

S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS

LACEY PROJECT NUMBER PW 2022-29

**SPECIFICATIONS AND BID DOCUMENTS
DEPARTMENT OF PUBLIC WORKS**

LACEY PROJECT NUMBER PW 2022-29

***CITY OF LACEY
WASHINGTON***

CITY OFFICIALS

MAYOR

ANDY RYDER

DEPUTY MAYOR

MALCOLM MILLER

COUNCIL MEMBERS

LENNY GREENSTEIN

MICHAEL STEADMAN

CAROLYN COX

NICOLAS DUNNING

ROBIN VAZQUEZ

CITY MANAGER

RICK WALK

CITY ATTORNEY

DAVID S. SCHNEIDER

DIRECTOR OF PUBLIC WORKS

SCOTT EGGER, P.E.

CITY ENGINEER

AUBREY COLLIER, P.E., S.E.

City of Lacey PW# 2022-29
S10 Generator, Well Pump, and Site Improvements

C E R T I F I C A T I O N

I hereby certify that the Project Specifications were prepared by me or under my direct supervision and I am a duly Registered Engineer under the laws of the State of Washington:

Trent Lougheed, P.E.
City of Lacey
Sections A,B,C,D,F



Keith Stewart, P.E.
Gray & Osborne, Inc.
Section E



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ADVERTISEMENT FOR BIDS

S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS

NOTICE IS HEREBY GIVEN that sealed bids will be received by the City of Lacey at City Hall, Lacey, Washington until 2:30 p.m., March 19, 2024, at which time bids will be publicly opened via a live video stream. Links to the YouTube live video stream can be found at <https://cityoflacey.org/rfp-rfq-rfi/> under the specific project section and on the specific project page on the Builders Exchange website located at http://bxwa.com/bxwa_toc/pub/2080/toc.html for the following work:

This contract provides for the installation of approximately 70 linear feet (LF) of 12-inch diameter water main, approximately 80 LF of 12inch diameter PVC storm piping, replacement of an existing vertical turbine well pump with a submersible pump, rehabilitation of an existing well, installation of a below grade vault, replacement of an existing sodium hypochlorite metering and monitoring system, and installation of a new, diesel powered generator with sub-base fuel tank. The project also includes electrical, site, and restoration activities associated with the project components listed above.

Each bid must be accompanied by a certified check for five percent of the amount of the proposal made payable to the City Treasurer, or an approved bid bond for five percent of the amount of the proposal executed on the approved form attached to these specifications. If bid bond is used, the five percent may be shown in dollars and cents or the form may be filled in by inserting therein, in lieu thereof, "five percent of the amount of the accompanying proposal". Check of unsuccessful bidders will be returned immediately upon award of contract.

The City Council reserves the right to reject any and all bids and to waive all informalities.

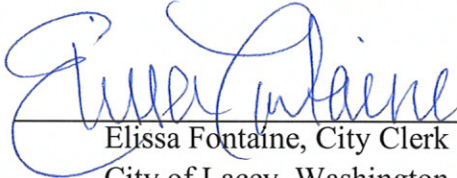
Plans, Specifications, and Addenda for this project are available through the "City of Lacey" on-line plan room. Free of charge access is provided by going to <http://bxwa.com> and clicking on: "Posted Projects", "Public Works", "City of Lacey", and "Projects Bidding". Bidders are asked to "Register" in order to receive automatic email notification of future addenda and to be placed on the "Bidders List". Any questions regarding this contract can be directed to:

Trent J. Lougheed, P.E.
(360) 486-8733
tloughee@ci.lacey.wa.us

The range for this project is \$1,000,000 to \$1,500,000.

A NON-MANDATORY PREBID CONFERENCE IS SCHEDULED FOR March 7, 2024 AT 9:00 a.m. We will meet at 5138 Yelm Highway; Lacey, WA 98503. From I-5: Take College Street Exit, proceed south on College Street, then turn left (east) on Yelm Highway, then turn left (north) on Parkside Drive SE to the site on the left.

Publish: 2/27/2024
3/05/2024



Elissa Fontaine, City Clerk
City of Lacey, Washington

A INSTRUCTIONS

INSTRUCTIONS TO BIDDERS

Bidders shall examine contract and bid documents and the site and shall satisfy themselves as to conditions that exist.

Each Bidder shall submit to the City Clerk, Lacey, Washington a sealed bid endorsed upon the outside wrapper with **S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS** at the time and place designated in the advertisement.

Bids may be delivered in person to Lacey City Hall, 420 College Street SE, or by mail to City of Lacey 420 College St SE Lacey, WA 98503.

Bids will be publicly opened via a live video stream. Links to the YouTube live video stream can be found at <https://cityoflacey.org/rfp-rfq-rfi/> or under the specific project section and on the specific project page on the Builders Exchange website.

The City of Lacey is committed to offering reasonable accommodations to persons with disabilities. We invite any person with special needs to contact the City Clerk at (360) 491-3212 at least seventy-two (72) hours before the meeting to discuss any special accommodations that may be necessary. Citizens with hearing impairment may call the TDD line at (800) 833-6388.

Each Bidder shall complete the proposal with prices in figures with the extension properly computed. The proposal must be properly signed by a duly authorized agent. Proposal must acknowledge addenda, if any, received.

