc Ethernet Data Radio – 3x Banner DXER9

2. Bulkhead Surge Arrestor – 3x Banner BWC-LFNBMN-DC

3. Fiberglass Yagi Antenna, 902-928 MHz 10 dBI – 2x Banner BWA-9Y10-A

4. Fiberglass Omni Antenna, 902-928 MHz 6 dBI – 1x Banner BWA-9O6-AS

5. Radio to Bulkhead Cable – 3x Banner BWC-1MRSFRSB length as needed

6. Bulkhead to Antenna Cable, LMR400 – length as needed

2.4 CONTROL PANEL ANCILLARY DEVICES

A. RECEPTACLES MOUNTED IN CONTROL PANELS

120 Vac power to convenience and device receptacle in control panels shall not be derived from the same panelboard circuit as that used for process control devices (PLC, flow meters, autodialers, DC power supplies, etc.).

1. Convenience Receptacles

Convenience receptacles in control panels are not dedicated and are intended for providing 120 Vac convenience power for non-motor-operated equipment.

Convenience receptacles shall be GFCI, 15 amp, 125 Vac, duplex, white, in a DIN-rail mount, cast aluminum box. Stamped steel boxes shall not be used.

2. Device Receptacles

Device receptacles are dedicated for communication and control devices operating within the control panel on a continuous basis. These include devices with 120 Vac power packs like VPNs, Fiber-to-Voice Converters, Data-to-Voice Converters, and etc.

Device receptacles shall be non-GFCI, 15 amp, 125 Vac, duplex, white, in a DIN-rail mount, cast aluminum box. Stamped steel boxes shall not be used.

On Communication Patch Panels, these receptacle circuits can be extended with surge- and load-protected power strips.

B. PANEL LIGHTING

For all panels so designated on the Plans, provide an LED lighting package, under cabinet style, hardwired, 120 Vac, with integral door-activated ON/OFF switch.

Provide additional spare lamp.

120 Vac power to the panel light shall not be derived from the same Panelboard circuit as that used for process control devices (PLC, flow meters, autodialers, DC power supplies, etc.).

C. PANEL HEATER

Provide a panel heater with thermostat in each outdoor control panel and all panels so designated on the Plans. Each heater shall include a DIN-rail mounted disconnect breaker and associated feedthrough and grounding terminals for connection to external 120 Vac line, neutral, and ground conductors. The heater and thermostat shall be prewired to these terminals and breaker.

The wattages shown below are minimum values. The Contractor shall size the panel heaters based on enclosure size, internal load heat generation, minimum operating temperature of devices in the enclosures, and minimum ambient temperature. Contractor shall include panel heating calculations with control panel submittals.

For panels with a front surface area greater than 11 square feet, provide a touch-safe, 550 watt minimum, 120 Vac panel heater with integral thermostat.

For panels with a front surface area less than 11 square feet, provide a semiconductor type, 30 watt minimum, 120 Vac, DIN-rail panel heater. Provide a N.C., DIN-rail heater thermostat with 15 amp contacts at 120 Vac.

120 Vac power to panel heaters shall not be derived from the same panelboard circuit as that used for process control devices (PLC, flow meters, autodialers, DC power supplies, etc.).

D. PANEL COOLING FANS

Provide a panel cooling system in enclosures that contain motor starters, drives, PLCs, RTUs, and other electronic devices that can generate heat and have maximum operating temperature limits unless specifically shown otherwise in the Plans. The panel cooling system shall include one or more fans with a thermostat as a minimum. The cooling system shall be sufficiently sized to maintain an internal enclosure temperature below the maximum operating temperature of all internal devices.

Provide a thermostat for cooling, N.O. contact, adjustable set point range 32-140 degrees F, 15 amp-rated contact at 120 Vac.

Cooling fans shall be configured to exhaust air. Vents shall be provided for supply air. Layout fans and vents in such a manner as to:

1. Maximize cooling of critical components,
2. Minimize air flow restriction,
3. Eliminate entry of water or dust particles into the enclosure.

Provide vent covers over fan and vent openings to eliminate rain and moderate washdown for all outdoor panels and all panels so designated on the Plans.

Provide a “washdown filter” fan set, capable of eliminating sprayed water entry, stainless steel, 120 VAC, 310 CFM, 3.8 Amps max., 18" x 10" x5".

120 Vac power to panel fans shall not be derived from the same panelboard circuit as that used for process control devices (PLC, flow meters, autodialers, DC power supplies, etc.).

E. TERMINAL BLOCKS

1. For Power Circuits > 30 Amps

Terminations for power circuits greater than 150 V to ground or greater than 30 A shall be made using 600 Vac, UL listed, screw type, Power Distribution Blocks.

2. For Non-Fused Control, Instrumentation, and Power Circuits < 30 Vdc, < 150 Vac, and <= 30 amps

Provide standard feed-through DIN-rail type IEC terminal blocks, single circuit, screw terminal type, #22 - #10 AWG, rated 600 V AC/DC at 30 A, white or grey; Allen Bradley Bulletin 1492-J4 series or equal.

Exceptions:

- *For equipment/chassis grounded circuits*

  Provide DIN-rail type IEC grounding blocks, single circuit, screw terminal type, #22 - #10 AWG, rated 600 V AC/DC at 30 A, green/yellow in color; Allen Bradley Bulletin 1492-WG6 or equal. These ground blocks shall be inherently connected to the din rail.

- *For instrumentation cable shield terminations (reference Section 3.1 E).*

  Provide standard feed-through DIN-rail type IEC terminal blocks, single circuit, screw terminal type, #22 - #10 AWG, rated 600 V AC/DC at 30 A, blue; Allen Bradley Bulletin 1492-J4-B or equal.

5. Terminals used for digital and analog I/O field connections shall be grouped as shown in Section 3.1 E, FABRICATION, FIELD CONNECTIONS TO PLC I/O.

F. PANEL WIRING PRODUCTS

1. Power Circuit Wiring; Reference Section16120.

2. Control Circuit Wiring; Reference Section 16120.

3. Analog PLC I/O Wiring

Signal cables connected completely inside control panels between analog input and output field terminal groupings and their associated PLC analog cards shall be #22 AWG, stranded, tinned copper, twisted pair, 300 V, 100 percent overall foil shielded cable with #22 AWG tinned copper drain wire; Belden #8451 or equal.

2.5 CONTROL PANEL ACCESSORIES

A. PANEL NAMEPLATES AND IDENTIFICATION

1. Identify each item on the control panel with rectangular nameplates.

2. Provide nameplates of rigid phenolic plastic laminate with engraved lettering or engraved metal plate with filled lettering. Use black background with white lettering.

3. Minimum letter height is 1/2 inch for instrument description and 1/4-inch height for instrument tag number.

4. Provide each panel with a 2-inch by 10-inch (minimum) nameplate with 1-inch-high lettering with panel identification.

5. Abbreviations are not permitted unless approved by the Owner or specifically shown on the nameplates, schedules, or plans.

6. Install nameplates plumb and parallel to the lines of doors or structure to which they are attached. Attach to the sheet metal structure by a thin coat of adhesive and sheet metal screws. Make adhesive and screw applications in such a manner as to avoid nameplate buckling or distortion due to use of excessive adhesive or over tightening of screws.

PART 3 INSTALLATION

3.1 FABRICATION

A. GENERAL

1. Control panels are factory or shop fabricated units completely assembled, wired, and tested before shipment to the job site.

2. Panel construction, in general, meets JIC EMP-1 standards and applicable NEMA and IEEE standards.

   Exception:

   - *Where open penetrations are required, such as for fans and vents, the NEMA rating of the panel may be modified to meet the intent of the design and fit the environment of the application. Verify the change of a panel's NEMA rating with the Engineer.*

3. The panels shall be constructed in accordance with Article 409 of the NEC and electrical testing laboratory standards and shall be so labeled (the standards of a recognized electrical testing laboratory).

4. Size panels for enclosed equipment and available space for mounting of panel or as shown on the Plans.

5. Panels shall be descaled, cleaned, and primed in preparation for painting. Painting shall consist of one coat of flat white enamel in the interior and two coats of hard finish exterior enamel, gray in color. Paint shall be suitable for field touch-up. Spare paint (1 quart) shall be provided for touch-up purposes.

   Exceptions:

   - *If the panel is to be used in eastern Washington, then the final outer coating shall be high gloss white.*

   - *Unless shown otherwise in the Plans stainless steel enclosures shall not be painted.*

6. Panel material, penetrations, and etc. shall be verified for proper operation in their intended locations. Issues and concerns shall be brought to the attention of the Engineer prior to fabrication within or on the panel.

B. FREE-STANDING PANELS

1. Welded construction

2. Completely enclosed, self-supporting, and gasketed dust-tight.

3. Seams and corners welded and ground smooth.

4. Furnish doors with keyed alike locking handles and three point catch.

5. Provide each panel with lifting eyebolts. Furnish stainless steel base channels.

6. Slotted bolt holes in base, 1-1/2 long for field adjustment.

C. COMPONENT INSTALLATION

1. Minimize welding to panel fronts and avoid distortion of panel metal.

2. Reinforce around areas of the enclosure weakened by openings or mounting of heavy equipment/components.

3. Accurately and cleanly cut or nibble cutouts, and finish free of sharp edges or burrs. Make cutouts plumb, level, and on-line vertically or horizontally within 1/32 of an inch where components are in rows or columns.

4. Provide minimum 1-5/8-inches spacing between horizontal rows of externally mounted components; 1-1/2 inches minimum between vertical columns of components.

5. The distance from the bottom row of components to the floor shall be not less than 36 inches, unless specifically shown as less. In general, all indicating lights, pushbuttons, etc., shall be mounted in accordance with the sequence of operation from left to right and top to bottom.

6. Provide minimum 1/4-inch spacing between components mounted on the panel sub-plate, Provide minimum spacing between the component and the wire duct of 1-1/2 inches above, and 1 inch below.

7. Components mounted in the interior shall be fastened to an interior subpanel using machine screws plus adhesive to ensure vibration-free attachment.

8. Interior component mounting and wiring shall be grouped as much as possible by function and then by component type. Interiors shall be so arranged that control relays, terminal blocks, fuses, etc., can be replaced or added without disturbing adjacent components.

9. AC UPS systems and associated batteries shall be mounted on a shelf specifically sized and braced for the UPS system. This rack shall assure that the UPS system is not resting on the bottom of the Control Panel and that no part of the UPS system blocks, or in any other way interferes with devices, terminals, or wireways that are not specifically a part of the UPS system. The shelf shall have a raised lip around all sides that are not in contact with a wall. The bottom of the shelf shall be at least 4 inches above the bottom of the enclosure (this provides a free flow of cables and conductors from conduits entering the bottom of the panel). Straps shall be provided to secure the UPS to the shelf.

   If insufficient room is available on the panel's backplane, then mount the shelf to the inside of the door. When mounted on the door, secure all cables to the door in such a manner that assures:

   a. Highly reliable secured connections to the UPS (not affected by movement of the door),

   b. Free and unencumbered door movement,

   c. Door movement that does not stress the cables.

10. Open batteries provided to support DC UPS systems shall be mounted on 316L stainless steel shelves and provided with non-conducting bracing straps to firmly hold the battery in place. The shelves shall have a raised lip around all sides that are not in contact with a wall. The bottom of the shelf shall be at least 4 inches above the bottom of the enclosure.

    Batteries provided with manufacturer's mounting systems do not require the additional stainless steel shelving.

D. PANEL WIRING METHODS

1. Provide PLC analog and digital input and output circuit field terminations and wiring methods per Section 3.1 E.

2. Field wiring terminations to control panel terminal strips shall be connected as shown on the Plans. Cable shields or "drain" wires shall be terminated as per manufacturer's recommendations.

3. Provide a chassis-connected equipment ground bus at the bottom of PLC control panels.

4. Provide an isolated ground bus, dedicated solely for analog shield connections, adjacent to the equipment ground bus. Provide a separate and dedicated #10 AWG minimum green-insulated ground wire from the Panelboard ground bus to the isolated ground bus.

5. Provide raceways for panel wiring.

   a. Size raceways per the requirements of NEC.

   b. Provide panel wireways between each row of components, and adjacent to each terminal strip.

   c. Wireways are a minimum of 1 inch wide and 3 inches deep with removable snap-on covers and perforated walls for easy wire entrance. Wireways shall be constructed of non-metallic materials with a voltage insulation in excess of the maximum voltage carried therein Panduit type LG, Panel Channel or equal

6. Run wires neatly in wiring duct tied and bundled with tie wraps or similar materials.

7. Provide wire bending space per NEMA ICS 6.

8. Label wiring within the panel with wire numbers using the same number on both ends of the wire. Identify each wire termination, including long jumpers, with wire markers. Arrange wire labels to permit reading of identification when installed.

9. Connect wiring internal to the panel to one side, leaving the opposite side for field terminations. Connect no more than two wires to any one control terminal point.

10. Arrange wiring inside the panel to separate instrumentation cables, conductors, and terminals at least 12 inches from 120 Vac power and control circuits.

11. Connect electrical equipment grounds to the chassis grounding bus.

12. Provide necessary power supplies for control equipment.

E. WIRE TERMINATION METHODS

1. Power conductors terminated on Power Distribution Blocks shall be covered with the block manufacturer's transparent cover and a caution sticker stating the voltage and available bolted fault current.

2. Terminate one end of all instrumentation cable shields to blue isolated-ground terminals (reference Section 2.4 E).

3. Provide fused terminals as shown on the Plans or defined herein. Reference Section 2.2 for materials

4. Terminals used for 4-20 mA analog input and output circuits shall be grouped as shown herein. This grouping shall be provided for each analog input and output connected to a PLC, whether assigned or unassigned (spare).

5. Provide terminal strips for the termination of panel wiring not directly connected to panel mounted devices.

6. Terminals shall facilitate wire sizes as follows:

   a. 120 Vac applications: Wire size 12 AWG and smaller.

   b. Other: Wire size 14 AWG and smaller.

7. Tag each I/O terminal to indicate tag number of the connected device or wire.

8. Provide 20 percent excess terminals (minimum) for future expansion.

9. Provide a minimum of 1.5 inches between terminal strips and wireways or between terminal strips.

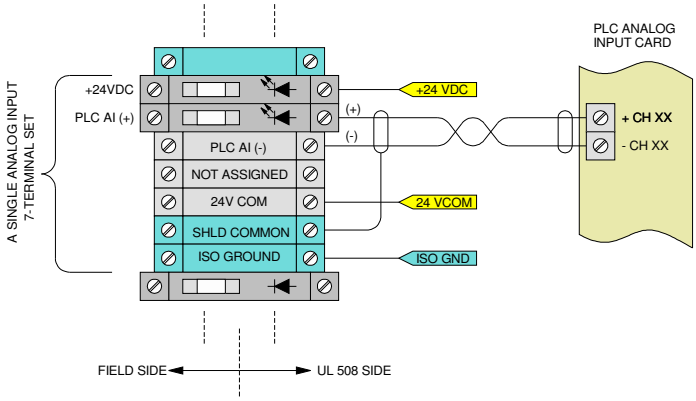
F. FIELD CONNECTIONS TO PLC I/O

1. ANALOG INPUT, Termination and Connectivity

Each 4-20 mA PLC analog input shall be connected to a 7-terminal grouping as shown below and as detailed on the Analog Loop Diagrams on the Plans whether the input channel is assigned or unassigned (spare) and whether the input is single-ended, differential, or isolated. No chassis-grounded terminals shall be used. Reference table below.

7-Terminal Analog Input Grouping, Terminal Assignments

Internal Panel Connections	Clarification	Terminal Type and Color
+24 Vdc	+24 Vdc Power	Fused, Black
PLC AI (+)	PLC Analog Input, +	Fused, Black
PLC AI (-)	PLC Analog Input, -	Feedthrough, Gray
NOT ASSIGNED	2-Device Connection	Feedthrough, Gray
24VCOM	24 V Common	Feedthrough, Gray
SHLD COMMON	Shield Common	Feedthrough, Blue
ISO GROUND	Isolated Ground	Feedthrough, Blue



All connections on the UL 508 side are the same, regardless of the type of field connection.

Bundle all analog input terminal groups in the same sequence as the analog input cards and channels.

Maintain a minimum of 12 inches between analog terminal groups and AC power circuits.

The shields shall be connected at the terminal block-end only. Shields shall not be connected at the PLC cards.

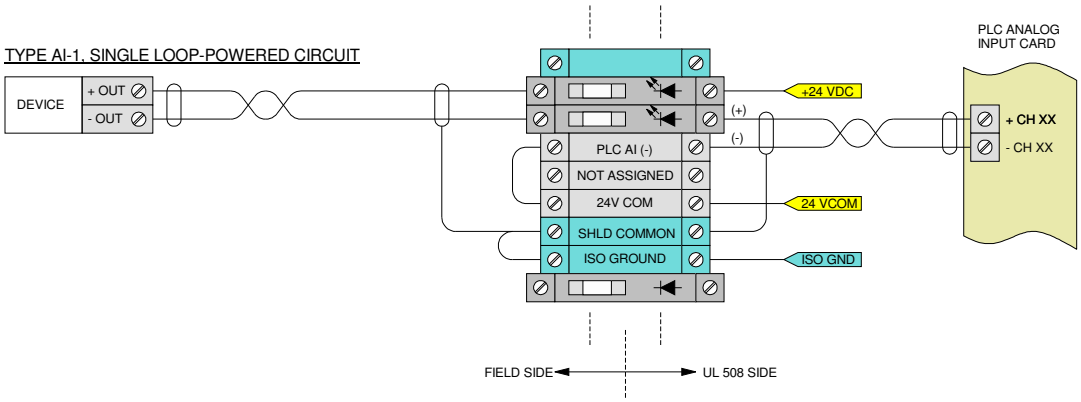
No additional 24 Vdc fusing is to be provided.

For cable type between terminal groupings and analog input PLC cards, reference Section 2.4 F.

2. ANALOG INPUT, 7-Terminal Connection Methods

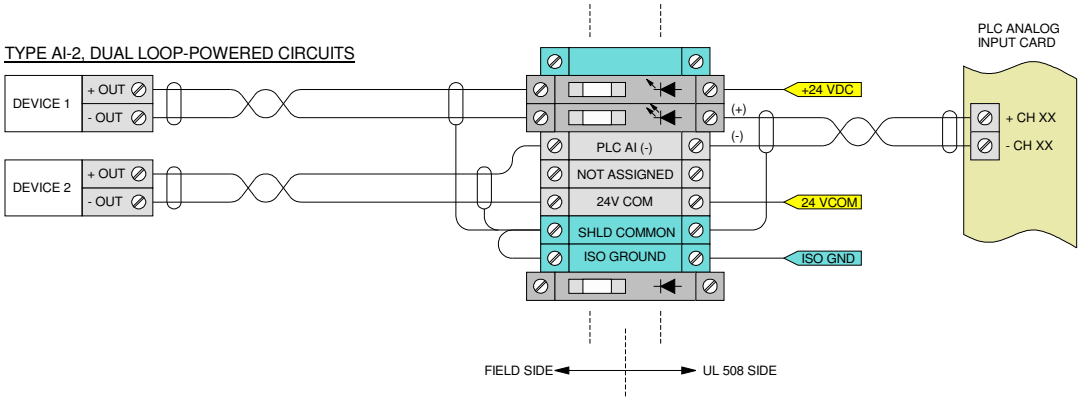
a. Field Connection **TYPE AI-1**, connection to a single loop-powered field device

The Figure below shows the method of connecting a PLC analog input to a single loop-powered field device using a 7-terminal standard analog input terminal group.



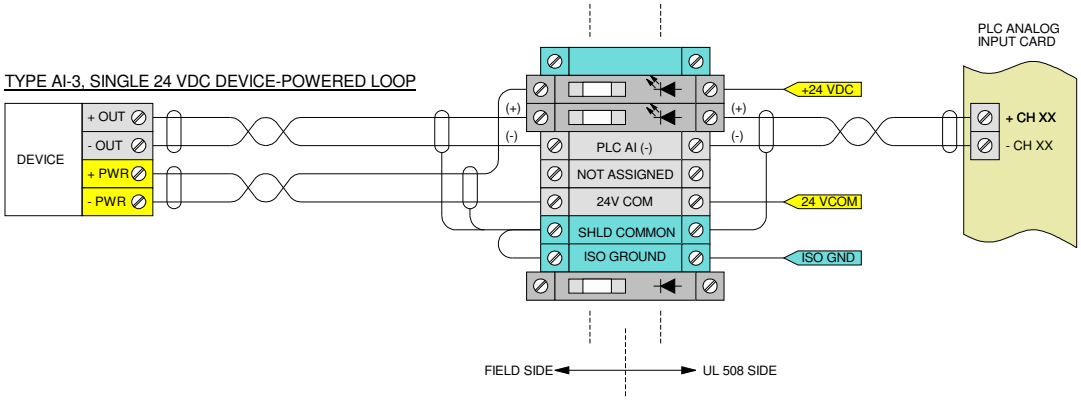
b. Field Connection **TYPE AI-2**, connection to two loop-powered field devices

The Figure below shows the method of connecting a PLC analog input to two loop-powered field devices using a 7-terminal standard analog input terminal group.



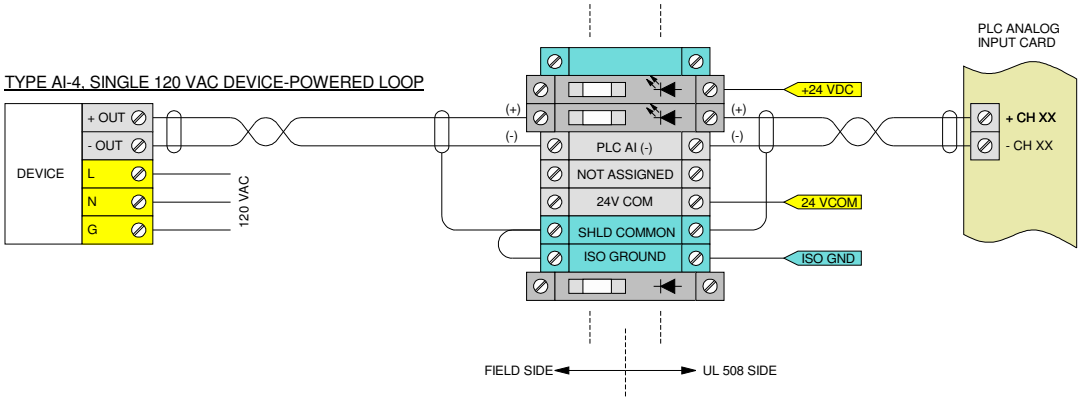
c. Field Connection **TYPE AI-3**, connection to a single 24 Vdc device-powered field device

The Figure below shows the method of connecting a PLC analog input to a single 24 Vdc device-powered field device using a 7-terminal standard analog input terminal group. Device power is provided by the control system power.



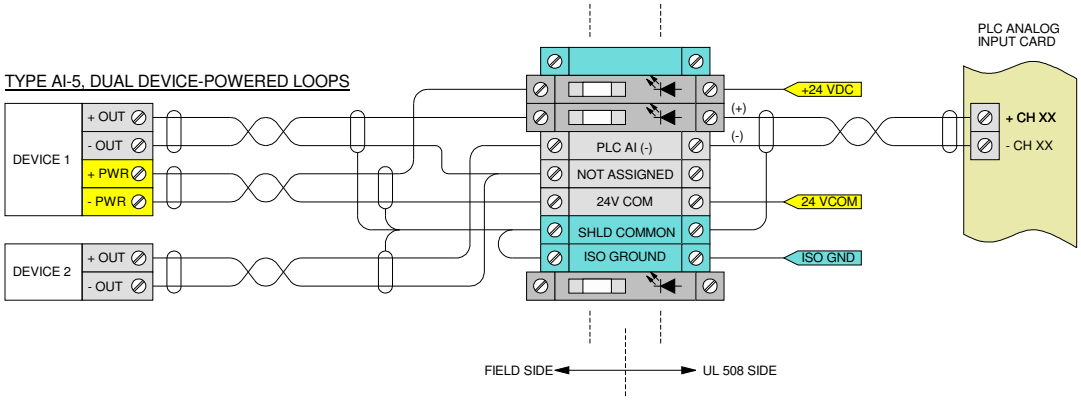
d. Field Connection **TYPE AI-4**, connection to a single 120 Vac device-powered field device

The Figure below shows the method of connecting a PLC analog input to a single 120 Vac device-powered field device using a 7-terminal standard analog input terminal group.



e. Field Connection **TYPE AI-5**, connection to a set of 24 Vdc device-powered and loop-powered field devices

The Figure below shows the method of connecting a PLC analog input to two field devices, with at least one requiring 24 Vdc device power using a 7-terminal standard analog input terminal group. Device power is provided by the control system power.

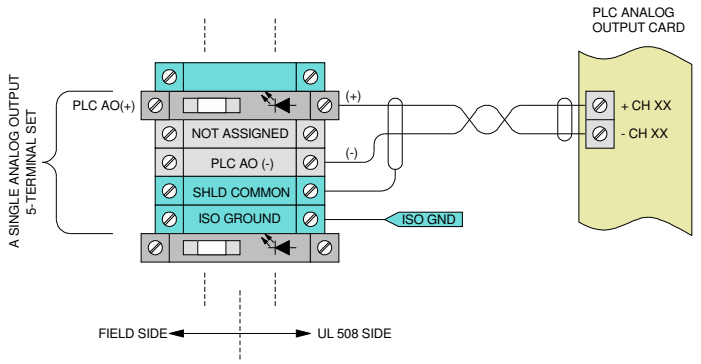


3. Analog Output, Termination and Connectivity

Each 4-20 mA PLC analog output channel shall be connected to a 5-terminal grouping as shown below and as detailed on the Plans whether the input channel is assigned or unassigned and whether the output is isolated or not. No chassis-grounded terminals shall be used. Reference table below.

5-Terminal Analog Input Grouping, Terminal Assignments

Internal Panel Connections	Clarification	Terminal Type and Color
PLC AO(+)	PLC Analog Output, +	Fused, Black
NOT ASSIGNED	2-Device Connection	Feedthrough, Gray
PLC AO(-)	PLC Analog Output, -	Feedthrough, Gray
SHLD COMMON	Shield Common	Feedthrough, Blue
ISO GROUND	Isolated Ground	Feedthrough, Blue



All connections on the UL 508 side are the same, regardless of the type of field connection.

Bundle all analog output terminal groups in the same sequence as the analog output cards and channels.

Maintain a minimum of 12 inches between analog terminal groups and AC power circuits.

The shields shall be connected at the terminal block-end only. Shields shall not be connected at the PLC cards.

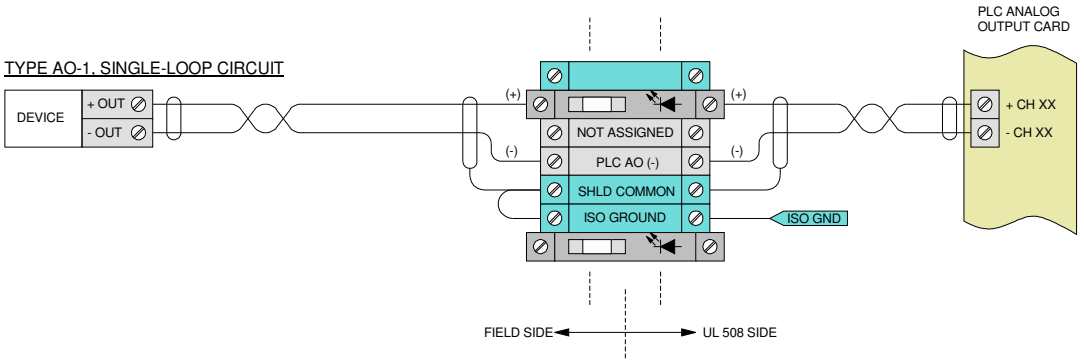
No additional 24 Vdc fusing is to be provided.

For cable type between terminal groupings and analog input PLC cards, reference Section 2.4 F.

4. Analog Output, 5-Terminal Connection Methods

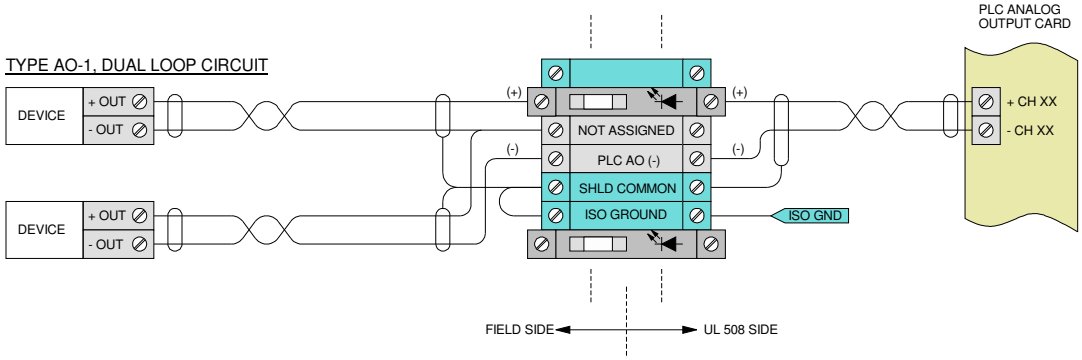
   a. Field Connection **TYPE AO-1**, connection to a single field device

The Figure below shows the method of connecting a PLC analog output to a single field device using a 5-terminal standard analog output terminal group.



b. Field Connection **TYPE AO-2**, connection to two field devices

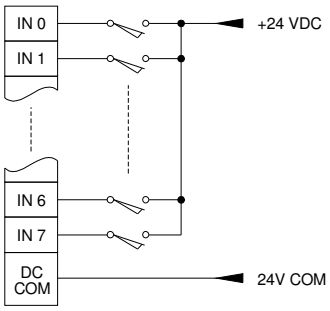
The Figure below shows the method of connecting a PLC analog output to two field devices using a 5-terminal standard analog output terminal group. These devices can be loop-powered or device powered.



5. Digital Input, Termination and Connectivity

a. Digital Input Type

All digital inputs shall be the “sinking” type as shown below. Reference Specification Section 13450, Programmable Logic Controller (PLC) Hardware.



1/2 OF 24 VDC, 16 CHANNEL PLC
DIGITAL SINKING INPUT CIRCUIT

b. Digital Input Fusing to Field Circuits

Provide fusing for each field-connected digital input. A single fuse shall be used for a group of field inputs from a common remote panel providing that the inputs are connected to the same input card. A common fuse shall not be used for separate cards.

Separate fuses shall be provided for field inputs that are not terminated in a common remote panel.

Provide a separate fuse for each set of 4 unassigned (spare) Digital Inputs.

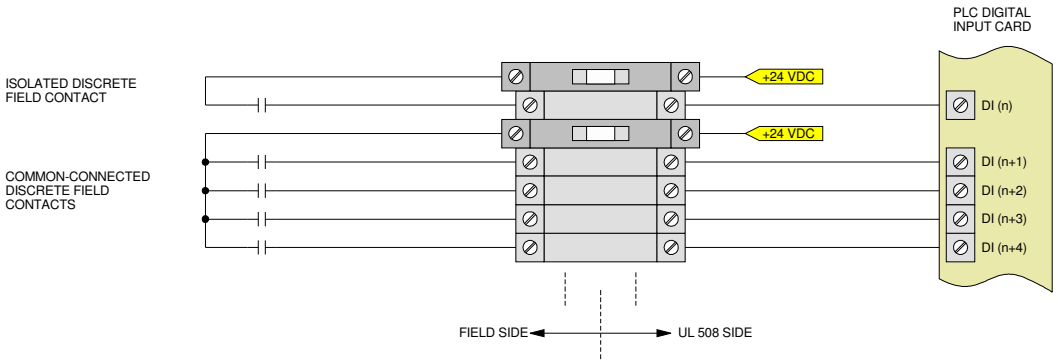
Fuses shall be 0.5 Amp.

Provide a separate gray feedthrough terminal for each digital input channel whether the input channel is assigned or unassigned.

c. Digital Input Connection Methods

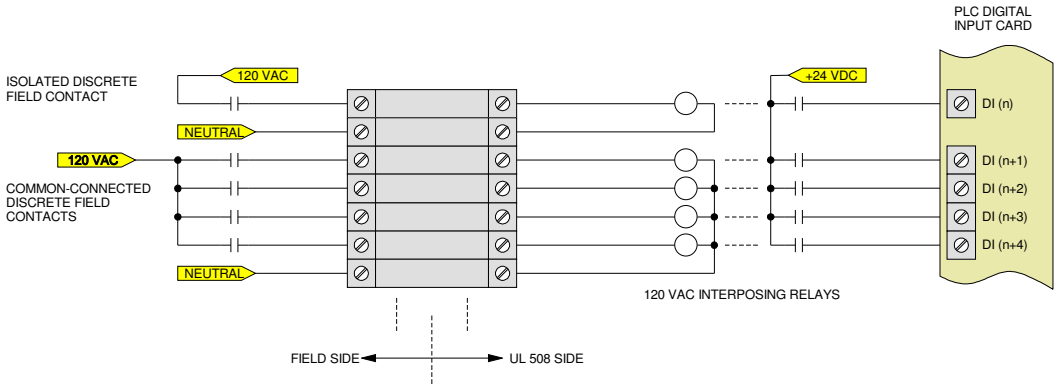
i. Connections to “Dry” Field Contacts

Discrete input field devices with dry Form A or Form B contacts sharing a common cabinet or piece of equipment may be combined into a group sharing a single +24 Vdc fused common as shown below.