If alternates are included in the proposal the Bidder shall complete the alternates. The City will award the contract to the lowest responsible Bidder as determined by the Special Provisions. The City reserves the right to delete alternates after award.

A Bidder will be deemed not responsible if the Bidder does not meet the mandatory bidder responsibility criteria in RCW 39.04.350(1).

The City does not pre-qualify Bidders. However, if the apparent low Bidder has not already been determined qualified, the City shall afford seven (7) days after notification for the low Bidder to provide evidence for evaluation, as to capability to perform the work. The evaluation will include consideration of experience, personnel, equipment, financial resources as well as performance record. The information must be sufficient to enable the Bidder to obtain the required qualification rating prior to the award of the contract.

No bidder may withdraw his bid after the hour set for the opening of bids or before award of the contract unless said award is delayed for a period of forty-five (45) days.

CONTRACT PARTS

The contract to be executed as a result of this bid consists of multiple parts, all of which pertain as if fully attached hereto and Bidder shall consider all parts as a complete document. In the event of discrepancies between the various parts, precedent shall be in the following order:

1. Contract Form,
 2. Addenda (if any),
 3. Proposal Form,
 4. Special Provisions,
 5. Technical Specifications,
 6. Contract Plans,
 7. WSDOT Standard Specifications for Road, Bridge, and Municipal Construction,
 8. City of Lacey Development Guidelines and Public Works Standards, and
 9. WSDOT Standard Plans for Road, Bridge and Municipal Construction
- The Bidder is directed to complete and return the forms in Section B as a bid proposal.

BIDDER'S CHECKLIST

The bidder's attention is especially called to the following forms which must be executed in full as required, and submitted with the bid proposal:

1. Proposal: The unit prices bid must be shown in the space provided.
2. Proposal Signature Sheet: To be filled in and signed by the bidder. All addenda must be acknowledged.
3. Bid Deposit: Any bid shall be accompanied by a deposit of cash, certified check, cashier's check, or surety bond, in an amount equal to at least five percent (5%) of the total amount bid. Checks shall be payable to the City Clerk, City of Lacey, Washington.

If a surety bond is used, it shall be submitted on a form furnished by the Commission and signed by the bidder and his surety company. The sureties' "attorney-in-fact" must be registered with the Washington State Insurance Commissioner. The power of attorney must also be submitted with the bond. See Specification section 1-02.7 for more information.

4. Non-Collusion and Debarment Affidavit
5. Subcontractors List

The following form must be submitted within 24 hours following the bid submittal deadlines.

6. Certification of Compliance with Wage Payment Statutes

The following must be submitted by 2:30 P.M. of the second business day following the bid submittal deadline:

7. Supplemental Criteria per Specification section 1-02.14

The following must be completed before the contract can be awarded:

8. L&I training on the requirements related to public works and prevailing wages per RCW 39.04.350
9. Certification of Employment Security Department (ESD) good standing

The following forms are to be executed after the contract is awarded:

10. Contract: This agreement to be executed by the successful bidder
11. Performance and Payment Bond
12. Insurance Certificate

Bidder's Checklist

- | | |
|---|--|
| 1. Proposal | |
| 2. Proposal Signature Sheet | |
| Addenda Acknowledged | |
| 3. Bid Deposit | |
| Power of Attorney included if applicable | |
| 4. Non-Collusion and Debarment Affidavit | |
| 5. Subcontractor List | |
| 6. Certification of Compliance with Wage Payment Statutes | |
| 7. Contractor has verified they can meet bidding qualifications/supplemental criteria | |
| 8. L&I Public Works Prevailing Wage Training | |
| 9. ESD Certification | |

B

BID DOCUMENTS

CITY OF LACEY

S10 Generator, Well Pump, and Site Improvements

Lacey Contract Number: PW 2022-29

Federal Aid Project Number:

WSDOT Contract Number:

TIB Contract Number:

Contract Proposal

DATE: _____

The undersigned, as bidder, has examined the bid documents as prepared by the Public Works Department, City of Lacey.

The undersigned, as bidder, proposes to furnish all material and perform all labor in accordance with the bid documents at the following prices.

Bidder must fill in unit prices in figures for each item and total.

Bidder shall sign this proposal form and submit all required paperwork with the bid.

A Water

No.	Quantity	Unit	Item ID	Item Description	Unit Price	Extended Price
A1	75000	MC	104-010	Minor Change	\$1.00	\$75,000.00
A2	1	LS	105-010	Record Drawing	\$5,000.00	\$5,000.00
A3	1	LS	109-010	Mobilization	LUMP SUM	
A4	1	LS	110-010	Project Temporary Traffic Control	LUMP SUM	
A5	1	LS	110-017	Pedestrian Traffic Control	LUMP SUM	
A6	1	LS	201-010	Clearing and Grubbing	LUMP SUM	
A7	1	LS	202-520	Special Removal of Structures and Obstructions	LUMP SUM	
A8	10	CY	203-120	Unsuitable Foundation Excavation Incl. Haul		
A9	20	TN	203-190	Gravel Borrow Incl. Haul		
A10	1	LS	205-510	Trench Safety System	LUMP SUM	
A11	10	TN	404-010	Crushed Surfacing Base Course		
A12	10	TN	404-020	Crushed Surfacing Top Course		
A13	10	TN	504-110	Commercial HMA		
A14	80	LF	704-512	12 Inch Diameter Storm Sewer Pipe		
A15	1	EA	705-450	Connection to Drainage Structure		
A16	70	LF	709-512	12 Inch D.I. Water Main		
A17	2	EA	709-950	Connect to Existing Water Main		
A18	1	LS	722-520	Pumps & Mechanical	LUMP SUM	
A19	1	LS	726-510	Contractor-Supplied Temporary Pump	LUMP SUM	
A20	10	HR	726-520	Pumping Test		
A21	1	LS	726-530	Control of Rehabilitation Derived Waste	LUMP SUM	

A22	30	HR	726-540	Well Rehabilitation - Brushing		
A23	30	HR	726-550	Well Rehabilitation - Redevelopment		
A24	10	FA	726-560	Well Rehabilitation - Force Account		
A25	10	HR	726-600	Authorized Standby Time		
A26	20	LF	804-010	Cement Conc. Traffic Curb and Gutter		
A27	10	SY	814-510	Cement Conc. Sidewalk		
A28	1	LS	850-501	Restoration	LUMP SUM	
A29	1	LS	850-720	Well Pump and Motor	LUMP SUM	
A30	1	LS	850-725	Electrical	LUMP SUM	
A31	1	LS	850-730	Telemetry and Automatic Control	LUMP SUM	
A32	1	LS	850-735	Startup	LUMP SUM	
A33	1	LS	850-792	Project Closeout	\$5,000.00	\$5,000.00
A34	1	LS	850-802	Standby Generator	LUMP SUM	
A35	1	LS	890-515	Temporary Water Pollution/Erosion Control	LUMP SUM	

Schedule A Subtotal:

Tax Rate (%) : 9.70 Tax:

Schedule A Total:

Contract Total:

(All Schedules)

The undersigned also agrees as follows:

- Within 10 calendar days after the contract is awarded to sign and return the contract and provide insurance documents.
- That this proposal cannot be withdrawn within 45 days after receipt of bids.
- That it is the understanding that the City of Lacey may accept or reject any or all bids.
- The undersigned hereby agrees to pay for labor not less than the prevailing rates of wages per the bid documents.
- Enclosed with this proposal is a bid deposit in the sum of 5% of the bid total amount which it is agreed shall be collected and retained by the City of Lacey as liquidated damages in the event this proposal is accepted by the City of Lacey with 45 calendar days after the receipt of bids and the undersigned fails to execute the contract and the required bond with the City of Lacey, under the conditions thereof, within 10 calendar days after the undersigned is notified that said proposal has been accepted, otherwise said bid deposit shall be returned to the undersigned upon demand.
- A Performance/Payment Bond will be furnished to the City with the contract.
- Retention will be held on this contract per RCW 60.28.011.

Addenda Receipt Acknowledged

Signature of Bidder

Date

(If an Individual, Partnership, or Non-Incorporated organization)

Firm Name

Please Print

Phone

Address of Bidder: _____

Name and Address of Firm Members:

Signature of Bidder (if a Corporation)

Title: _____

Firm Name: _____

Phone: _____

Business Address: _____

Incorporated under the Laws of the State of _____

Officers

Address

President: _____

Secretary: _____

Treasurer: _____

BID DEPOSIT SELECTION

A bid deposit in an amount of five percent (5%) of the total bid amount is attached hereto:

CASH ☐ In the amount of _____

CASHIER'S CHECK ☐ In the amount of _____

CERTIFIED CHECK ☐ In the amount of _____

BID BOND ☐ In the amount of 5% of the total bid amount

CONTRACTOR'S BID DEPOSIT SURETY BOND
to City of Lacey, Washington

We, _____, as Principal, existing under and by virtue of the laws of the State of Washington and authorized to do business in the State of Washington, and _____, as Surety, organized and existing under the laws of the State of _____, are held and firmly bound unto the City of Lacey, a Washington municipality, as Obligee, in the penal sum of 5% of the total amount bid, not to exceed \$ _____, for the payment of which we jointly and severally bind ourselves, and our legal representatives and successors.

WHEREAS, the Principal has submitted a bid for **S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS**.

NOW THEREFORE, the condition of the obligation is such that if the Obligee shall accept the bid of Principal and make timely award to the Principal according to the terms of the bid documents; and the Principal shall, within ten days after notice of the award, exclusive of the day of notice, enter into the contract with the Obligee and furnish the contractor's bonds (performance and payment bonds) with Surety satisfactory to the Obligee in an amount equal to 100% of the amount of the bid proposed including additives, alternatives and Washington State sales tax, then this obligation shall be null and void; otherwise if the Principal fails to enter into the contract and fails to furnish the contractor's bonds within ten days of notice of award, exclusive of the day of notice, the amount of the bid deposit shall be forfeited to the Obligee, payable by the Surety; but in no event will the Surety's liability exceed the face amount of this bid bond.

This bond may be executed in two 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 (CONTRACTOR)

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:

NON-COLLUSION AND DEBARMENT AFFIDAVIT

State of _____)

)ss

County of _____)

I, the undersigned, being duly sworn, deposes and says that the person, firm, association, copartnership or corporation herein named, has 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 the preparation and submission of a proposal of the City of Lacey for consideration in the award of a contract on the improvement described as follows.