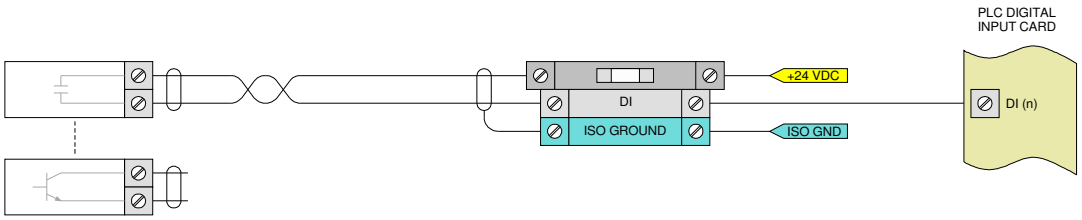
ii. Connections to "Hot" (wet) 120 Vac Field Circuits

Digital inputs derived from 120 Vac "hot" circuits shall be buffered through interposing relays inside the PLC control panel prior to connection to the 24 Vdc Digital Input PLC cards in a manner shown in the Figure below. Reference "PLC 120 Vac - to - 24 Vdc Input Buffer Relays" in Section 2.2 for relay product type.



iii. Digital Pulse Inputs

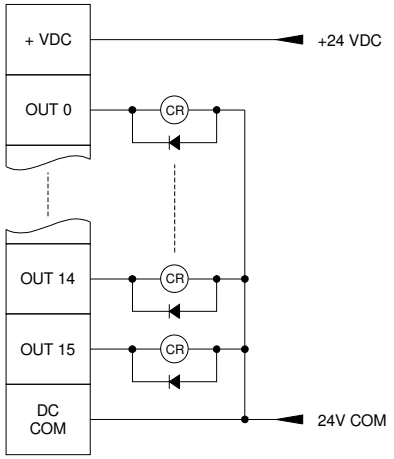
Digital pulse inputs shall be either dry Form A or Form B contacts or active open-collector circuits as shown in the Figure below. The +24 Vdc power shall be provided by the 24 Vdc control system power and shall be separately fused.



6. DIGITAL OUTPUT, Termination and Connectivity

a. Digital Output Type

All digital outputs shall be the "sourcing" type as shown below. Reference Section 13450, Programmable Logic Controller (PLC) Hardware.



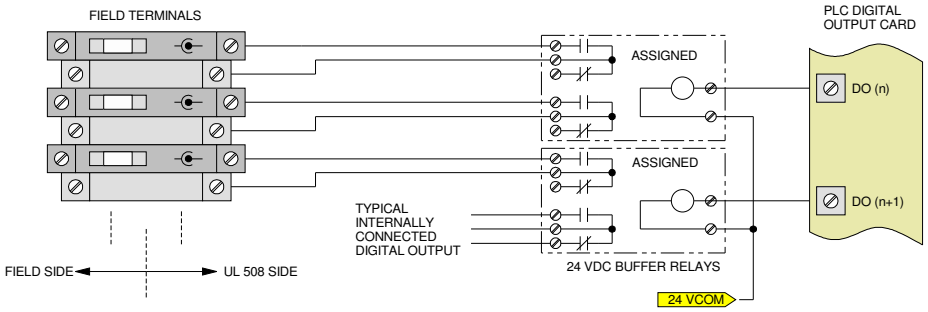
24 VDC, 16 CHANNEL PLC
DIGITAL SOURCING OUTPUT CIRCUI

b. Digital Output Buffer Relays

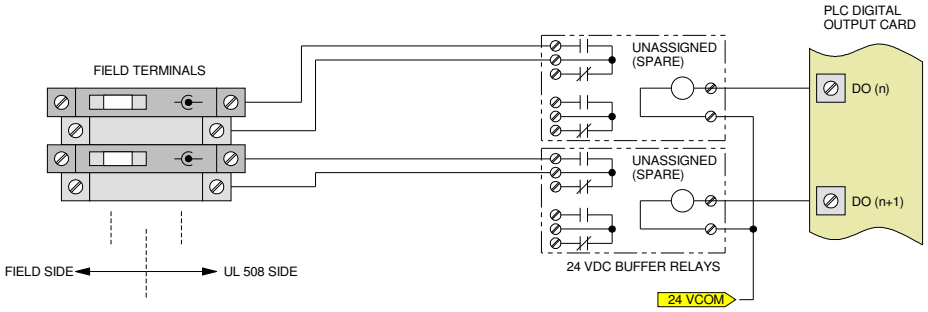
All 24 Vdc digital outputs, even if unassigned (spare), shall be buffered through a DPDT (minimum) interposing relay prior to being connected to other internal circuits or field terminals. 4PDT relays shall be provided where shown on wiring diagrams. Reference "PLC 24 Vdc Output Buffer Relays" in Part 2 for product type.

Internally connected buffered outputs shall not be fused.

Assigned digital outputs shall be assigned to single or double fused output terminal pairs as shown in the Figure below.



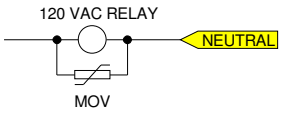
All unassigned digital outputs shall be buffered to a single fused output terminal pair as shown in the Figure below.



G. RELAY COIL SURGE SUPPRESSION

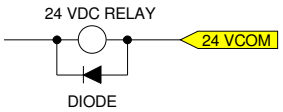
1. 120 Vac Coil Surge Suppression

All 120 Vac coils shall be paralleled by a Metal Oxide Varistor (MOV) type surge suppressor as shown in the Figure below. The suppressor shall be connected directly across the relay socket coil terminals with short wire leads.



2. 24 Vdc Coil Surge Suppression

All 24 Vdc coils shall be paralleled by a reverse-connected shunt diode as shown in the Figure below. The diode shall be connected directly across the relay socket coil terminals with short wire leads. The diode shall be rated at 1 A, 100 PIV minimum.



3.2 SOURCE QUALITY CONTROL

A. Submit a shop test plan indicating how the test will be conducted, and how the system will be verified.

B. Revise all plans upon completion of the work to show the "as shipped" condition of the panel.

C. Allow for the owner and Engineer to witness the shop test. Provide a minimum of 15-days notice prior to the test.

D. Provide a shop test after factory completion and prior to shipment.

1. Test Documentation

   a. Provide a testing procedure and submit to the Engineer at least 1 week prior to the shop test.

   b. Document all required corrections, even those that may be remedied during the shop test.

   c. Issue a copy of the test procedures and necessary corrections to the General Contractor and the Engineer.

   d. Make all necessary corrections before shipping any panels, equipment, or devices to the job site.

   e. Issue a final signed document verifying that each correction has been made.

2. PLC Control Test

   a. Conduct a burn-in period (minimum of 2 days) where the system is operated continuously and checked for proper operation.

   b. Utilize simulated I/Os to verify proper operation. Demonstrate the operation of each digital and analog I/O point.

c. Demonstrate compete connectivity and data transfer over the process control network. Verify the operation of all motor starters and remote devices monitored and controlled over the network.

d. Provide a computer and the software required for testing such that the owner may view the simulation of operator entries of field parameters such as set points and alarm values during the test.

3. Relay and Process Controller Test

Demonstrate the complete operation of the relay logic, backup logic, process controllers, and etc.

4. Motor Starter Test

a. Demonstrate the complete operation of all motor starters. Connect a portable motor to each starter and operate the motor in HAND, OFF, and AUTO modes. Demonstrate the proper operation of all motor safety interlocks.

b. Preprogram all motor starter Human Interface Modules (HIMs) for compliance with motor manufacturer's protection criteria and compliance with the design engineer's control requirements.

5. Other Tests

a. Provide normal operating voltage to all equipment. Demonstrate the operation of all equipment while under power.

b. The entire assembled panel shall be tested to be free from grounds and shorts.

c. Controllers, circuits and interlocks shall be rung out and tested to assure that they function correctly before the panel is shipped.

3.3 INSTALLATION

A. Install freestanding panels on concrete housekeeping pads.

B. Anchor panels rigidly in place with approved anchorage devices. If mounting details are shown on the Plans, then these methods shall be used.

***** END OF SECTION *****

PART 5

WAGE RATES

WASHINGTON STATE PREVAILING WAGE RATES

State of Washington
Department of Labor & Industries

Prevailing Wage Section - Telephone 360-902-5335
PO Box 44540, Olympia, WA 98504-4540

Washington State Prevailing Wage

The PREVAILING WAGES listed here include both the hourly wage rate and the hourly rate of fringe benefits. On public works projects, worker's wage and benefit rates must add to not less than this total. A brief description of overtime calculation requirements are provided on the Benefit Code Key.

Journey Level Prevailing Wage Rates for the Effective Date: 03/24/2016

County	Trade	Job Classification	Wage	Holiday	Overtime	Note
Pacific	Asbestos Abatement Workers	Journey Level	$43.95	5D	1H	
Pacific	Boilermakers	Journey Level	$64.29	5N	1C	
Pacific	Brick Mason	Journey Level	$52.82	5A	1M	
Pacific	Brick Mason	Pointer-Caulker-Cleaner	$52.82	5A	1M	
Pacific	Building Service Employees	Janitor	$9.47		1	
Pacific	Building Service Employees	Shampooer	$9.47		1	
Pacific	Building Service Employees	Waxer	$9.47		1	
Pacific	Building Service Employees	Window Cleaner	$13.22		1	
Pacific	Cabinet Makers (In Shop)	Journey Level	$13.12		1	
Pacific	Carpenters	Acoustical Worker	$54.02	5D	4C	
Pacific	Carpenters	Bridge, Dock And Wharf Carpenters	$54.02	5D	4C	
Pacific	Carpenters	Carpenter	$54.02	5D	4C	
Pacific	Carpenters	Carpenters on Stationary Tools	$54.15	5D	4C	
Pacific	Carpenters	Creosoted Material	$54.12	5D	4C	
Pacific	Carpenters	Floor Finisher	$54.02	5D	4C	
Pacific	Carpenters	Floor Layer	$54.02	5D	4C	
Pacific	Carpenters	Scaffold Erector	$54.02	5D	4C	
Pacific	Cement Masons	Journey Level	$35.33		1	
Pacific	Divers & Tenders	Diver	$107.22	5D	4C	8A
Pacific	Divers & Tenders	Diver On Standby	$64.42	5D	4C	
Pacific	Divers & Tenders	Diver Tender	$58.33	5D	4C	
Pacific	Divers & Tenders	Surface Rcv & Rov Operator	$58.33	5D	4C	
Pacific	Divers & Tenders	Surface Rcv & Rov Operator Tender	$54.27	5A	4C	
Pacific	Dredge Workers	Assistant Engineer	$56.44	5D	3F	
Pacific	Dredge Workers	Assistant Mate (Deckhand)	$56.00	5D	3F	
Pacific	Dredge Workers	Boatmen	$56.44	5D	3F	
Pacific	Dredge Workers	Engineer Welder	$57.51	5D	3F	

Pacific	Dredge Workers	Leverman, Hydraulic	$58.67	5D	3F	
Pacific	Dredge Workers	Mates	$56.44	5D	3F	
Pacific	Dredge Workers	Oiler	$56.00	5D	3F	
Pacific	Drywall Applicator	Journey Level	$54.02	5D	1H	
Pacific	Drywall Tapers	Journey Level	$15.00		1	
Pacific	Electrical Fixture Maintenance Workers	Journey Level	$9.47		1	
Pacific	Electricians - Inside	Cable Splicer	$63.44	5C	1G	
Pacific	Electricians - Inside	Journey Level	$59.79	5C	1G	
Pacific	Electricians - Inside	Lead Covered Cable Splicer	$67.09	5C	1G	
Pacific	Electricians - Inside	Welder	$63.44	5C	1G	
Pacific	Electricians - Motor Shop	Craftsman	$15.37		1	
Pacific	Electricians - Motor Shop	Journey Level	$14.69		1	
Pacific	Electricians - Powerline Construction	Cable Splicer	$74.92	5A	4D	
Pacific	Electricians - Powerline Construction	Certified Line Welder	$65.71	5A	4D	
Pacific	Electricians - Powerline Construction	Groundperson	$44.12	5A	4D	
Pacific	Electricians - Powerline Construction	Heavy Line Equipment Operator	$65.71	5A	4D	
Pacific	Electricians - Powerline Construction	Journey Level Lineperson	$65.71	5A	4D	
Pacific	Electricians - Powerline Construction	Line Equipment Operator	$55.34	5A	4D	
Pacific	Electricians - Powerline Construction	Pole Sprayer	$65.71	5A	4D	
Pacific	Electricians - Powerline Construction	Powderperson	$49.16	5A	4D	
Pacific	Electronic Technicians	Journey Level	$12.07		1	
Pacific	Elevator Constructors	Mechanic	$85.80	5N	4A	
Pacific	Elevator Constructors	Mechanic In Charge	$92.74	5N	4A	
Pacific	Fabricated Precast Concrete Products	Journey Level - In-Factory Work Only	$13.50		1	
Pacific	Fence Erectors	Fence Erector	$13.80		1	
Pacific	Fence Erectors	Fence Laborer	$11.60		1	
Pacific	Flaggers	Journey Level	$37.26	7A	3I	
Pacific	Glaziers	Journey Level	$27.24	5R	1Z	
Pacific	Heat & Frost Insulators And Asbestos Workers	Journeyman	$63.18	5J	1S	
Pacific	Heating Equipment Mechanics	Journey Level	$72.83	7F	1E	
Pacific	Hod Carriers & Mason Tenders	Journey Level	$45.32	7A	3I	
Pacific	Industrial Power Vacuum Cleaner	Journey Level	$9.47		1	
Pacific	Inland Boatmen	Boat Operator	$56.78	5B	1K	
Pacific	Inland Boatmen	Cook	$53.30	5B	1K	
Pacific	Inland Boatmen	Deckhand	$53.30	5B	1K	
Pacific	Inland Boatmen	Deckhand Engineer	$54.32	5B	1K	

Pacific	Inland Boatmen	Launch Operator	$55.57	5B	1K	
Pacific	Inland Boatmen	Mate	$55.57	5B	1K	
Pacific	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Cleaner Operator, Foamer Operator	$9.73		1	
Pacific	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Grout Truck Operator	$11.48		1	
Pacific	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Head Operator	$12.78		1	
Pacific	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Technician	$9.47		1	
Pacific	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Tv Truck Operator	$10.53		1	
Pacific	Insulation Applicators	Journey Level	$54.02	5D	4C	
Pacific	Ironworkers	Journey Level	$48.33		1	
Pacific	Laborers	Air, Gas Or Electric Vibrating Screed	$43.95	7A	3I	
Pacific	Laborers	Airtrac Drill Operator	$45.32	7A	3I	
Pacific	Laborers	Ballast Regular Machine	$43.95	7A	3I	
Pacific	Laborers	Batch Weighman	$37.26	7A	3I	
Pacific	Laborers	Brick Pavers	$43.95	7A	3I	
Pacific	Laborers	Brush Cutter	$43.95	7A	3I	
Pacific	Laborers	Brush Hog Feeder	$43.95	7A	3I	
Pacific	Laborers	Burner	$43.95	7A	3I	
Pacific	Laborers	Caisson Worker	$45.32	7A	3I	
Pacific	Laborers	Carpenter Tender	$43.95	7A	3I	
Pacific	Laborers	Caulker	$43.95	7A	3I	
Pacific	Laborers	Cement Dumper-paving	$44.76	7A	3I	
Pacific	Laborers	Cement Finisher Tender	$43.95	7A	3I	
Pacific	Laborers	Change House Or Dry Shack	$43.95	7A	3I	
Pacific	Laborers	Chipping Gun (under 30 Lbs.)	$43.95	7A	3I	
Pacific	Laborers	Chipping Gun(30 Lbs. And Over)	$44.76	7A	3I	
Pacific	Laborers	Choker Setter	$43.95	7A	3I	
Pacific	Laborers	Chuck Tender	$43.95	7A	3I	
Pacific	Laborers	Clary Power Spreader	$44.76	7A	3I	
Pacific	Laborers	Clean-up Laborer	$43.95	7A	3I	
Pacific	Laborers	Concrete Dumper/chute Operator	$44.76	7A	3I	
Pacific	Laborers	Concrete Form Stripper	$43.95	7A	3I	
Pacific	Laborers	Concrete Placement Crew	$44.76	7A	3I	
Pacific	Laborers	Concrete Saw Operator/core Driller	$44.76	7A	3I	
Pacific	Laborers	Crusher Feeder	$37.26	7A	3I	
Pacific	Laborers	Curing Laborer	$43.95	7A	3I	