I further certify that, except as noted below, the firm, association or corporation or any person in a controlling capacity associated therewith or any position involving the administration of State or federal funds; is not currently under suspension, debarment, voluntary exclusion, or determination of ineligibility by any federal or State agency; has not been suspended, debarred, voluntarily excluded or determined ineligible by any federal or State agency within the past three years; does not have a proposed debarment pending; and has not been indicted, convicted, or had a civil judgment rendered against said person, firm, association or corporation by a court of competent jurisdiction in any matter involving fraud or official misconduct within the past three years.

I further acknowledge that by signing my signature, I am deemed to have signed and have agreed to the provisions of this affidavit.

S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS

Name of Project

Name of Firm

Signature of Authorized Member

Sworn to before me this

_____ day of _____, 20 _____

Notary Public

(CORPORATE SEAL)

CERTIFICATION OF COMPLIANCE WITH WAGE PAYMENT STATUTES

The bidder hereby certifies that, within the three-year period immediately preceding the bid solicitation date, the bidder is not a "willful" violator, as defined in RCW 49.48.082, of any provision of chapters 49.46, 49.48, or 49.52 RCW, as determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction.

I certify under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

Bidder's Business Name

Signature of Authorized Official*

Printed Name

Title

Date

City

State

Check One:

Sole Proprietorship ☐ Partnership ☐ Joint Venture ☐ Corporation ☐

State of Incorporation, or if not a corporation, State where business entity was formed:

If a co-partnership, give firm name under which business is transacted:

** If a corporation, proposal must be executed in the corporate name by the president or vice-president (or any other corporate officer accompanied by evidence of authority to sign). If a co-partnership, proposal must be executed by a partner.*

This form must be submitted with the Bid Proposal or as a Supplement to the Bid no later than 24 hours after the time for delivery of the Bid Proposal, as provided for in Section 1-02.9 of the Contract Provisions.

**CERTIFICATION OF EMPLOYMENT SECURITY DEPARTMENT (ESD)
GOOD STANDING AND NUMBER**

The bidder hereby provides an ESD number and certifies that per RCW 39.04.350 and Title 50 RCW, in which the City will verify prior to entering into contract with the Contractor, that the Bidder has a valid ESD number and is deemed to be in good standing with Washington State's Employment Security Department.

I certify under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

Bidder's Business Name

Employment Security Department (ESD) Number

WA State Unified Business Identifier (UBI #)

Signature of Authorized Official*

Printed Name

Title

Date

City

State

SUBCONTRACTOR LIST

Prepared in compliance with RCW 39.30.060 as amended

To Be Submitted with the Bid Proposal

Project Name: S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS

Failure to list subcontractors with whom the bidder, if awarded the contract, will directly subcontract for performance of the work of structural steel installation and rebar installation, heating, ventilation and air conditioning, plumbing, as described in Chapter 18.106RCW, and electrical, as described in Chapter 19.28 RCW or naming more than one subcontractor to perform the same work will result in your bid being non-responsive and therefore void.

Subcontractor(s) with whom the bidder will directly subcontract that are proposed to perform the work of structural steel installation and rebar installation, heating, ventilation and air conditioning, plumbing, as described in Chapter 18.106 RCW, and electrical as described in Chapter 19.28 RCW **must** be listed below. The work to be performed is to be listed below the subcontractor(s) name.

To the extent the Project includes one or more categories of work referenced in RCW 39.30.060, and no subcontractor is listed below to perform such work, the bidder certifies that the work will either (i) be performed by the bidder itself, or (ii) be performed by a lower tier subcontractor who will not contract directly with the bidder.

Subcontractor Name: _____

Work to be Performed: Structural steel installation

Subcontractor Name: _____

Work to be Performed: Rebar installation

Subcontractor Name: _____

Work to be Performed: Plumbing

Subcontractor Name: _____

Work to be Performed: Electrical

Subcontractor Name: _____

Work to be Performed: Heating ventilation and air conditioning

* Bidder's are notified that is the opinion of the enforcement agency that PVC or metal conduit, junction boxes, etc, are considered electrical equipment and therefore considered part of electrical work, even if the installation is for future use and no wiring or electrical current is connected during the project.

C CONTRACT DOCUMENTS

CONSTRUCTION CONTRACT

THIS AGREEMENT, made and effective as of the date of the last signature below, between the City of Lacey, hereinafter called Owner, under and by virtue of the charter, laws and ordinances of the said Owner and the laws of the State of Washington, and

_____ hereinafter called Contractor,

WITNESSETH:

That in consideration of the payment, covenants and agreement hereinafter mentioned, attached and made a part of this Agreement, to be made and performed by the parties hereto, the parties covenant and agree as follows regarding:

City of Lacey Contract No. PW 2022-29 for the “**S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS**” project in the sum of SAMPLE - (SPELL OUT DOLLAR AMOUNT XX/100 Dollars (\$XXX,XXX.XX)) including applicable sales tax.

1. The Contractor shall do all work and furnish all tools, materials and equipment in accordance with and as described in the attached Plans and Specifications, and in full compliance with the terms, conditions and stipulations herein set forth and attached, now referred to and by such reference incorporated herein and made a part hereof as fully for all purposes as if here set forth at length, and shall perform any alterations in or in addition to the work covered by this Contract and every part thereof and any force account work which may be ordered as provided in this Contract and every part thereof.

The Contractor shall provide and bear the expense of all materials, labor, equipment, tools, implements and conveniences and things of every description that may be requisite for the transfer of materials and for constructing and completing the work provided for in this Contract and every part thereof, except such as are mentioned in the Specifications to be furnished by the Owner.

2. The Owner hereby promises and agrees with the Contractor to employ, and does employ the Contractor to provide the materials and to do and cause to be done the above described work and to complete and finish the same according to the attached Plans and Specifications and the schedule of unit or itemized prices hereto attached, at the time and in the manner and upon the conditions provided for in this Contract and every part thereof.
3. Contractor, for himself and for his heirs, executors, administrators, successors, assigns, does hereby agree to the full performance of all the covenants herein contained upon the part of Contractor.
4. It is further provided that no liability shall attach to Owner or Agent thereof by reason of entering into this Contract, except as expressly provided herein.

5. Payments will be made under the Contract according to the schedule of rates and prices and the specification attached and made a part thereof. Partial payments under the Contract will be made at the request of the Contractor not more than once each month upon approval of the Owner, as hereinafter specified, provided they are in accordance with the provisions of RCW 60.28.010. There will be reserved and retained from monies earned by the Contractor, as determined by such monthly estimates, a sum equal to 5 percent of the Contract price.

Payment of the retained percentage shall be withheld for a period of forty-five (45) days following the final acceptance of the work and materials by the Owner, and shall be paid the Contractor at the expiration of said forty-five (45) days in event no claims, as provided by law, have been filed against such funds; and provided further, that releases have been obtained from all departments and agencies having jurisdiction over the activities of the Contractor. In the event such claims are filed, Contractor shall be paid such retained percentages less an amount sufficient to pay any such claims together with a sum sufficient to pay the cost of such action, and to cover attorney fees as determined by the Owner.

6. Requests for review of substitute items of material or equipment will not be accepted by the Owner or Agent from anyone other than the Contractor. If the Contractor wishes to furnish a substitute item, the Contractor shall make written application to the Owner's Agent for acceptance thereof, certifying that the proposed substitute will perform adequately the functions called for by the general design, be similar and of equal substance to that specified and be suited to the same use and capable of performing the same function as that specified. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, which shall be considered by the Owner in evaluating the proposed substitute. The Owner may require the Contractor to furnish at the Contractor's expense, additional data about the proposed substitute. The Owner will be the sole judge of acceptability, and no substitute will be ordered without the Owner's prior written acceptance. The Owner may require the Contractor to furnish at the Contractor's expense, a special performance guarantee or other surety with respect to any other substitute.

The Owner or Agent will record the time and expenses in evaluating substitutions proposed by the Contractor. Whether or not the Owner accepts a proposed substitute, the Contractor shall reimburse the Owner for the costs of evaluating any proposed substitute.

7. The Owner reserves the right, after the final payment has been made, to claim and recover by process of law such sums as may be sufficient to make good any defects in the equipment or to recover any over-payment resulting from dishonest acts of the Contractor.
8. The contract time will commence to run, and the Contractor shall start to perform his obligation under the contract documents, on the day indicated in the Notice to Proceed given by Owner to Contractor; but in no event shall contract time commence to run later than the 30th calendar day after the date when both Owner and Contractor execute the Contract. A Notice to Proceed may be given at any time within thirty (30) calendar days after the date when both Owner and Contractor execute the Contract.

9. The Contractor shall guarantee the materials and workmanship for a period of one (1) year from and after the date of final acceptance by the Owner.

If, within said guarantee period, repairs are required which, in the opinion of the Owner, are rendered necessary as a result of work or materials which are inferior, defective or not in accordance with the terms of the Contract, the Contractor shall, promptly upon receipt of notice from the Owner, and without expense to the Owner, (a) correct all defects and place in satisfactory condition in every particular all of such guaranteed work and materials; (b) make good all damage which in the opinion of the Owner is caused by such defects; and (c) make good any other work or material or the equipment and contents of a building, structure or site disturbed in fulfilling any such guarantee.

If the Contractor, after notice, fails within ten (10) days to proceed to comply to the terms of this guarantee, the Owner may have the defects corrected, and the Contractor and his Surety shall be liable for all expense incurred, provided, however, that in case of an emergency where, in the opinion of the Owner, delay would cause serious loss or damage, repairs may be made without notice being given to the Contractor and the Contractor shall pay the cost thereof.

IN WITNESS WHEREOF, the said Contractor has executed this instrument and the City Manager, pursuant to resolution duly adopted, has caused this instrument to be executed in the name of the City of Lacey the day and year first above-written.

Contractor Date

Contractor's Registration Number (UBI No.)

City of Lacey Business License Number

City Manager Date

ATTEST:

By:

City Clerk

APPROVED AS TO FORM:

By :

City Attorney

**CONTRACTOR'S PERFORMANCE/PAYMENT BOND
to City of Lacey, Washington**

The City of Lacey, Washington, in Thurston County, has awarded to _____ (Contractor), as Principal, a contract for the construction of the project designated as **S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS**, Project No. **PW 2022-29** in Lacey, Washington, and said Principal is required under the terms of the Contract to furnish a performance/payment bond in accordance with chapter 39.08 Revised Code of Washington (RCW).

The Principal, and _____ (Surety), a corporation, organized under the laws 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 City of Lacey, as Obligee, in the sum of \$ _____ total Contract amount (including Washington State sales tax), subject to the provisions herein.