Pacific	Laborers	Demolition: Wrecking & Moving (incl. Charred Material)	$43.95	7A	3I	
Pacific	Laborers	Ditch Digger	$43.95	7A	3I	
Pacific	Laborers	Diver	$45.32	7A	3I	
Pacific	Laborers	Drill Operator (hydraulic,diamond)	$44.76	7A	3I	
Pacific	Laborers	Dry Stack Walls	$43.95	7A	3I	
Pacific	Laborers	Dump Person	$43.95	7A	3I	
Pacific	Laborers	Epoxy Technician	$43.95	7A	3I	
Pacific	Laborers	Erosion Control Worker	$43.95	7A	3I	
Pacific	Laborers	Faller & Bucker Chain Saw	$44.76	7A	3I	
Pacific	Laborers	Fine Graders	$43.95	7A	3I	
Pacific	Laborers	Firewatch	$37.26	7A	3I	
Pacific	Laborers	Form Setter	$43.95	7A	3I	
Pacific	Laborers	Gabian Basket Builders	$43.95	7A	3I	
Pacific	Laborers	General Laborer	$43.95	7A	3I	
Pacific	Laborers	Grade Checker & Transit Person	$45.32	7A	3I	
Pacific	Laborers	Grinders	$43.95	7A	3I	
Pacific	Laborers	Grout Machine Tender	$43.95	7A	3I	
Pacific	Laborers	Groutmen (pressure)including Post Tension Beams	$44.76	7A	3I	
Pacific	Laborers	Guardrail Erector	$43.95	7A	3I	
Pacific	Laborers	Hazardous Waste Worker (level A)	$45.32	7A	3I	
Pacific	Laborers	Hazardous Waste Worker (level B)	$44.76	7A	3I	
Pacific	Laborers	Hazardous Waste Worker (level C)	$43.95	7A	3I	
Pacific	Laborers	High Scaler	$45.32	7A	3I	
Pacific	Laborers	Jackhammer	$44.76	7A	3I	
Pacific	Laborers	Laserbeam Operator	$44.76	7A	3I	
Pacific	Laborers	Maintenance Person	$43.95	7A	3I	
Pacific	Laborers	Manhole Builder-mudman	$44.76	7A	3I	
Pacific	Laborers	Material Yard Person	$43.95	7A	3I	
Pacific	Laborers	Motorman-dinky Locomotive	$44.76	7A	3I	
Pacific	Laborers	Nozzleman (concrete Pump, Green Cutter When Using Combination Of High Pressure Air & Water On Concrete & Rock, Sandblast, Gunite, Shotcrete, Water Bla	$44.76	7A	3I	
Pacific	Laborers	Pavement Breaker	$44.76	7A	3I	
Pacific	Laborers	Pilot Car	$37.26	7A	3I	
Pacific	Laborers	Pipe Layer Lead	$45.32	7A	3I	
Pacific	Laborers	Pipe Layer/tailor	$44.76	7A	3I	
Pacific	Laborers	Pipe Pot Tender	$44.76	7A	3I	
Pacific	Laborers	Pipe Reliner	$44.76	7A	3I	
Pacific	Laborers	Pipe Wrapper	$44.76	7A	3I	

Pacific	Laborers	Pot Tender	$43.95	7A	3I	
Pacific	Laborers	Powderman	$45.32	7A	3I	
Pacific	Laborers	Powderman's Helper	$43.95	7A	3I	
Pacific	Laborers	Power Jacks	$44.76	7A	3I	
Pacific	Laborers	Railroad Spike Puller - Power	$44.76	7A	3I	
Pacific	Laborers	Raker - Asphalt	$45.32	7A	3I	
Pacific	Laborers	Re-timberman	$45.32	7A	3I	
Pacific	Laborers	Remote Equipment Operator	$44.76	7A	3I	
Pacific	Laborers	Rigger/signal Person	$44.76	7A	3I	
Pacific	Laborers	Rip Rap Person	$43.95	7A	3I	
Pacific	Laborers	Rivet Buster	$44.76	7A	3I	
Pacific	Laborers	Rodder	$44.76	7A	3I	
Pacific	Laborers	Scaffold Erector	$43.95	7A	3I	
Pacific	Laborers	Scale Person	$43.95	7A	3I	
Pacific	Laborers	Sloper (over 20")	$44.76	7A	3I	
Pacific	Laborers	Sloper Sprayer	$43.95	7A	3I	
Pacific	Laborers	Spreader (concrete)	$44.76	7A	3I	
Pacific	Laborers	Stake Hopper	$43.95	7A	3I	
Pacific	Laborers	Stock Piler	$43.95	7A	3I	
Pacific	Laborers	Tamper & Similar Electric, Air & Gas Operated Tools	$44.76	7A	3I	
Pacific	Laborers	Tamper (multiple & Self-propelled)	$44.76	7A	3I	
Pacific	Laborers	Timber Person - Sewer (lagger, Shorer & Cribber)	$44.76	7A	3I	
Pacific	Laborers	Toolroom Person (at Jobsite)	$43.95	7A	3I	
Pacific	Laborers	Topper	$43.95	7A	3I	
Pacific	Laborers	Track Laborer	$43.95	7A	3I	
Pacific	Laborers	Track Liner (power)	$44.76	7A	3I	
Pacific	Laborers	Traffic Control Laborer	$39.84	7A	3I	8R
Pacific	Laborers	Traffic Control Supervisor	$39.84	7A	3I	8R
Pacific	Laborers	Truck Spotter	$43.95	7A	3I	
Pacific	Laborers	Tugger Operator	$44.76	7A	3I	
Pacific	Laborers	Tunnel Work-Compressed Air Worker 0-30 psi	$74.29	7A	3I	8Q
Pacific	Laborers	Tunnel Work-Compressed Air Worker 30.01-44.00 psi	$79.32	7A	3I	8Q
Pacific	Laborers	Tunnel Work-Compressed Air Worker 44.01-54.00 psi	$83.00	7A	3I	8Q
Pacific	Laborers	Tunnel Work-Compressed Air Worker 54.01-60.00 psi	$88.70	7A	3I	8Q
Pacific	Laborers	Tunnel Work-Compressed Air Worker 60.01-64.00 psi	$90.82	7A	3I	8Q
Pacific	Laborers	Tunnel Work-Compressed Air Worker 64.01-68.00 psi	$95.92	7A	3I	8Q
Pacific	Laborers	Tunnel Work-Compressed Air Worker 68.01-70.00 psi	$97.82	7A	3I	8Q

Pacific	Laborers	Tunnel Work-Compressed Air Worker 70.01-72.00 psi	$99.82	7A	3I	8Q
Pacific	Laborers	Tunnel Work-Compressed Air Worker 72.01-74.00 psi	$101.82	7A	3I	8Q
Pacific	Laborers	Tunnel Work-Guage and Lock Tender	$45.42	7A	3I	8Q
Pacific	Laborers	Tunnel Work-Miner	$45.42	7A	3I	8Q
Pacific	Laborers	Vibrator	$44.76	7A	3I	
Pacific	Laborers	Vinyl Seamer	$43.95	7A	3I	
Pacific	Laborers	Watchman	$33.86	7A	3I	
Pacific	Laborers	Welder	$44.76	7A	3I	
Pacific	Laborers	Well Point Laborer	$44.76	7A	3I	
Pacific	Laborers	Window Washer/cleaner	$33.86	7A	3I	
Pacific	Laborers - Underground Sewer & Water	General Laborer & Topman	$43.95	7A	3I	
Pacific	Laborers - Underground Sewer & Water	Pipe Layer	$44.76	7A	3I	
Pacific	Landscape Construction	Irrigation Or Lawn Sprinkler Installers	$11.42		1	
Pacific	Landscape Construction	Landscape Equipment Operators Or Truck Drivers	$9.47		1	
Pacific	Landscape Construction	Landscaping Or Planting Laborers	$9.47		1	
Pacific	Lathers	Journey Level	$54.02	5D	1H	
Pacific	Marble Setters	Journey Level	$52.82	5A	1M	
Pacific	Metal Fabrication (In Shop)	Fitter	$15.16		1	
Pacific	Metal Fabrication (In Shop)	Laborer	$11.13		1	
Pacific	Metal Fabrication (In Shop)	Machine Operator	$10.66		1	
Pacific	Metal Fabrication (In Shop)	Painter	$11.41		1	
Pacific	Metal Fabrication (In Shop)	Welder	$15.16		1	
Pacific	Millwright	Journey Level	$55.52	5D	4C	
Pacific	Modular Buildings	Cabinet Assembly	$9.98		1	
Pacific	Modular Buildings	Electrician	$9.98		1	
Pacific	Modular Buildings	Equipment Maintenance	$9.98		1	
Pacific	Modular Buildings	Plumber	$9.98		1	
Pacific	Modular Buildings	Production Worker	$9.75		1	
Pacific	Modular Buildings	Tool Maintenance	$9.98		1	
Pacific	Modular Buildings	Utility Person	$9.98		1	
Pacific	Modular Buildings	Welder	$9.98		1	
Pacific	Painters	Journey Level	$39.35	6Z	2B	
Pacific	Pile Driver	Journey Level	$39.51		1	
Pacific	Plasterers	Journey Level	$51.68	7Q	1R	
Pacific	Playground & Park Equipment Installers	Journey Level	$9.47		1	
Pacific	Plumbers & Pipefitters	Journey Level	$38.95		1	
Pacific	Power Equipment Operators	Asphalt Plant Operator	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Assistant Engineers	$53.57	7A	3C	8P

Pacific	Power Equipment Operators	Barrier Machine (zipper)	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Batch Plant Operator: Concrete	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Bobcat	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Brokk - Remote Demolition Equipment	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Brooms	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Bump Cutter	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Cableways	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Chipper	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Compressor	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Concrete Pump: Truck Mount With Boom Attachment Over 42m	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Concrete Finish Machine -laser Screed	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Concrete Pump: Truck Mount With Boom Attachment Up To 42m	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Conveyors	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Cranes, 100 Tons - 199 Tons, Or 150 Ft Of Boom (including Jib With Attachments)	$57.51	7A	3C	8P
Pacific	Power Equipment Operators	Cranes, 200 Tons To 300 Tons, Or 250 Ft Of Boom (including Jib With Attachments)	$58.10	7A	3C	8P
Pacific	Power Equipment Operators	Cranes: 20 Tons Through 44 Tons With Attachments	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Cranes: 45 Tons Through 99 Tons, Under 150' Of Boom (including Jib With Attachments)	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Cranes: A-frame - 10 Tons And Under	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Cranes: Friction 100 Tons Through 199 Tons	$58.10	7A	3C	8P
Pacific	Power Equipment Operators	Cranes: Friction Over 200 Tons	$58.67	7A	3C	8P
Pacific	Power Equipment Operators	Cranes: Over 300 Tons, Or 300' Of Boom (Including Jib With Attachments)	$58.67	7A	3C	8P
Pacific	Power Equipment Operators	Cranes: Through 19 Tons With Attachments A-frame Over 10 Tons	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Crusher	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Deck Engineer/deck Winches (power)	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Derricks, On Building Work	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Dozers D-9 & Under	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Drill Oilers: Auger Type, Truck Or Crane Mount	$56.00	7A	3C	8P

Pacific	Power Equipment Operators	Drilling Machine	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Elevator And Man-lift: Permanent And Shaft Type	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Finishing Machine, Bidwell And Gamaco & Similar Equipment	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Forklift: 3000 Lbs And Over With Attachments	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Forklifts: Under 3000 Lbs. With Attachments	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Grade Engineer: Using Blueprints, Cut Sheets,etc.	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Gradechecker/stakeman	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Guardrail Punch	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Horizontal/directional Drill Locator	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Horizontal/directional Drill Operator	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Hydralifts/Boom Trucks Over 10 Tons	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Hydralifts/boom Trucks, 10 Tons And Under	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Loader, Overhead 8 Yards. & Over	$57.51	7A	3C	8P
Pacific	Power Equipment Operators	Loader, Overhead, 6 Yards. But Not Including 8 Yards	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Loaders, Overhead Under 6 Yards	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Loaders, Plant Feed	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Loaders: Elevating Type Belt	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Locomotives, All	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Material Transfer Device	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Mechanics, All (Leadmen - $0.50 Per Hour Over Mechanic)	$57.51	7A	3C	8P
Pacific	Power Equipment Operators	Motor Patrol Grader - Non-finishing	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Motor Patrol Graders, Finishing	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header And/or Shield	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Oil Distributors, Blower Distribution & Mulch Seeding Operator	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Outside Hoists (elevators And Manlifts), Air Tuggers,strato	$56.00	7A	3C	8P

Pacific	Power Equipment Operators	Overhead, Bridge Type Crane: 20 Tons Through 44 Tons	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Overhead, Bridge Type: 100 Tons And Over	$57.51	7A	3C	8P
Pacific	Power Equipment Operators	Overhead, Bridge Type: 45 Tons Through 99 Tons	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Pavement Breaker	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Pile Driver (other Than Crane Mount)	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Plant Oiler - Asphalt, Crusher	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Posthole Digger, Mechanical	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Power Plant	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Pumps - Water	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Quad 9, HD 41, D10 And Over	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Quick Tower - No Cab, Under 100 Feet In Height Based To Boom	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Remote Control Operator On Rubber Tired Earth Moving Equipment	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Rigger And Bellman	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Rollagon	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Roller, Other Than Plant Mix	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Roller, Plant Mix Or Multi-lift Materials	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Roto-mill, Roto-grinder	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Saws - Concrete	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Scraper, Self Propelled Under 45 Yards	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Scrapers - Concrete & Carry All	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Scrapers, Self-propelled: 45 Yards And Over	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Service Engineers - Equipment	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Shotcrete/gunite Equipment	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Shovel , Excavator, Backhoe, Tractors Under 15 Metric Tons.	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	$57.51	7A	3C	8P
Pacific	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 90 Metric Tons	$58.10	7A	3C	8P
Pacific	Power Equipment Operators	Slipform Pavers	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Spreader, Topsider & Screedman	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Subgrader Trimmer	$56.44	7A	3C	8P

Pacific	Power Equipment Operators	Tower Bucket Elevators	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Tower Crane Over 175'in Height, Base To Boom	$58.10	7A	3C	8P
Pacific	Power Equipment Operators	Tower Crane Up: To 175' In Height, Base To Boom	$57.51	7A	3C	8P
Pacific	Power Equipment Operators	Transporters, All Track Or Truck Type	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Trenching Machines	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Truck Crane Oiler/driver - 100 Tons And Over	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Truck Crane Oiler/driver Under 100 Tons	$56.00	7A	3C	8P
Pacific	Power Equipment Operators	Truck Mount Portable Conveyor	$56.44	7A	3C	8P
Pacific	Power Equipment Operators	Welder	$56.94	7A	3C	8P
Pacific	Power Equipment Operators	Wheel Tractors, Farmall Type	$53.57	7A	3C	8P
Pacific	Power Equipment Operators	Yo Yo Pay Dozer	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Asphalt Plant Operator	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Assistant Engineers	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Barrier Machine (zipper)	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Batch Plant Operator: Concrete	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Bobcat	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Brokk - Remote Demolition Equipment	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Brooms	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Bump Cutter	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Cableways	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Chipper	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Compressor	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Over 42m	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Concrete Finish Machine -laser Screed	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Up To 42m	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Conveyors	$56.00	7A	3C	8P

Pacific	Power Equipment Operators-Underground Sewer & Water	Cranes, 100 Tons - 199 Tons, Or 150 Ft Of Boom (including Jib With Attachments)	$57.51	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Cranes, 200 Tons To 300 Tons, Or 250 Ft Of Boom (including Jib With Attachments)	$58.10	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Cranes: 20 Tons Through 44 Tons With Attachments	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Cranes: 45 Tons Through 99 Tons, Under 150' Of Boom (including Jib With Attachments)	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Cranes: A-frame - 10 Tons And Under	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Cranes: Friction 100 Tons Through 199 Tons	$58.10	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Cranes: Friction Over 200 Tons	$58.67	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Cranes: Over 300 Tons, Or 300' Of Boom (Including Jib With Attachments)	$58.67	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Cranes: Through 19 Tons With Attachments A-frame Over 10 Tons	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Crusher	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Deck Engineer/deck Winches (power)	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Derricks, On Building Work	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Dozers D-9 & Under	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Drill Oilers: Auger Type, Truck Or Crane Mount	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Drilling Machine	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Elevator And Man-lift: Permanent And Shaft Type	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Finishing Machine, Bidwell And Gamaco & Similar Equipment	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Forklift: 3000 Lbs And Over With Attachments	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Forklifts: Under 3000 Lbs. With Attachments	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Grade Engineer: Using Blueprints, Cut Sheets,etc.	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Gradechecker/stakeman	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Guardrail Punch	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over	$56.94	7A	3C	8P

Pacific	Power Equipment Operators-Underground Sewer & Water	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Horizontal/directional Drill Locator	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Horizontal/directional Drill Operator	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Hydralifts/Boom Trucks Over 10 Tons	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Hydralifts/boom Trucks, 10 Tons And Under	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Loader, Overhead 8 Yards. & Over	$57.51	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Loader, Overhead, 6 Yards. But Not Including 8 Yards	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Loaders, Overhead Under 6 Yards	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Loaders, Plant Feed	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Loaders: Elevating Type Belt	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Locomotives, All	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Material Transfer Device	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Mechanics, All (Leadmen - $0.50 Per Hour Over Mechanic)	$57.51	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Motor Patrol Grader - Non-finishing	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Motor Patrol Graders, Finishing	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header And/or Shield	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Oil Distributors, Blower Distribution & Mulch Seeding Operator	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Outside Hoists (elevators And Manlifts), Air Tuggers,strato	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Overhead, Bridge Type Crane: 20 Tons Through 44 Tons	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Overhead, Bridge Type: 100 Tons And Over	$57.51	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Overhead, Bridge Type: 45 Tons Through 99 Tons	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Pavement Breaker	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Pile Driver (other Than Crane Mount)	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Plant Oiler - Asphalt, Crusher	$56.00	7A	3C	8P

Pacific	Power Equipment Operators-Underground Sewer & Water	Posthole Digger, Mechanical	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Power Plant	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Pumps - Water	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Quad 9, HD 41, D10 And Over	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Quick Tower - No Cab, Under 100 Feet In Height Based To Boom	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Remote Control Operator On Rubber Tired Earth Moving Equipment	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Rigger And Bellman	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Rollagon	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Roller, Other Than Plant Mix	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Roller, Plant Mix Or Multi-lift Materials	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Roto-mill, Roto-grinder	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Saws - Concrete	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Scraper, Self Propelled Under 45 Yards	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Scrapers - Concrete & Carry All	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Scrapers, Self-propelled: 45 Yards And Over	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Service Engineers - Equipment	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Shotcrete/gunite Equipment	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Shovel , Excavator, Backhoe, Tractors Under 15 Metric Tons.	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	$57.51	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 90 Metric Tons	$58.10	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Slipform Pavers	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Spreader, Topsider & Screedman	$56.94	7A	3C	8P

Pacific	Power Equipment Operators-Underground Sewer & Water	Subgrader Trimmer	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Tower Bucket Elevators	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Tower Crane Over 175'in Height, Base To Boom	$58.10	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Tower Crane: Up To 175' In Height, Base To Boom	$57.51	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Transporters, All Track Or Truck Type	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Trenching Machines	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Truck Crane Oiler/driver - 100 Tons And Over	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Truck Crane Oiler/driver Under 100 Tons	$56.00	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Truck Mount Portable Conveyor	$56.44	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Welder	$56.94	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Wheel Tractors, Farmall Type	$53.57	7A	3C	8P
Pacific	Power Equipment Operators-Underground Sewer & Water	Yo Yo Pay Dozer	$56.44	7A	3C	8P
Pacific	Power Line Clearance Tree Trimmers	Journey Level In Charge	$45.75	5A	4A	
Pacific	Power Line Clearance Tree Trimmers	Spray Person	$43.38	5A	4A	
Pacific	Power Line Clearance Tree Trimmers	Tree Equipment Operator	$45.75	5A	4A	
Pacific	Power Line Clearance Tree Trimmers	Tree Trimmer	$40.84	5A	4A	
Pacific	Power Line Clearance Tree Trimmers	Tree Trimmer Groundperson	$30.74	5A	4A	
Pacific	Refrigeration & Air Conditioning Mechanics	Mechanic	$64.86	5A	1G	
Pacific	Residential Brick Mason	Journey Level	$17.82		1	
Pacific	Residential Carpenters	Journey Level	$17.94		1	
Pacific	Residential Cement Masons	Journey Level	$25.55		1	
Pacific	Residential Drywall Applicators	Journey Level	$40.64	5D	4C	
Pacific	Residential Drywall Tapers	Journey Level	$10.02		1	
Pacific	Residential Electricians	Journey Level	$30.28	5A	1B	
Pacific	Residential Glaziers	Journey Level	$10.72		1	
Pacific	Residential Insulation Applicators	Journey Level	$9.47		1	
Pacific	Residential Laborers	Journey Level	$25.59		1	
Pacific	Residential Marble Setters	Journey Level	$17.82		1	
Pacific	Residential Painters	Journey Level	$9.79		1	
Pacific	Residential Plumbers & Pipefitters	Journey Level	$22.95		1	

Pacific	Residential Refrigeration & Air Conditioning Mechanics	Journey Level	$9.47		1	
Pacific	Residential Sheet Metal Workers	Journey Level (Field or Shop)	$30.73		1	
Pacific	Residential Soft Floor Layers	Journey Level	$10.88		1	
Pacific	Residential Sprinkler Fitters (Fire Protection)	Journey Level	$9.47		1	
Pacific	Residential Stone Masons	Journey Level	$17.82		1	
Pacific	Residential Terrazzo Workers	Journey Level	$9.47		1	
Pacific	Residential Terrazzo/Tile Finishers	Journey Level	$9.47		1	
Pacific	Residential Tile Setters	Journey Level	$9.47		1	
Pacific	Roofers	Journey Level	$37.03		1	
Pacific	Sheet Metal Workers	Journey Level (Field or Shop)	$72.83	7F	1E	
Pacific	Sign Makers & Installers (Electrical)	Journey Level	$18.04		1	
Pacific	Sign Makers & Installers (Non-Electrical)	Journey Level	$18.04		1	
Pacific	Soft Floor Layers	Journey Level	$10.88		1	
Pacific	Solar Controls For Windows	Journey Level	$10.31		1	
Pacific	Sprinkler Fitters (Fire Protection)	Journey Level	$34.70		1	
Pacific	Stage Rigging Mechanics (Non Structural)	Journey Level	$13.23		1	
Pacific	Stone Masons	Journey Level	$52.82	5A	1M	
Pacific	Street And Parking Lot Sweeper Workers	Journey Level	$16.00		1	
Pacific	Surveyors	All Classifications	$44.15	Null	1	
Pacific	Telecommunication Technicians	Journey Level	$12.07		1	
Pacific	Telephone Line Construction - Outside	Cable Splicer	$37.60	5A	2B	
Pacific	Telephone Line Construction - Outside	Hole Digger/Ground Person	$20.79	5A	2B	
Pacific	Telephone Line Construction - Outside	Installer (Repairer)	$36.02	5A	2B	
Pacific	Telephone Line Construction - Outside	Special Aparatus Installer I	$37.60	5A	2B	
Pacific	Telephone Line Construction - Outside	Special Apparatus Installer II	$36.82	5A	2B	
Pacific	Telephone Line Construction - Outside	Telephone Equipment Operator (Heavy)	$37.60	5A	2B	
Pacific	Telephone Line Construction - Outside	Telephone Equipment Operator (Light)	$34.94	5A	2B	
Pacific	Telephone Line Construction - Outside	Telephone Lineperson	$34.93	5A	2B	
Pacific	Telephone Line Construction - Outside	Television Groundperson	$19.73	5A	2B	
Pacific	Telephone Line Construction - Outside	Television Lineperson/Installer	$26.31	5A	2B	
Pacific	Telephone Line Construction - Outside	Television System Technician	$31.50	5A	2B	

Pacific	Telephone Line Construction - Outside	Television Technician	$28.23	5A	2B	
Pacific	Telephone Line Construction - Outside	Tree Trimmer	$34.93	5A	2B	
Pacific	Terrazzo Workers	Journey Level	$47.46	5A	1M	
Pacific	Tile Setters	Journey Level	$47.46	5A	1M	
Pacific	Tile, Marble & Terrazzo Finishers	Finisher	$38.29	5A	1B	
Pacific	Traffic Control Stripers	Journey Level	$44.63	7P	1K	
Pacific	Truck Drivers	Asphalt Mix Over 16 Yards (W. WA-Joint Council 28)	$51.25	5D	3A	8L
Pacific	Truck Drivers	Asphalt Mix To 16 Yards (W. WA-Joint Council 28)	$50.41	5D	3A	8L
Pacific	Truck Drivers	Dump Truck	$17.98		1	
Pacific	Truck Drivers	Dump Truck And Trailer	$17.98		1	
Pacific	Truck Drivers	Other Trucks	$21.54		1	
Pacific	Truck Drivers	Transit Mixer	$22.31		1	
Pacific	Well Drillers & Irrigation Pump Installers	Irrigation Pump Installer	$11.60		1	
Pacific	Well Drillers & Irrigation Pump Installers	Oiler	$9.47		1	
Pacific	Well Drillers & Irrigation Pump Installers	Well Driller	$11.60		1	

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Overtime Codes

Overtime calculations are based on the hourly rate actually paid to the worker. On public works projects, the hourly rate must be not less than the prevailing rate of wage minus the hourly rate of the cost of fringe benefits actually provided for the worker.

1. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.

B. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

C. The first two (2) hours after eight (8) regular hours Monday through Friday and the first ten (10) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other overtime hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

D. The first two (2) hours before or after a five-eight (8) hour workweek day or a four-ten (10) hour workweek day and the first eight (8) hours worked the next day after either workweek shall be paid at one and one-half times the hourly rate of wage. All additional hours worked and all worked on Sundays and holidays shall be paid at double the hourly rate of wage.

E. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

F. The first two (2) hours after eight (8) regular hours Monday through Friday and the first ten (10) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other overtime hours worked, except Labor Day, shall be paid at double the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage.

G. The first ten (10) hours worked on Saturdays and the first ten (10) hours worked on a fifth calendar weekday in a four-ten hour schedule, shall be paid at one and one-half times the hourly rate of wage. All hours worked in excess of ten (10) hours per day Monday through Saturday and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

H. All hours worked on Saturdays (except makeup days if work is lost due to inclement weather conditions or equipment breakdown) shall be paid at one and one-half times the hourly rate of wage. All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

I. All hours worked on Sundays and holidays shall also be paid at double the hourly rate of wage.

J. The first two (2) hours after eight (8) regular hours Monday through Friday and the first ten (10) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked over ten (10) hours Monday through Saturday, Sundays and holidays shall be paid at double the hourly rate of wage.

K. All hours worked on Saturdays and Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.

M. All hours worked on Saturdays (except makeup days if work is lost due to inclement weather conditions) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

N. All hours worked on Saturdays (except makeup days) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

Overtime Codes Continued

1. O. The first ten (10) hours worked on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays, holidays and after twelve (12) hours, Monday through Friday and after ten (10) hours on Saturday shall be paid at double the hourly rate of wage.

P. All hours worked on Saturdays (except makeup days if circumstances warrant) and Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.

Q. The first two (2) hours after eight (8) regular hours Monday through Friday and up to ten (10) hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked in excess of ten (10) hours per day Monday through Saturday and all hours worked on Sundays and holidays (except Christmas day) shall be paid at double the hourly rate of wage. All hours worked on Christmas day shall be paid at two and one-half times the hourly rate of wage.

R. All hours worked on Sundays and holidays shall be paid at two times the hourly rate of wage.

S. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays and all other overtime hours worked, except Labor Day, shall be paid at double the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage.

U. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays (except Labor Day) shall be paid at two times the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage.

V. All hours worked on Sundays and holidays (except Thanksgiving Day and Christmas day) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Thanksgiving Day and Christmas day shall be paid at double the hourly rate of wage.

W. All hours worked on Saturdays and Sundays (except make-up days due to conditions beyond the control of the employer)) shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.

X. The first four (4) hours after eight (8) regular hours Monday through Friday and the first twelve (12) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked over twelve (12) hours Monday through Saturday, Sundays and holidays shall be paid at double the hourly rate of wage. When holiday falls on Saturday or Sunday, the day before Saturday, Friday, and the day after Sunday, Monday, shall be considered the holiday and all work performed shall be paid at double the hourly rate of wage.

Y. All hours worked outside the hours of 5:00 am and 5:00 pm (or such other hours as may be agreed upon by any employer and the employee) and all hours worked in excess of eight (8) hours per day (10 hours per day for a 4 x 10 workweek) and on Saturdays and holidays (except labor day) shall be paid at one and one-half times the hourly rate of wage. (except for employees who are absent from work without prior approval on a scheduled workday during the workweek shall be paid at the straight-time rate until they have worked 8 hours in a day (10 in a 4 x 10 workweek) or 40 hours during that workweek.) All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and Labor Day shall be paid at double the hourly rate of wage.

Z. All hours worked on Saturdays and Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid the straight time rate of pay in addition to holiday pay.

Overtime Codes Continued

2. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.

   B. All hours worked on holidays shall be paid at one and one-half times the hourly rate of wage.

   C. All hours worked on Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at two times the hourly rate of wage.

   F. The first eight (8) hours worked on holidays shall be paid at the straight hourly rate of wage in addition to the holiday pay. All hours worked in excess of eight (8) hours on holidays shall be paid at double the hourly rate of wage.

   G. All hours worked on Sunday shall be paid at two times the hourly rate of wage. All hours worked on paid holidays shall be paid at two and one-half times the hourly rate of wage including holiday pay.

   H. All hours worked on Sunday shall be paid at two times the hourly rate of wage. All hours worked on holidays shall be paid at one and one-half times the hourly rate of wage.

   O. All hours worked on Sundays and holidays shall be paid at one and one-half times the hourly rate of wage.

   R. All hours worked on Sundays and holidays and all hours worked over sixty (60) in one week shall be paid at double the hourly rate of wage.

   U. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked over 12 hours in a day or on Sundays and holidays shall be paid at double the hourly rate of wage.

   W. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage. On a four-day, ten-hour weekly schedule, either Monday thru Thursday or Tuesday thru Friday schedule, all hours worked after ten shall be paid at double the hourly rate of wage. The first eight (8) hours worked on the fifth day shall be paid at one and one-half times the hourly rate of wage. All other hours worked on the fifth, sixth, and seventh days and on holidays shall be paid at double the hourly rate of wage.

3. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.

   A. Work performed in excess of eight (8) hours of straight time per day, or ten (10) hours of straight time per day when four ten (10) hour shifts are established, or forty (40) hours of straight time per week, Monday through Friday, or outside the normal shift, and all work on Saturdays shall be paid at time and one-half the straight time rate. Hours worked over twelve hours (12) in a single shift and all work performed after 6:00 pm Saturday to 6:00 am Monday and holidays shall be paid at double the straight time rate of pay. Any shift starting between the hours of 6:00 pm and midnight shall receive an additional one dollar ($1.00) per hour for all hours worked that shift. The employer shall have the sole discretion to assign overtime work to employees. Primary consideration for overtime work shall be given to employees regularly assigned to the work to be performed on overtime situations. After an employee has worked eight (8) hours at an applicable overtime rate, all additional hours shall be at the applicable overtime rate until such time as the employee has had a break of eight (8) hours or more.

   C. Work performed in excess of eight (8) hours of straight time per day, or ten (10) hours of straight time per day when four ten (10) hour shifts are established, or forty (40) hours of straight time per week, Monday through Friday, or outside the normal shift, and all work on Saturdays shall be paid at one and one-half times the hourly rate of wage. All work performed after 6:00 pm Saturday to 5:00 am Monday and Holidays shall be paid at double the hourly rate of wage. After an employee has worked eight (8) hours at an applicable overtime rate, all additional hours shall be at the applicable overtime rate until such time as the employee has had a break of eight (8) hours or more.

Overtime Codes Continued

3. D. All hours worked between the hours of 6:00 pm and 6:00 am, Monday through Saturday, shall be paid at a premium rate of 15% over the hourly rate of wage. All other hours worked after 6:00 am on Saturdays, shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

   E. All hours worked Sundays and holidays shall be paid at double the hourly rate of wage. Each week, once 40 hours of straight time work is achieved, then any hours worked over 10 hours per day Monday through Saturday shall be paid at double the hourly wage rate.

   F. All hours worked on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sunday shall be paid at two times the hourly rate of wage. All hours worked on paid holidays shall be paid at two and one-half times the hourly rate of wage including holiday pay.

   H. All work performed on Sundays between March 16th and October 14th and all Holidays shall be compensated for at two (2) times the regular rate of pay. Work performed on Sundays between October 15th and March 15th shall be compensated at one and one half (1-1/2) times the regular rate of pay.

   I. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. In the event the job is down due to weather conditions during a five day work week (Monday through Friday,) or a four day-ten hour work week (Tuesday through Friday,) then Saturday may be worked as a voluntary make-up day at the straight time rate. However, Saturday shall not be utilized as a make-up day when a holiday falls on Friday. All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

4. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.

   A. All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at double the hourly rate of wage. All hours worked on Saturdays, Sundays and holidays shall be paid at double the hourly rate of wage.

   B. All hours worked over twelve (12) hours per day and all hours worked on holidays shall be paid at double the hourly rate of wage.

   C. On Monday through Friday, the first four (4) hours of overtime after eight (8) hours of straight time work shall be paid at one and one half (1-1/2) times the straight time rate of pay, unless a four (4) day ten (10) hour workweek has been established. On a four (4) day ten (10) hour workweek scheduled Monday through Thursday, or Tuesday through Friday, the first two (2) hours of overtime after ten (10) hours of straight time work shall be paid at one and one half (1-1/2) times the straight time rate of pay. On Saturday, the first twelve (12) hours of work shall be paid at one and one half (1-1/2) times the straight time rate of pay, except that if the job is down on Monday through Friday due to weather conditions or other conditions outside the control of the employer, the first ten (10) hours on Saturday may be worked at the straight time rate of pay. All hours worked over twelve (12) hours in a day and all hours worked on Sunday and Holidays shall be paid at two (2) times the straight time rate of pay.

Overtime Codes Continued

4. D. All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at double the hourly rate of wage. All hours worked on Saturday, Sundays and holidays shall be paid at double the hourly rate of pay. Rates include all members of the assigned crew.

EXCEPTION:
On all multipole structures and steel transmission lines, switching stations, regulating, capacitor stations, generating plants, industrial plants, associated installations and substations, except those substations whose primary function is to feed a distribution system, will be paid overtime under the following rates:

The first two (2) hours after eight (8) regular hours Monday through Friday of overtime on a regular workday, shall be paid at one and one-half times the hourly rate of wage. All hours in excess of ten (10) hours will be at two (2) times the hourly rate of wage. The first eight (8) hours worked on Saturday will be paid at one and one-half (1-1/2) times the hourly rate of wage. All hours worked in excess of eight (8) hours on Saturday, and all hours worked on Sundays and holidays will be at the double the hourly rate of wage.

All overtime eligible hours performed on the above described work that is energized, shall be paid at the double the hourly rate of wage.

E. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

On a four-day, ten-hour weekly schedule, either Monday thru Thursday or Tuesday thru Friday schedule, all hours worked after ten shall be paid at double the hourly rate of wage. The Monday or Friday not utilized in the normal four-day, ten hour work week, and Saturday shall be paid at one and one half (1½) times the regular shift rate for the first eight (8) hours. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

F. All hours worked between the hours of 6:00 pm and 6:00 am, Monday through Saturday, shall be paid at a premium rate of 20% over the hourly rate of wage. All hours worked on Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.

G. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

Holiday Codes

5. A. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, and Christmas Day (7).

B. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, the day before Christmas, and Christmas Day (8).

C. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8).

D. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8).

H. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, the Day after Thanksgiving Day, And Christmas (6).

Holiday Codes Continued

5. I. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day (6).

J. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Eve Day, And Christmas Day (7).

K. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday After Thanksgiving Day, The Day Before Christmas, And Christmas Day (9).

L. Holidays: New Year's Day, Martin Luther King Jr. Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (8).

N. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, The Friday After Thanksgiving Day, And Christmas Day (9).

P. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday And Saturday After Thanksgiving Day, The Day Before Christmas, And Christmas Day (9). If A Holiday Falls On Sunday, The Following Monday Shall Be Considered As A Holiday.

Q. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day (6).

R. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Day After Thanksgiving Day, One-Half Day Before Christmas Day, And Christmas Day. (7 1/2).

S. Paid Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, And Christmas Day (7).

T. Paid Holidays: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, Christmas Day, And The Day Before Or After Christmas (9).

Z. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8).

6. A. Paid Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8).

E. Paid Holidays: New Year's Day, Day Before Or After New Year's Day, Presidents Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and a Half-Day On Christmas Eve Day. (9 1/2).

G. Paid Holidays: New Year's Day, Martin Luther King Jr. Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and Christmas Eve Day (11).

H. Paid Holidays: New Year's Day, New Year's Eve Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday After Thanksgiving Day, Christmas Day, The Day After Christmas, And A Floating Holiday (10).

I. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday After Thanksgiving Day, And Christmas Day (7).

Holiday Codes Continued

6. T. Paid Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, The Last Working Day Before Christmas Day, And Christmas Day (9).

   Z. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (7). If a holiday falls on Saturday, the preceding Friday shall be considered as the holiday. If a holiday falls on Sunday, the following Monday shall be considered as the holiday.

7. A. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any Holiday Which Falls On A Sunday Shall Be Observed As A Holiday On The Following Monday. If any of the listed holidays falls on a Saturday, the preceding Friday shall be a regular work day.

   B. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

   C. Holidays: New Year's Day, Martin Luther King Jr. Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

   D. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8). Unpaid Holidays: President's Day. Any paid holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any paid holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

   E. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

   F. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the last working day before Christmas day and Christmas day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

   G. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day (6). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday.

   H. Holidays: New Year's Day, Martin Luther King Jr. Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the Last Working Day before Christmas Day and Christmas Day (9). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

   I. Holidays: New Year's Day, President's Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, The Day Before Christmas Day And Christmas Day (9). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

   J. Holidays: New Year's Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day and Christmas Day (6). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

Holiday Codes Continued

7. K. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

L. Holidays: New Year's Day, Memorial Day, Labor Day, Independence Day, Thanksgiving Day, the Last Work Day before Christmas Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

M. Paid Holidays: New Year's Day, The Day after or before New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, And the Day after or before Christmas Day (10). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

N. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. When Christmas falls on a Saturday, the preceding Friday shall be observed as a holiday.

P. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday.

Q. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the Last Working Day before Christmas Day and Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. If any of the listed holidays falls on a Saturday, the preceding Friday shall be a regular work day.

R. Paid Holidays: New Year's Day, the day after or before New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and the day after or before Christmas Day (10). If any of the listed holidays fall on Saturday, the preceding Friday shall be observed as the holiday. If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.

S. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Day, the Day after Christmas, and A Floating Holiday (9). If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.

T. Paid Holidays: New Year's Day, the Day after or before New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and The Day after or before Christmas Day. (10). If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

Note Codes

8. A. In addition to the hourly wage and fringe benefits, the following depth premiums apply to depths of fifty feet or more:
Over 50' To 100' -$2.00 per Foot for Each Foot Over 50 Feet
Over 100' To 150' -$3.00 per Foot for Each Foot Over 100 Feet
Over 150' To 220' -$4.00 per Foot for Each Foot Over 150 Feet
Over 220' -$5.00 per Foot for Each Foot Over 220 Feet

Note Codes Continued

8. C. In addition to the hourly wage and fringe benefits, the following depth premiums apply to depths of fifty feet or more:
Over 50’ To 100' -$1.00 per Foot for Each Foot Over 50 Feet
Over 100' To 150' -$1.50 per Foot for Each Foot Over 100 Feet
Over 150' To 200' -$2.00 per Foot for Each Foot Over 150 Feet
Over 200' -Divers May Name Their Own Price

D. Workers working with supplied air on hazmat projects receive an additional $1.00 per hour.

L. Workers on hazmat projects receive additional hourly premiums as follows -Level A: $0.75, Level B: $0.50, And Level C: $0.25.

M. Workers on hazmat projects receive additional hourly premiums as follows: Levels A & B: $1.00, Levels C & D: $0.50.

N. Workers on hazmat projects receive additional hourly premiums as follows -Level A: $1.00, Level B: $0.75, Level C: $0.50, And Level D: $0.25.

P. Workers on hazmat projects receive additional hourly premiums as follows -Class A Suit: $2.00, Class B Suit: $1.50, Class C Suit: $1.00, And Class D Suit $0.50.

Q. The highest pressure registered on the gauge for an accumulated time of more than fifteen (15) minutes during the shift shall be used in determining the scale paid.

R. Effective August 31, 2012 – A Traffic Control Supervisor shall be present on the project whenever flagging or spotting or other traffic control labor is being utilized. A Traffic Control Laborer performs the setup, maintenance and removal of all temporary traffic control devices and construction signs necessary to control vehicular, bicycle, and pedestrian traffic during construction operations. Flaggers and Spotters shall be posted where shown on approved Traffic Control Plans or where directed by the Engineer. All flaggers and spotters shall possess a current flagging card issued by the State of Washington, Oregon, Montana, or Idaho. These classifications are only effective on or after August 31, 2012.

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U. Workers on hazmat projects receive additional hourly premiums as follows – Class A Suit: $2.00, Class B Suit: $1.50, And Class C Suit: $1.00. Workers performing underground work receive an additional $0.40 per hour for any and all work performed underground, including operating, servicing and repairing of equipment. The premium for underground work shall be paid for the entire shift worked. Workers who work suspended by a rope or cable receive an additional $0.50 per hour. The premium for work suspended shall be paid for the entire shift worked. Workers who do “pioneer” work (break open a cut, build road, etc.) more than one hundred fifty (150) feet above grade elevation receive an additional $0.50 per hour.

FEDERAL WAGE RATES

General Decision Number: WA160080 01/08/2016 WA80

Superseded General Decision Number: WA20150080

State: Washington

Construction Type: Heavy
including water and sewer line construction

County: Pacific County in Washington.

HEAVY CONSTRUCTION PROJECTS (including sewer/water construction).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the 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 $10.15 (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 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/08/2016

CARP0003-015 06/01/2014

PACIFIC COUNTY (South of a straight line made by extending the north boundary line of Wahkiakum County west to Willapa Bay to the Pacific Ocean, and thence north through the natural waterway to the Pacific Ocean (this will include the entire peninsula west of Willapa Bay)

	Rates	Fringes
CARPENTER (Including Formwork)	$ 33.94	14.83
MILLWRIGHT	$ 34.09	14.83

Zone Differential (Add up Zone 1 rates):
Zone 2 - $0.85
Zone 3 - 1.25
Zone 4 - 1.70
Zone 5 - 2.00
Zone 6 - 3.00

BASEPOINTS: ASTORIA, LONGVIEW, PORTLAND, THE DALLES, AND VANCOUVER, (NOTE: All dispatches for Washington State Counties: Cowlitz, Wahkiakum and Pacific shall be from Longview Local #1707 and mileage shall be computed from that point.)

ZONE 1: Projects located within 30 miles of the respective city hall of the above mentioned cities
ZONE 2: Projects located more than 30 miles and less than 40 miles of the respective city of the above mentioned cities

ZONE 3: Projects located more than 40 miles and less than 50 miles of the respective city of the above mentioned cities
ZONE 4: Projects located more than 50 miles and less than 60 miles of the respective city of the above mentioned cities.
ZONE 5: Projects located more than 60 miles and less than 70 miles of the respective city of the above mentioned cities
ZONE 6: Projects located more than 70 miles of the respected city of the above mentioned cities

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* CARP0770-007 06/01/2015

PACIFIC COUNTY (North of a straight line made by extending the north boundary line of Wahkiakum County west to the Pacific Ocean)

	Rates	Fringes
CARPENTER (Including Formwork)	$ 40.36	13.66
MILLWRIGHT	$ 41.86	13.66

(HOURLY ZONE PAY: WESTERN AND CENTRAL WASHINGTON - ALL CLASSIFICATIONS EXCEPT MILLWRIGHTS AND PILEDRIVERS

Hourly Zone Pay shall be paid on jobs located outside of the free zone computed from the city center of the following listed cities:

Seattle	Olympia	Bellingham
Auburn	Bremerton	Anacortes
Renton	Shelton	Yakima
Aberdeen-Hoquiam	Tacoma	Wenatchee
Ellensburg	Everett	Port Angeles
Centralia	Mount Vernon	Sunnyside
Chelan	Pt. Townsend	

Zone Pay:

0 -25 radius miles	Free
26-35 radius miles	$1.00/hour
36-45 radius miles	$1.15/hour
46-55 radius miles	$1.35/hour
Over 55 radius miles	$1.55/hour

(HOURLY ZONE PAY: WESTERN AND CENTRAL WASHINGTON - MILLWRIGHT AND PILEDRIVER ONLY)

Hourly Zone Pay shall be computed from Seattle Union Hall, Tacoma City center, and Everett City center

Zone Pay:

0 -25 radius miles	Free
26-45 radius miles	$ .70/hour
Over 45 radius miles	$1.50/hour

ELEC0076-005 09/01/2014

	Rates	Fringes
ELECTRICIAN	$ 34.49	23.36

ENGI0612-019 06/01/2014

PACIFIC (portion lying north of a parallel line extending west from the northern boundary of Wahkaikum County to the sea) COUNTY

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1A	$ 38.39	17.40
GROUP 1AA	$ 38.96	17.40
GROUP 1AAA	$ 39.52	17.40
GROUP 1	$ 37.84	17.40
GROUP 2	$ 37.35	17.40
GROUP 3	$ 36.93	17.40
GROUP 4	$ 34.57	17.40

Zone Differential (Add to Zone 1 rates):
Zone 2 (26-45 radius miles) = $1.00
Zone 3 (Over 45 radius miles) - $1.30

BASEPOINTS: CENTRALIA, OLYMPIA, TACOMA

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1AAA - Cranes-over 300 tons, or 300 ft of boom (including jib with attachments)

GROUP 1AA - Cranes 200 to 300 tons, or 250 ft of boom (including jib with attachments); Tower crane over 175 ft in height, base to boom; Excavator/Trackhoe, Backhoe: Over 90 metric tons

GROUP 1A - Cranes, 100 tons thru 199 tons, or 150 ft of boom (including jib with attachments); Crane-overhead, bridge type, 100 tons and over; Tower crane up to 175 ft in height base to boom; Excavator/Trackhoe, Backhoe: over 50 metric tons to 90 metric tons;

GROUP 1 - Cranes 45 tons thru 99 tons, under 150 ft of boom (including jib with attachments); Crane-overhead, bridge type, 45 tons thru 99 tons; Derricks on building work;; Excavator/Trackhoe, Backhoe: over 30 metric tons to 50 metric tons;

GROUP 2 - Cranes, 20 tons thru 44 tons with attachments; Crane-overhead, bridge type-20 tons through 44 tons; Excavator/Trackhoe, Backhoe: 15 to 30 metric tons; Drilling Machine; Grader-finishing

GROUP 3 - Cranes-thru 19 tons with attachments; A-frame crane over 10 tons; Excavator/Trackhoe, Backhoe: under 15 metric tons; Forklift: 3000 lbs and over with attachments; Oiler; Grader-nonfinishing; Boom Truck over 10 tons

GROUP 4 -Cranes-A frame-10 tons and under; Forklift: under 3000 lbs with attachments; BoomTruck 10 tons and under

HANDLING OF HAZARDOUS WASTE MATERIALS: Personnel in all craft classifications subject to working inside a federally designated hazardous perimeter shall be elgible for

compensation in accordance with the following group schedule relative to the level of hazardous waste as outlined in the specific hazardous waste project site safety plan.

H-1 Base wage rate when on a hazardous waste site when not outfitted with protective clothing, Class "D" Suit - Base wage rate plus $ .50 per hour.
H-2 Class "C" Suit - Base wage rate plus $1.00 per hour.
H-3 Class "B" Suit - Base wage rate plus $1.50 per hour.
H-4 Class "A" Suit - Base wage rate plus $2.00 per hour.

ENGI0701-012 01/01/2015

PACIFIC COUNTY (REMAINDER OF COUNTY)

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	$ 39.47	14.10
GROUP 1A	$ 41.44	14.10
GROUP 1B	$ 43.42	14.10
GROUP 2	$ 37.58	14.10
GROUP 3	$ 36.44	14.10
GROUP 4	$ 35.36	14.10
GROUP 5	$ 34.13	14.10
GROUP 6	$ 30.94	14.10

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

Group 1
Concrete Batch Plan and or Wet mix three (3) units or more; Crane, Floating one hundred and fifty (150) ton but less than two hundred and fifty (250) ton; Crane, two hundred (200) ton through two hundred ninety nine (299) ton with two hundred foot (200') boom or less (including jib, inserts and/or attachments); Crane, ninety (90) ton through one hundred ninety nine (199) ton with over two hundred (200') boom Including jib, inserts and/or attachments); Crane, Tower Crane with one hundred seventy five foot (175') tower or less and with less than two hundred foot (200') jib; Crane, Whirley ninety (90) ton and over; Helicopter when used in erecting work

Group 1A
Crane, floating two hundred fifty (250) ton and over; Crane, two hundred (200) ton through two hundred ninety nine (299) ton, with over two hundred foot (200') boom (including jib, inserts and/or attachments); Crane, three hundred (300) ton through three hundred ninety nine (399) ton; Crane, Tower Crane with over one hundred seventy five foot (175') tower or over two hundred foot (200') jib; Crane, tower Crane on rail system or 2nd tower or more in work radius

Group 1B

Crane, three hundred (300) ton through three hundred ninety nine (399) ton, with over two hundred foot (200') boom (including jib, inserts and/or attachments); Floating crane, three hundred fifty (350) ton and over; Crane, four

hundred (400) ton and over

Group 2
Asphalt Plant (any type); Asphalt Roto-Mill, pavement profiler eight foot (8') lateral cut and over; Auto Grader or "Trimmer"; Blade, Robotic; Bulldozer, Robotic Equipment (any type); Bulldozer, over one hundred twenty thousand (120,000) lbs. and above; Concrete Batch Plant and/or Wet Mix one (1) and two (2) drum; Concrete Diamond Head Profiler; Canal Trimmer; Concrete, Automatic Slip Form Paver (Assistant to the Operator required); Crane, Boom Truck fifty (50) ton and with over one hundred fifty foot (150') boom and over; Crane, Floating (derrick barge) thirty (30) ton but less than one hundred fifty (150) ton; Crane, Cableway twenty-five (25) ton and over; Crane, Floating Clamshell three (3) cu. Yds. And over; Crane, ninety (90) ton through one hundred ninety nine (199) ton up to and including two hundred foot (200') of boom (including jib inserts and/or attachments); Crane, fifty (50) ton through eighty nine (89) ton with over one hundred fifty foot (150') boom (including jib inserts and/or attachments); Crane, Whirley under ninety (90) ton; Crusher Plant; Excavator over one hundred thirty thousand (130,000) lbs.; Loader one hundred twenty thousand (120,000) lbs. and above; Remote Controlled Earth Moving Equipment; Shovel, Dragline, Clamshell, five (5) cu. Yds. And over; Underwater Equipment remote or otherwise, when used in construction work; Wheel Excavator any size

Group 3
Bulldozer, over seventy thousand (70,000) lbs. up to and including one hundred twenty thousand (120,000) lbs.; Crane, Boom Truck fifty (50) ton and over with less than one hundred fifty foot (150') boom; Crane, fifty (50) ton through eighty nine (89) ton with one hundred fifty foot (150') boom or less (including jib inserts and/or attachments); Crane, Shovel, Dragline or Clamshell three (3) cu. yds. but less than five (5) cu. Yds.; Excavator over eighty thousand (80,000) lbs. through one hundred thirty thousand (130,000) lbs.; Loader sixty thousand (60,000) lbs. and less than one hundred twenty thousand (120,000) lbs.