The obligations of this 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; shall pay all persons in accordance with chapters 39.08, 39.12, and 60.28 RCW, including all workers, laborers, mechanics, subcontractors, and material suppliers, and all persons who shall supply such contractor or subcontractor with provisions and supplies for the carrying on of such work; shall warranty the work as provided in the Contract and shall indemnify and hold harmless the Obligee from any defects in the workmanship and materials incorporated into the work for the period identified in the Contract; and if such 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 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 (CONTRACTOR)

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:

**DECLARATION OF OPTION FOR MANAGEMENT OF
STATUTORY RETAINED PERCENTAGE**

- A. I hereby elect to have the retained percentage of this contract held in a fund by the City of Lacey until forty-five (45) days following final acceptance of the work.

Contractor (please print)

Date

Signature

- B. I hereby elect to have the City of Lacey invest the retained percentage of this contract from time to time as such retained percentage accrues and in accordance with RCW Ch. 60.28.

I hereby designate _____ as the repository for the escrow of said funds.

I hereby further agree to be fully responsible for payment of all costs or fees incurred as a result of placing said percentage in escrow and investing it as authorized by statute.

The City of Lacey shall not be liable in any way for any costs or fees in connection therewith.

Contractor (please print)

Date

Signature

- C. I hereby elect to hold a retainage bond.

Contractor (please print)

Date

Signature

VERSION 02/14/2023

D SPECIAL PROVISIONS

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SPECIAL PROVISIONS

INTRODUCTION TO THE SPECIAL PROVISIONS

(January 19, 2022 APWA GSP)

The work on this project shall be accomplished in accordance with the *Standard Specifications for Road, Bridge and Municipal Construction*, 2023 edition, as issued by the Washington State Department of Transportation (WSDOT) and the American Public Works Association (APWA), Washington State Chapter (hereafter “Standard Specifications”). The Standard Specifications, as modified or supplemented by these Special Provisions, all of which are made a part of the Contract Documents, shall govern all of the Work.

These Special Provisions are made up of both General Special Provisions (GSPs) from various sources, which may have project-specific fill-ins; and project-specific Special Provisions. Each Provision either supplements, modifies, or replaces the comparable Standard Specification, or is a new Provision. The deletion, amendment, alteration, or addition to any subsection or portion of the Standard Specifications is meant to pertain only to that particular portion of the section, and in no way should it be interpreted that the balance of the section does not apply.

The project-specific Special Provisions are not labeled as such, but are generally denoted with (*****). The GSPs are labeled under the headers of each GSP, with the effective date of the GSP and its source, except WSDOT uses a date only (2nd on list). For example:

(March 8, 2013 APWA GSP)

(April 1, 2013)

(May 1, 2013 Lacey GSP)

Also incorporated into the Contract Documents by reference are:

- *Manual on Uniform Traffic Control Devices for Streets and Highways*, currently adopted edition, with Washington State modifications, if any
- *Standard Plans for Road, Bridge and Municipal Construction*, WSDOT/APWA, current edition
- City of Lacey Development Guidelines and Public Works Standards, current edition

Contractor shall obtain copies of these publications, at Contractor’s own expense.

DESCRIPTION OF WORK

This contract provides for the installation of approximately 80 linear feet (LF) of 12-inch diameter water main, installation of approximately 80 LF of 12inch diameter PVC storm piping, installation of one new catch basin, connection to an existing catch basin, replacement of an existing vertical turbine well pump, rehabilitation of an existing well, installation of a below grade vault, replacement of an existing sodium hypochlorite metering and monitoring system, and installation of a new, diesel powered generator with sub-base fuel tank. The project also includes electrical, site, and restoration activities associated with the project components listed above.

1-01 DEFINITIONS AND TERMS

1-01.3 Definitions

(January 19, 2022 APWA GSP)

Delete the heading Completion Dates and the three paragraphs that follow it, and replace them with the following:

Dates

Bid Opening Date

The date on which the Contracting Agency publicly opens and reads the Bids.

Award Date

The date of the formal decision of the Contracting Agency to accept the lowest responsible and responsive Bidder for the Work.

Contract Execution Date

The date the Contracting Agency officially binds the Agency to the Contract.

Notice to Proceed Date

The date stated in the Notice to Proceed on which the Contract time begins.

Substantial Completion Date

The day the Engineer determines the Contracting Agency has full and unrestricted use and benefit of the facilities, both from the operational and safety standpoint, any remaining traffic disruptions will be rare and brief, and only minor incidental work, replacement of temporary substitute facilities, plant establishment periods, or correction or repair remains for the Physical Completion of the total Contract.

Physical Completion Date

The day all of the Work is physically completed on the project. All documentation required by the Contract and required by law does not necessarily need to be furnished by the Contractor by this date.

Completion Date

The day all the Work specified in the Contract is completed and all the obligations of the Contractor under the contract are fulfilled by the Contractor. All documentation required by the Contract and required by law must be furnished by the Contractor before establishment of this date.

Final Acceptance Date

The date on which the Contracting Agency accepts the Work as complete.

Supplement this Section with the following:

All references in the Standard Specifications or WSDOT General Special Provisions, to the terms “Department of Transportation”, “Washington State Transportation Commission”, “Commission”, “Secretary of Transportation”, “Secretary”, “Headquarters”, and “State Treasurer” shall be revised to read “Contracting Agency”.