Group 4

Asphalt, Screed; Asphalt Paver; Asphalt Roto-Mill, pavement profiler, under eight foot (8') lateral cut; Asphalt, Material Transfer Vehicle Operator; Back Filling Machine; Backhoe, Robotic, track and wheel type up to and including twenty thousand (20,000) lbs. with any attachments; Blade (any type); Boatman; Boring Machine; Bulldozer over twenty thousand (20,000) lbs. and more than one hundred (100) horse up to seventy thousand (70,000) lbs.; Cable-Plow (any type); Cableway up to twenty five (25) ton; Cat Drill (John Henry); Chippers; Compactor, multi-engine; Compactor, Robotic; Compactor with blade self-propelled; Concrete, Breaker; Concrete, Grout Plant; Concrete, Mixer Mobile; Concrete, Paving Road Mixer; Concrete, Reinforced Tank Banding Machine; Crane, Boom Truck twenty (20) ton and under fifty (50) ton; Crane, Bridge Locomotive, Gantry and Overhead; Crane, Carry Deck; Crane, Chicago Boom and similar types; Crane, Derrick Operator, under one hundred

(100) ton; Crane, Floating Clamshell, Dragline, etc. Operator, under three (3) cu. yds. Or less than thirty (30) ton; Crane, under fifty (50) ton; Crane, Quick Tower under one hundred foot (100') in height and less than one hundred fifty foot (150') jib (on rail included); Diesel-Electric Engineer (Plant or Floating); Directional Drill over twenty thousand (20,000) lbs. pullback; Drill Cat Operator; Drill Doctor and/or Bit Grinder; Driller, Percussion, Diamond, Core, Cable, Rotary and similar type; Excavator Operator over twenty thousand (20,000) lbs. through eighty thousand (80,000) lbs.; Generator Operator; Grade-all; Guardrail Machines, i.e. punch, auger, etc.; Hammer Operator (Piledriver); Hoist, stiff leg, guy derrick or similar type, fifty (50) ton and over; Hoist, two (2) drums or more; Hydro Axe (loader mounted or similar type); Jack Operator, Elevating Barges, Barge Operator, self-unloading; Loader Operator, front end and overhead, twenty five thousand (25,000) lbs. and less than sixty thousand (60,000) lbs.; Log Skidders; Piledriver Operator (not crane type); Pipe, Bending, Cleaning, Doping and Wrapping Machines; Rail, Ballast Tamper Multi-Purpose; Rubber-tired Dozers and Pushers; Scraper, all types; Side-Boom; Skip Loader, Drag Box; Strump Grinder (loader mounted or similar type); Surface Heater and Planer; Tractor, rubber-tired, over fifty (50) HP Flywheel; Trenching Machine three foot (3') depth and deeper; Tub Grinder (used for wood debris); Tunnel Boring Machine Mechanic; Tunnel, Mucking Machine; Ultra High Pressure Water Jet Cutting Tool System Operator; Vacuum Blasting Machine Operator; Water pulls, Water wagons

Group 5

Asphalt, Extrusion Machine; Asphalt, Roller (any asphalt mix); Asphalt, Roto-Mill pavement profiler ground man; Bulldozer, twenty thousand (20,000) lbs. or less, or one hundred (100) horse or less; Cement Pump; Chip Spreading Machine; Churn Drill and Earth Boring Machine; Compactor, self-propelled without blade; Compressor, (any power) one thousand two hundred fifty (1,250) cu. ft. and over, total capacity; Concrete, Batch Plant Quality control; Concrete, Combination Mixer and compressor operator, gunite work; Concrete, Curb Machine, Mechanical Berm, Curb and/or Curb and Gutter; Concrete, Finishing Machine; Concrete, Grouting Machine; Concrete, Internal Full Slab Vibrator Operator; Concrete, Joint Machine; Concrete, Mixer single drum, any capacity; Concrete, Paving Machine eight foot (8') or less; Concrete, Planer; Concrete, Pump; Concrete, Pump Truck; Concrete, Pumpcrete Operator (any type); Concrete, Slip Form Pumps, power driven hydraulic lifting device for concrete forms; Conveyored Material Hauler; Crane, Boom Truck under twenty (20) tons; Crane, Boom Type lifting device, five (5) ton capacity or less; Drill, Directional type less than twenty thousand (20,000) lbs. pullback; Fork Lift, over ten (10) ton or Robotic; Helicopter Hoist; Hoist Operator, single drum; Hydraulic Backhoe track type up to and including twenty thousand (20,000) lbs.; Hydraulic Backhoe wheel type (any make); Laser Screed; Loaders, rubber-tired type, less than twenty five thousand (25,000) lbs.; Pavement Grinder and/or Grooving Machine (riding type); Pipe, cast in place Pipe Laying Machine; Pulva-Mixer or similar types; Pump Operator, more than five (5) pumps (any size); Rail, Ballast Compactor, Regulator, or Tamper

machines; Service Oiler (Greaser); Sweeper Self-Propelled; Tractor, Rubber-Tired, fifty (50) HP flywheel and under; Trenching Machine Operator, maximum digging capacity three foot (3') depth; Tunnel, Locomotive, Dinkey; Tunnel, Power Jumbo setting slip forms, etc.

Group 6

Asphalt, Pugmill (any type); Asphalt, Raker; Asphalt, Truck Mounted Asphalt Spreader, with Screed; Auger Oiler; Boatman; Bobcat, skid steed (less than one (1) yard); Broom, self-propelled; Compressor Operator (any power) under 1,250 cu. ft. total capacity; Concrete Curing Machine (riding type); Concrete Saw; Conveyor Operator or Assistant; Crane, Tugger; Crusher Feederman; Crusher Oiler; Deckhand; Drill, Directional Locator; Fork Lift; Grade Checker; Guardrail Punch Oiler; Hydrographic Seeder Machine, straw, pulp or seed; Hydrostatic Pump Operator; Mixer Box (CTB, dry batch, etc.); Oiler; Plant Oiler; Pump (any power); Rail, Brakeman, Switchman, Motorman; Rail, Tamping Machine, mechanical, self-propelled; Rigger; Roller grading (not asphalt); Truck, Crane Oiler-Driver

Zone Differential (add to Zone 1 rates):
Zone 2 - $3.00
Zone 3 - $6.00

For the following metropolitan counties: MULTNOMAH; CLACKAMAS; MARION; WASHINGTON; YAMHILL; AND COLUMBIA; CLARK; AND COWLITZ COUNTY, WASHINGTON WITH MODIFICATIONS AS INDICATED:

All jobs or projects located in Multnomah, Clackamas and Marion Counties, West of the western boundary of Mt. Hood National Forest and West of Mile Post 30 on Interstate 84 and West of Mile Post 30 on State Highway 26 and West of Mile Post 30 on Highway 22 and all jobs or projects located in Yamhill County, Washington County and Columbia County and all jobs or porjects located in Clark & Cowlitz County, Washington except that portion of Cowlitz County in the Mt. St. Helens "Blast Zone" shall receive Zone I pay for all classifications.

All jobs or projects located in the area outside the identified boundary above, but less than 50 miles from the Portland City Hall shall receive Zone II pay for all classifications.

All jobs or projects located more than 50 miles from the Portland City Hall, but outside the identified border above, shall receive Zone III pay for all classifications.

For the following cities: ALBANY; BEND; COOS BAY; EUGENE; GRANTS PASS; KLAMATH FALLS; MEDFORD; ROSEBURG

All jobs or projects located within 30 miles of the respective city hall of the above mentioned cities shall receive Zone I pay for all classifications.

All jobs or projects located more than 30 miles and less than 50 miles from the respective city hall of the above

mentioned cities shall receive Zone II pay for all classifications.

All jobs or projects located more than 50 miles from the respective city hall of the above mentioned cities shall receive Zone III pay for all classifications.

IRON0086-012 07/01/2015

	Rates	Fringes
Ironworker (REINFORCING & STRUCTURAL)	$ 40.04	23.19

LABO0001-004 06/01/2014

PACIFIC (North of a straight line made by extending the north boundary of Wahkiakum County west to the Pacific Ocean), COUNTY, ZONE 1:

	Rates	Fringes
Laborers:		
GROUP 2	$ 25.79	10.30
GROUP 3	$ 32.29	10.30
GROUP 4	$ 33.08	10.30
GROUP 5	$ 33.62	10.30

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
ZONE 2 - $1.00
ZONE 3 - $1.30

BASE POINTS: BELLINGHAM, MT. VERNON, EVERETT, SEATTLE, KENT, TACOMA, OLYMPIA, CENTRALIA, ABERDEEN, SHELTON, PT. TOWNSEND, PT. ANGELES, AND BREMERTON

ZONE 1 - Projects within 25 radius miles of the respective city hall
ZONE 2 - More than 25 but less than 45 radius miles from the respective city hall
ZONE 3 - More than 45 radius miles from the respective city hall

LABORERS CLASSIFICATIONS
GROUP 2: Flagger

GROUP 3: Mason Tender-Cement/Concrete; Chipping Guns (under 30 lbs)

GROUP 4: Grade Checker; Pipe Layer; Chipping Guns (over 30 lbs)

GROUP 5: Mason Tender-Brick

LABO0335-003 06/01/2013

PACIFIC (South of a straight line made by extending the north Boundary line of Wahkiakum County west to the Pacific Ocean) COUNTY

	Rates	Fringes
Laborers:		
ZONE 1:		
GROUP 3	$ 29.69	10.05
GROUP 4	$ 30.07	10.05
GROUP 5	$ 26.15	10.05

LABORERS CLASSIFICATIONS

GROUP 2: Mason Tender-Cement/Concrete; Chipping Guns

GROUP 4: Grade Checker; Pipelayer

GROUP 5: Flagger

ZONE DIFFERENTIAL (Add to Zone Rates): ZONE 2 - $0.65
ZONE 3 - 1.15
ZONE 4 - 1.70
ZONE 5 - 2.75

ZONE 1: Projects within 30 miles of the respective city hall.

ZONE 2: More than 30 miles but less than 40 miles from the respective city hall.

ZONE 3: More than 40 miles but less than 50 miles from the respective city hall.

ZONE 4: More than 50 miles but less than 80 miles from the respective city hall.

ZONE 5: More than 80 miles from the respective city hall.

BASE POINTS: GOLDENDALE, LONGVIEW, AND VANCOUVER

LABO0335-009 09/01/2013

PACIFIC(south of a straight line made by extending the north boundary of Wahkiakum County west to the Pacific Ocean)

	Rates	Fringes
Hod Carrier		
Brick Mason Tender/Hod Carrier	$ 30.47	10.05

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* PAIN0055-017 07/01/2015

	Rates	Fringes
PAINTER		
Brush, Roller	$ 23.05	10.85
Spray	$ 23.05	10.85

PLAS0528-004 06/01/2015

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 38.52	15.43

SUWA2009-046 08/07/2009

	Rates	Fringes
FENCE ERECTOR	$ 15.00	0.00
LABORER: Common or General	$ 22.93	5.60
LABORER: Landscape	$ 14.67	0.00
OPERATOR: Bulldozer	$ 27.22	7.63
OPERATOR: Loader	$ 26.11	7.87
OPERATOR: Mechanic	$ 25.53	7.70
OPERATOR: Roller	$ 25.25	8.20
PIPEFITTER	$ 33.77	8.82
TRUCK DRIVER: Dump Truck	$ 20.50	6.56
TRUCK DRIVER: Water Truck	$ 24.36	8.30
TRUCK DRIVER: 10 Yard Truck	$ 24.61	8.34

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

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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

PART 6

APPENDIX

APPENDIX A

WASHINGTON STATE DEPARTMENT OF COMMERCE
DRINKING WATER STATE REVOLVING FUND
SPECIFICATIONS INSERT

WASHINGTON STATE DEPARTMENT OF COMMERCE
DRINKING WATER STATE REVOLVING FUND (DWSRF)

SPECIFICATIONS INSERT

The following clauses will be incorporated into construction contracts receiving financial assistance from the Washington State Department of Commerce Drinking Water State Revolving Fund. In the event of conflict within the contract these clauses shall take precedence.

Required Bid Submittals

The following submittals are required to be submitted with the bid proposal:

- EPA Form 6100-4 (DBE Subcontractor Utilization Form)
- EPA Form 6100-3 (DBE Subcontractor Performance Form) for all DBE subcontractors.
- Complete Bidders List

Compliance with State and Local Laws

The Contractor shall assure compliance with all applicable federal, state, and local laws, requirements, and ordinances as they pertain to the design, implementation, and administration of the approved project.

Civil Rights

All contracts must include and comply with the following:

Title VI of the Civil Rights Act of 1964, 42 U.S.C. § 2000d
No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance.

Section 504 of the Rehabilitation Act of 1973, 29 U.S.C. § 794
(n)o otherwise qualified individual with a disability in the United States . . . shall, solely by reason of his or her disability, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving
federal financial assistance

The Age Discrimination Act of 1975, 42 U.S.C. § 6102
no person in the United States shall, on the basis of age, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance.

Equal Employment Opportunity, Executive Order No. 11246 (1965)

Through a series of Executive Orders, and a decision by the Equal Employment Opportunity Commission, the federal government has established a national policy designed to battle discrimination based on race, color, sex, religion, and national origin in federal assistance programs and to enhance hiring, training, and promotion opportunities for minorities and women in construction programs financed, in part, by federal dollars.

If a Contract exceeds $10,000, the Contractor shall comply with Executive Order 11246, "Equal Employment Opportunity," as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and as supplemented by regulations at 41 CFR part 60.

Contractor's compliance with Executive Order 11246 shall be based on implementation of the Equal Opportunity Clause, and specific affirmative active obligations required by the Standard Federal Equal Employment Opportunity Construction Contract Specifications, as set forth in 41 CFR Part 60-4.

Must be included in all contracts:

Equal Opportunity Clause (41 CFR part 60-1.4(b))
During the performance of this contract, the contractor agrees as follows:

1. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.
3. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
5. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by

the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

6. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
7. The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, That in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency the contractor may request the United States to enter into such litigation to protect the interests of the United States.

<u>Federal Equal Employment Opportunity Construction Contract Specifications</u>
(Executive Order 11246 and 41 CFR part 60-4.3)

1. As used in these specifications:
   a. “Covered area” means the geographical area described in the solicitation from which this contract resulted;
   b. “Director” means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
   c. “Employer identification number” means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
   d. “Minority” includes:
      i. Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
      ii. Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
      iii. Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
      iv. American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).
2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains

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

3. If the Contractor is participating (pursuant to 41 CFR 60–4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.
4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7 a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Registering notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.
5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.
6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.
7. The Contractor shall take specific affirmative action’s to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
    a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen,

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

b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore, along with whatever additional actions the Contractor may have taken.
d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.
f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates

doing business.

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

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

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

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

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

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

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

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

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to

take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.
11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.
12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.
13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60–4.8.
14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.
15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

Reporting Requirements (EEO-1)

On or before September 30 of each year, a contractor that is subject to Title VII of the Civil Rights Act of 1964, as amended, and that has 100 or more employees, shall file with the EEOC or its delegate an "Employer Information Report EEO-1". Instructions on how to file are available on the EEOC's website at http://www.eeoc.gov/employers/eeo1survey/howtofile.cfm. The contractor shall retain a copy of the most recent report filed.

Segregated Facilities (41 CFR part 60-1.8)
The contractor shall ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensuring that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. This obligation extends to all contracts containing the equal opportunity clause regardless of the amount of the contract. The term "facilities," as used in this section, means waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, wash rooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees; Provided, That separate or single-user restrooms and necessary dressing or sleeping areas shall be provided to assure privacy between the sexes.

Provision

During the performance of this Contract, the Contractor shall comply with all federal and state nondiscrimination laws, including, but not limited to Chapter 49.60 RCW, Washington's Law Against Discrimination, and 42 U.S.C. 12101 et seq, the Americans with Disabilities Act (ADA).

In the event of the Contractor's noncompliance or refusal to comply with any applicable nondiscrimination law, regulation, or policy, this Contract may be rescinded, canceled, or terminated in whole or in part, and the Contractor may be declared ineligible for further contracts with the Board. The Contractor shall, however, be given a reasonable time in which to cure this noncompliance.

The Contractor must also include the following terms and conditions in contracts with all contractors, subcontractors, engineers, vendors, and any other entity for work or services listed in Attachment I: Scope of Work.

> "The Contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this Contract. The Contractor shall carry out applicable requirements of 40 CFR part 33 in the award and administration of contracts awarded under Environmental Protection Agency financial agreements. Failure by the Contractor to carry out these requirements is a material breach of this Contract which may result in termination of this Contract."

Prohibition Statement

Pursuant to Section 106 of the Trafficking Victims Protection Act of 2009, as amended, the Contractor and its employees may not engage in severe forms of trafficking in persons during the period of time the Contract is in effect, procure a commercial sex act during the period of time the Contract is in effect, or use forced labor during the performance of this Contract. The Contractor shall require this prohibition statement in contracts with all contractors,

subcontractors, engineers, vendors, and any other entity for work or services listed in Attachment I: Scope of Work.

In the event that the Contractor or any of its employees is determined to have violated the terms of this section, this Contract may be terminated.

Prevailing Wage

The work performed under this contract is subject to the wage requirements of the Davis-Bacon Act. The Contractor shall conform to the wage requirements prescribed by the federal Davis-Bacon and Relate Acts which requires that all laborers and mechanics employed by contractors and subcontractors performing on contracts funded in whole or in part by SRF appropriations in excess of $2000 pay their laborers and mechanics not less than the prevailing wage rates and fringe benefits, and determined by the Secretary of Labor, for corresponding classes of laborers and mechanics employed on similar projects in the area. Attachment 1A or 1B to this specification insert, and an up to date wage determination **must** be included in full into any contract and in any subcontract in excess of $2,000. Wage determinations can be found at http://www.wdol.gov.