All references to the terms “State” or “state” shall be revised to read “Contracting Agency” unless the reference is to an administrative agency of the State of Washington, a State statute or regulation, or the context reasonably indicates otherwise.

All references to “State Materials Laboratory” shall be revised to read “Contracting Agency designated location”.

All references to “final contract voucher certification” shall be interpreted to mean the Contracting Agency form(s) by which final payment is authorized, and final completion and acceptance granted.

Additive

A supplemental unit of work or group of bid items, identified separately in the Bid Proposal, which may, at the discretion of the Contracting Agency, be awarded in addition to the base bid.

Alternate

One of two or more units of work or groups of bid items, identified separately in the Bid Proposal, from which the Contracting Agency may make a choice between different methods or material of construction for performing the same work.

Business Day

A business day is any day from Monday through Friday except holidays as listed in Section 1-08.5.

Contract Bond

The definition in the Standard Specifications for "Contract Bond" applies to whatever bond form(s) are required by the Contract Documents, which may be a combination of a Payment Bond and a Performance Bond.

Contract Documents

See definition for "Contract".

Contract Time

The period of time established by the terms and conditions of the Contract within which the Work must be physically completed.

Notice of Award

The written notice from the Contracting Agency to the successful Bidder signifying the Contracting Agency's acceptance of the Bid Proposal.

Notice to Proceed

The written notice from the Contracting Agency or Engineer to the Contractor authorizing and directing the Contractor to proceed with the Work and establishing the date on which the Contract time begins.

Traffic

Both vehicular and non-vehicular traffic, such as pedestrians, bicyclists, wheelchairs, and equestrian traffic.

1-02 BID PROCEDURES AND CONDITIONS

1-02.1 Prequalification of Bidders

Delete this Section and replace it with the following:

1-02.1 Qualifications of Bidder

(January 24, 2011 APWA GSP)

Before award of a public works contract, a bidder must meet at least the minimum qualifications of RCW 39.04.350(1) to be considered a responsible bidder and qualified to be awarded a public works project.

1-02.1(1) Supplemental Qualifications Criteria

(July 31, 2017 APWA GSP)

In addition, the Contracting Agency has established Contracting Agency-specific and/or project-specific supplemental criteria, in accordance with RCW 39.04.350(3), for determining Bidder responsibility,

including the basis for evaluation and the deadline for appealing a determination that a Bidder is not responsible. These criteria are contained in Section 1-02.14 Option C of these Special Provisions.

1-02.2 Plans and Specifications

(June 27, 2011 APWA GSP)

Delete this section and replace it with the following:

Information as to where Bid Documents can be obtained or reviewed will be found in the Call for Bids (Advertisement for Bids) for the work.

After award of the contract, plans and specifications will be issued to the Contractor at no cost as detailed below:

To Prime Contractor	No. of Sets	Basis of Distribution
Reduced plans (11" x 17")	3	Furnished automatically upon award
Contract Provisions	3	Furnished automatically upon award
Large plans (22" x 34")	3	Furnished only upon request

Additional plans and Contract Provisions may be obtained by the Contractor from the source stated in the Call for Bids, at the Contractor's own expense.

1-02.4 Examination of Plans, Specifications and Site of Work

1-02.4(1) General

(December 30, 2022 APWA GSP Option B)

The first sentence of the ninth paragraph, beginning with "Prospective Bidder desiring...", is revised to read:

Prospective Bidder desiring an explanation or interpretation of the Bid Documents, shall request the explanation or interpretation in writing by close of business 5 business days preceding the bid opening to allow a written reply to reach all prospective Bidders before the submission of their Bids.

1-02.5 Proposal Forms

(July 31, 2017 APWA GSP)

Delete this section and replace it with the following:

The Proposal Form will identify the project and its location and describe the work. It will also list estimated quantities, units of measurement, the items of work, and the materials to be furnished at the unit bid prices. The bidder shall complete spaces on the proposal form that call for, but are not limited to, unit prices; extensions; summations; the total bid amount; signatures; date; and, where applicable, retail sales taxes and acknowledgment of addenda; the bidder's name, address, telephone number, and signature; the bidder's UDBE/DBE/M/WBE commitment, if applicable; a State of Washington Contractor's Registration Number; and a Business License Number, if applicable. Bids shall be completed by typing or shall be printed in ink by hand, preferably in black ink. The required certifications are included as part of the Proposal Form.

The Contracting Agency reserves the right to arrange the proposal forms with alternates and additives, if such be to the advantage of the Contracting Agency. The bidder shall bid on all alternates and additives set forth in the Proposal Form unless otherwise specified.

1-02.6 Preparation of Proposal

(March 3, 2022 Lacey GSP)

Supplement the second paragraph with the following:

4. If a minimum bid amount has been established for any item, the unit or lump sum price must equal or exceed the minimum amount stated.
5. Any correction to a bid made by interlineation, alteration, or erasure, shall be initialed by the signer of the bid.

Delete the last two paragraphs, and replace it with the following:

The Bidder shall submit a completed Contractor Certification Wage Law Compliance form, provided by the Contracting Agency. Failure to return this certification within 24 hours of the bid opening will make this Bid Nonresponsive and ineligible for Award. A Contractor Certification of Wage Law Compliance form is included in the Proposal Forms.