Certification Regarding Suspension, Debarment, Ineligibility Or Voluntary Exclusion

1. The CONTRACTOR, by signing this agreement, certifies that it is not suspended, debarred, proposed for debarment, declared ineligible or otherwise excluded from contracting with the federal government, or from receiving contracts paid for with federal funds. If the CONTRACTOR is unable to certify to the statements contained in the certification, they must provide an explanation as to why they cannot.

2. The CONTRACTOR shall provide immediate written notice to the Department if at any time the CONTRACTOR learns that its certification was erroneous when submitted or had become erroneous by reason of changed circumstances.

3. The terms covered transaction, debarred, suspended, ineligible, lower tier covered transaction, participant, person, primary covered transaction, principal, proposal, and voluntarily excluded, as used in this clause, have the meaning set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the department for assistance in obtaining a copy of those regulations..

4. The CONTRACTOR agrees it shall not knowingly enter into any lower tier covered transaction with a person who is proposed for debarment under the applicable Code of Federal Regulations, debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction.

5. The CONTRACTOR further agrees by signing this agreement, that it will include this clause titled “Certification Regarding Suspension, Debarment, Ineligibility Or Voluntary Exclusion” without modification in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

6. Pursuant to 2CFR180.330, the CONTRACTOR is responsible for ensuring that any lower tier covered transaction complies with certification of suspension and debarment requirements.

7. CONTRACTOR acknowledges that failing to disclose the information required in the Code of Federal Regulations may result in the delay or negation of this funding agreement, or pursuance of legal remedies, including suspension and debarment.

8. CONTRACTOR agrees to keep proof in its agreement file, that it, and all lower tier recipients or contractors, are not suspended or debarred, and will make this proof available to the Department upon request. RECIPIENT/CONTRACTOR must run a search in www.sam.gov and print a copy of completed searches to document proof of compliance.

This term and condition supersedes EPA Form 5700-49, "Certification Regarding Debarment, Suspension, and Other Responsibility Matters."

Disadvantaged Business Enterprises

Small, minority and women-owned firms should be afforded the maximum opportunity to compete for and obtain bid documents for projects funded by the DWSRF program. The level of participation by small, minority and women-owned firms should be consistent with their general availability within the professional community involved.

General Compliance (40 CFR Part 33).
The contractor shall comply with the requirements of the Environmental Protection Agency's Program for Participation By Disadvantaged Business Enterprises (DBE) 40 CFR Part 33.

Non-discrimination Provision (40CFR Appendix A to Part 33).
The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

The contractor shall comply with all federal and state nondiscrimination laws, including, but not limited to Title VI and VII of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, the Age Discrimination Act of 1975, and Chapter 49.60 RCW, Washington's Law Against Discrimination, and 42 U.S.C. 12101 et seq, the Americans with Disabilities Act (ADA).

Six Good Faith Efforts (40 CFR Part 33 Subpart C).
The contractor agrees to make the following good faith efforts whenever procuring subcontracts, equipment, services and supplies. The contractor shall retain records documenting compliance with the following six good faith efforts.

1. Ensuring Disadvantaged Business Enterprises are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State and Local and Government recipients, this will include placing Disadvantaged Business Enterprises on solicitation lists and soliciting them whenever they are potential sources. Qualified Women and Minority business enterprises may be found on the Internet at www.omwbe.wa.gov or by contacting the Washington State Office of Minority and Women's Enterprises at 360-704-1181.
2. Making information on forthcoming opportunities available to Disadvantaged Business Enterprises and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by Disadvantaged Business Enterprises in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of thirty (30) calendar days before the bid or proposal closing date.
3. Considering in the contracting process whether firms competing for large contracts could subcontract with Disadvantaged Business Enterprises. For Indian Tribal, State and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by Disadvantaged Business Enterprises in the competitive process.
4. Encourage contracting with a consortium of Disadvantaged Business Enterprises when a contract is too large for one of these firms to handle individually.
5. Using services and assistance of the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.
6. If the prime contractor awards subcontracts, requiring the subcontractors to take the six good faith efforts in paragraphs 1 through 5 above.

Fair Share Objective Goal (40 CFR Part 33 Subpart D).

A fair share objective is a goal based on the capacity and availability of qualified, certified Minority Business Enterprises (MBEs) and Women's Business Enterprises (WBEs) in the relevant geographic market. As mandated by EPA, all general contractors and subcontractors must comply with the requirements of the EPA's Program for Utilization of Small, Minority, and Women's Business Enterprises (40 CFR, Part 33) in procurement under the DWSRF program. The goals for the utilization of disadvantaged businesses are as follows:

Construction	10% MBE	6% WBE
Supplies	8% MBE	4% WBE
Equipment	8% MBE	4% WBE
Purchased Services	10% MBE	4% WBE

All general contractors and subcontractors must accept the fair share objective/goals stated above and attest to the fact they are purchasing the same or similar construction, supplies, services, and equipment, in the same or similar relevant geographic buying market as the Washington Office of Minority Women Business goals.

Under the DWSRF program, borrowers receiving a total of $250,000 or less in EPA funds in a given fiscal year are exempted from the Fair Share Objective requirements**.**

IMPORTANT: Only MBEs and WBEs that are certified by EPA, SBA, DOT, or by state, local, tribal or private entities whose certification criteria match EPA's can be counted towards the MBEs and WBEs utilization goal.

MBE/WBE Reporting (40 CFR Part 33 Parts 33.302, 33.502 and 33.503).
The contractor shall provide EPA Form 6100-2 DBE Subcontractor Participation Form to all DBE subcontractors. Subcontractors may submit EPA Form 6100-2 Subcontractor Participation Form to the EPA Region 10 DBE coordinator in order to document issues or concerns with their usage or payment for a subcontract. The contractor shall require all DBE subcontractors to complete EPA Form 6100-3 DBE Subcontractor Performance Form. The contractor shall complete EPA Form 6100-4 DBE Subcontractor Utilization Form.

The contractor shall submit EPA Form 6100-4 and all completed EPA Form 6100-3 forms with the bid proposal.

Bidders List (40 CFR Part 33 part 33.501)
All bidders shall submit the following information for all firms that bid or quote on subcontracts (including both DBE and non-DBE firms) with their bid proposal.

1. Entity's name with point of contact;
2. Entity's mailing address, telephone number, and e-mail address;
3. The procurement on which the entity bid or quoted, and when; and
4. Entity's status as an MBE/WBE or non-MBE/WBE.

Contract Administration Provisions (40 CFR part 33.302).
The contractor shall comply with the contract administration provisions of 40 CFR, Part33.302.

1. The contractor shall pay its subcontractor for satisfactory performance no more than 30 days from the contractor's receipt of payment.
2. The contractor shall notify the owner in writing prior to any termination of a DBE subcontractor.
3. If a DBE subcontractor fails to complete work under the subcontract for any reason, the contractor shall employ the six good faith efforts when soliciting a replacement subcontractor.
4. The contractor shall employ the six good faith efforts even if the contractor has achieved its fair share objectives.

Third Party Beneficiary

Partial funding of this project is being provided through the Washington State Department of Commerce Drinking Water State Revolving Fund. All parties agree that the State of Washington shall be, and is hereby, named as an express third-party beneficiary of this contract, with full rights as such.

Access to the Construction Site and to Records

The contractor shall provide for the safe access to the construction site and to the contractor's records by Washington State Department of Commerce, Washington State Department of Health, and Environmental Protection Agency (EPA) personnel.

The Contractor shall maintain accurate records and accounts to facilitate the Owner's audit requirements and shall ensure that all subcontractors maintain auditable records.

These Project records shall be separate and distinct from the Contractor's other records and accounts.

All such records shall be available to the Owner and to Washington State Department of Commerce, Washington State Department of Health and EPA personnel for examination. All records pertinent to this project shall be retained by the Contractor for a period of three (3) years after the final audit.

Attachments:

1. Wage Rate Requirements For Subrecipients
    a. Attachment 1A for municipal borrowers
2. Current Wage Rate Determination (Verified by CAU project Manager)
3. Certification Of Nonsegregated Facilities
4. Notice To Labor Unions Or Other Organization Of Workers: Non-Discrimination In Employment
5. EPA Form 6100-2 (DBE Subcontractor Participation Form)
6. EPA Form 6100-3 (DBE Subcontractor Performance Form) for all DBE subcontractors.
7. EPA Form 6100-4 (DBE Subcontractor Utilization Form)
8. Cowlitz Indian Tribe Inadvertent Discovery Language

WAGE RATE REQUIREMENTS FOR SUBRECIPIENTS

The following terms and conditions specify how recipients will assist EPA in meeting its Davis-Bacon (DB) responsibilities when DB applies to EPA awards of financial assistance under the FY 2013 Continuing Resolution with respect to State recipients and subrecipients that are governmental entities. If a subrecipient has questions regarding when DB applies, obtaining the correct DB wage determinations, DB provisions, or compliance monitoring, it may contact the State recipient.

1. Applicability of the Davis- Bacon (DB) prevailing wage requirements.

Under the FY 2013 Continuing Resolution, DB prevailing wage requirements apply to the construction, alteration, and repair of treatment works carried out in whole or in part with assistance made available by a State water pollution control revolving fund and to any construction project carried out in whole or in part by assistance made available by a drinking water treatment revolving loan fund. If a subrecipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the subrecipient must discuss the situation with the recipient State before authorizing work on that site.

2. Obtaining Wage Determinations.

(a) Subrecipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. Subrecipients need to submit the wage determination to Department of Commerce, Contracts Administration Unit project manager prior to inserting the wage determination into a solicitation, contract or issuing task orders, work assignments or similar instruments to existing contractors ordering instruments unless subsequently directed otherwise by the State recipient Award Official. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.

(i) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov weekly to ensure that the wage determination contained in the solicitation remains current. The subrecipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the subrecipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the subrecipient.

(ii) If the subrecipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient, at the request

of the subrecipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(b) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subrecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.

(c) Subrecipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(d) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a subrecipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the subrecipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the contract or ordering instrument. If this occurs, the subrecipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The subrecipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

ATTACHMENT 1A
LABOR STANDARDS PROVISIONS
MUNICIPAL BORROWERS

Contract and Subcontract provisions.

(a) The Recipient shall insure that the subrecipient(s) shall 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 treatment work under the CWSRF or a construction project under the DWSRF 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 § 5.1 or the FY 2013 Continuing Resolution, the following clauses:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work 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 § 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.

Subrecipients may obtain wage determinations from the U.S. Department of Labor’s web site, www.dol.gov.

(ii)(A) The subrecipient(s), on behalf of EPA, 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 State award official shall approve a request for 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 subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient (s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official 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 subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request 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 subrecipient(s), shall upon written request of the EPA Award Official or 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, 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. 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 subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall

provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls 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 the weekly payrolls. 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/wh347instr.htm 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 subrecipient(s) for transmission to the State or EPA if requested by EPA , the State, 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 subrecipient(s).

(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 § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 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 State, EPA 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 or State 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 EPA determines may by appropriate, 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 Subrecipient(s), State, EPA, 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.

4. **Contract Provision for Contracts in Excess of $100,000.**

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(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 Item 3, above or 29 CFR 4.6. 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 (a)(1) of this section the contractor and any subcontractor responsible therefore 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 (a)(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 (a)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The subrecipient**,** upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall 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 (a)(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 (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall 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 Subrecipient shall insert in any such contract a clause providing hat 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.

5. Compliance Verification

(a) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicated that there is a risk that the contractor or subcontractor is not complying with DB.
Subrecipients shall immediately conduct interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence."

(c) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable, the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract . Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d) The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at http://www.dol.gov/contacts/whd/america2.htm.

ATTACHMENT 2

FEDERAL & STATE WAGE RATE DETERMINATIONS

Federal (Davis – Bacon) and State wage determinations are listed in Part 5 of the Contract Documents.

ATTACHMENT 3
CERTIFICATION OF NONSEGREGATED FACILITIES

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

The federally assisted construction contractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor certified, further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract.

As used in this certification, the term "segregated facilities" means any waiting rooms, work area, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or area, in fact, segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. The federally assisted construction contractor agrees that (except where he has obtained identical certifications from proposed contractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause, and that he will retain such, certification in this file.

_____ _____

Signature Date

_____

Name and title of signer (please type)

[THIS FORM SHALL BE COMPLETED IN FULL AND SUBMITTED WITH THE BID PROPOSAL]

ATTACHMENT 4
NOTICE TO LABOR UNIONS OR OTHER ORGANIZATION OF WORKERS: NON-DISCRIMINATION IN EMPLOYMENT

TO: _____
(name of union or organization of worker)

The undersigned currently holds contract(s) with _____
(name of applicant)
involving funds or credit of the U.S. Government or (a) subcontract(s) with a prime contractor holding such contract(s).

You are advised that under the provisions of the above contract(s) or subcontract(s) and in accordance with Section 202 of Executive Order 11246 dated September 24, 1965, the undersigned is obliged not to discriminate against any employee or applicant for employment because of race, color, creed, or national origin. This obligation not to discriminate in employment includes, but is not limited to, the following:

EMPLOYMENT, UPGRADING, TRANSFER OR DEMOTION

RECRUITMENT AND ADVERTISING
RATES OF PAY OR OTHER FORMS OF COMPENSATION

SELECTION FOR TRAINING INCLUDING APPRENTICESHIP, LAYOFF OR TERMINATION

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

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

_____

_____

_____

_____
(contractor or subcontractor(s))

_____
(Date)

ATTACHMENT 5
EPA FORM 6100-2-DBE PROGRAM SUBCONTRACTOR PARTICIPATION FORM

United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

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 DBE[1] subcontractor[2] 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.

EPA United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

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.

EPA FORM 6100-2 (DBE Subcontractor Participation Form)

Attachment 6
EPA Form 6100-3-DBE Program Subcontractor Performance Form

EPA United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/ 13/ 2013
Approval Expires: 8/ 31/ 2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form

This form is intended to capture the DBE[1] subcontractor's[2] description of work to be performed and the price of the work submitted to the prime contractor. An EPA Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractors bid or proposal package.

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 Submitted to the Prime Contractor Involving Construction, Services , Equipment or Supplies	Price of Work Submitted to the Prime Contractor
DBE Certified By: ___ DOT ___ SBA ___ Other: _____	Meets/ exceeds EPA certification standards? ___ YES ___ NO ___ Unknown	

[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.

EPA FORM 6100-3 (DBE Subcontractor Performance Form)

United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	**Date**

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.

EPA FORM 6100-3 (DBE Subcontractor Performance Form)

ATTACHMENT 7
EPA FORM 6100-4-DBE PROGRAM SUBCONTRACTOR UTILIZATION FORM

EPA United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/ 13/ 2013
Approval Expires: 8/ 31/ 2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE[1] subcontractors[2] and the estimated dollar amount of each subcontract. An EPA Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

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

I have identified potential DBE certified subcontractors	___YES	___NO
If yes, please complete the table below. If no, please explain:		

Subcontractor Name/ Company Name	Company Address/ Phone/ Email	Est. Dollar Amt	Currently DBE Certified?

Continue on back if needed

[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.

EPA FORM 6100-4 (DBE Subcontractor Utilization Form)

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor 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.

EPA FORM 6100-4 (DBE Subcontractor Utilization Form)

COWLITZ INDIAN TRIBE

Cultural Resources Department

P.O. Box 2547 • 1055 9th Ave. Suite C • Longview, WA 98632

360.577.6962 • 577.6207 (f) • cowlitz.org

INADVERTENT DISCOVERY LANGUAGE

[revised 130220]

In the event any archaeological or historic materials are encountered during project activity, work in the immediate area (initially allowing for a 100' buffer; this number may vary by circumstance) must stop and the following actions taken:

1. Implement reasonable measures to protect the discovery site, including any appropriate stabilization or covering; and
2. Take reasonable steps to ensure the confidentiality of the discovery site; and,
3. Take reasonable steps to restrict access to the site of discovery.

The project proponent will notify the concerned Tribes and all appropriate county, state, and federal agencies, including the Department of Archaeology and Historic Preservation (SHPO in Oregon). The agencies and Tribe(s) will discuss possible measures to remove or avoid cultural material, and will reach an agreement with the project proponent regarding actions to be taken and disposition of material.

If human remains are uncovered, appropriate law enforcement agencies shall be notified first, and the above steps followed. If the remains are determined to be Native, consultation with the affected Tribes will take place in order to mitigate the final disposition of said remains.

See the Revised Code of Washington, Chapter 27.53, "Archaeological Sites and Resources," for applicable state laws and statutes. See also Washington State Executive Order 05-05, "Archaeological and Cultural Resources." Additional state and federal law(s) may also apply.

It is strongly encouraged copies of inadvertent discovery language/plan are retained on-site while project activity is underway.

Contact information:

dAVe burlingame
Director, Cultural Resources
360.577.6962
508.1677 cell
577.6207 fax
culture@cowlitz.org

Ed Arthur
Assistant Director, Cultural Resources
360.575.3314
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577.6207 fax
earthur@cowlitz.org