The Bidder shall make no stipulation on the Bid Form, nor qualify the bid in any manner.

A bid by a corporation shall be executed in the corporate name, by the president or a vice president (or other corporate officer accompanied by evidence of authority to sign).

A bid by a partnership shall be executed in the partnership name, and signed by a partner.

A bid by a joint venture shall be executed in the joint venture name and signed by a member of the joint venture.

1-02.6 Preparation of Proposal

(August 2, 2004 WSDOT 1-02.6OPT15.GR1)

The fifth and sixth paragraphs of Section 1-02.6 are deleted.

1-02.7 Bid Deposit

(March 8, 2013 APWA GSP)

Supplement this section with the following:

Bid bonds shall contain the following:

1. Contracting Agency-assigned number for the project;
2. Name of the project;
3. The Contracting Agency named as obligee;
4. The amount of the bid bond stated either as a dollar figure or as a percentage which represents five percent of the maximum bid amount that could be awarded;
5. Signature of the bidder's officer empowered to sign official statements. The signature of the person authorized to submit the bid should agree with the signature on the bond, and the title of the person must accompany the said signature;
6. The signature of the surety's officer empowered to sign the bond and the power of attorney.

If so stated in the Contract Provisions, bidder must use the bond form included in the Contract Provisions.

If so stated in the Contract Provisions, cash will not be accepted for a bid deposit.

1-02.9 Delivery of Proposal

(March 3, 2022 Lacey GSP)

Delete this section and replace it with the following:

Each Proposal shall be submitted in a sealed envelope, with the Project Name and Project Number as stated in the Call for Bids clearly marked on the outside of the envelope, or as otherwise required in the Bid Documents, to ensure proper handling and delivery.

If supplemental information is due after the Bid Proposal is due, the document(s) shall be submitted as follows:

1. In a sealed envelope labeled the same as for the Proposal, with “Supplemental Information” added, or
2. By e-mail to the following e-mail address: ProjectAdmin@ci.lacey.wa.us

All other information required to be submitted with the Bid Proposal must be submitted with the Bid Proposal itself, at the time stated in the Call for Bids.

Proposals that are received as required will be publicly opened and read as specified in Section 1-02.12. The Contracting Agency will not open or consider any Bid Proposal that is received after the time specified in the Call for Bids for receipt of Bid Proposals, or received in a location other than that specified in the Call for Bids. The Contracting Agency will not open or consider any “Supplemental Information” that is received after the time specified, or received in a location other than that specified in the Call for Bids.

If an emergency or unanticipated event interrupts normal work processes of the Contracting Agency so that Proposals cannot be received at the office designated for receipt of bids as specified in Section 1-02.12 the time specified for receipt of the Proposal will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which the normal work processes of the Contracting Agency resume.

1-02.10 Withdrawing, Revising, or Supplementing Proposal

(July 23, 2015 APWA GSP)

Delete this section in its entirety, and replace it with the following:

After submitting a physical Bid Proposal to the Contracting Agency, the Bidder may withdraw, revise, or supplement it if:

1. The Bidder submits a written request signed by an authorized person and physically delivers it to the place designated for receipt of Bid Proposals, and
2. The Contracting Agency receives the request before the time set for receipt of Bid Proposals, and
3. The revised or supplemented Bid Proposal (if any) is received by the Contracting Agency before the time set for receipt of Bid Proposals.

If the Bidder’s request to withdraw, revise, or supplement its Bid Proposal is received before the time set for receipt of Bid Proposals, the Contracting Agency will return the unopened Proposal package to the

Bidder. The Bidder must then submit the revised or supplemented package in its entirety. If the Bidder does not submit a revised or supplemented package, then its bid shall be considered withdrawn.

Late revised or supplemented Bid Proposals or late withdrawal requests will be date recorded by the Contracting Agency and returned unopened. Mailed, Emailed, or faxed requests to withdraw, revise, or supplement a Bid Proposal are not acceptable.

1-02.12 Public Opening of Proposals

(November 20, 2020 Lacey GSP)

Delete and replace this section with the following:

Proposals will be opened and publicly read by live video stream per the “Instructions to Bidders” in Section A of these Specifications at the time as indicated in the call for Bids

1-02.13 Irregular Proposals

(December 30, 2022 APWA GSP)

Delete this section and replace it with the following:

1. A Proposal will be considered irregular and will be rejected if:
 - a. The Bidder is not prequalified when so required;
 - b. The authorized Proposal form furnished by the Contracting Agency is not used or is altered;
 - c. The completed Proposal form contains any unauthorized additions, deletions, alternate Bids, or conditions;
 - d. The Bidder adds provisions reserving the right to reject or accept the award, or enter into the Contract;
 - e. A price per unit cannot be determined from the Bid Proposal;
 - f. The Proposal form is not properly executed;
 - g. The Bidder fails to submit or properly complete a Subcontractor list (WSDOT Form 271-015), if applicable, as required in Section 1-02.6;
 - h. The Bidder fails to submit or properly complete a Disadvantaged Business Enterprise Certification (WSDOT Form 272-056), if applicable, as required in Section 1-02.6;
 - i. The Bidder fails to submit Written Confirmation (WSDOT Form 422-031) from each DBE firm listed on the Bidder’s completed DBE Utilization Certification that they are in agreement with the bidder’s DBE participation commitment, if applicable, as required in Section 1-02.6, or if the written confirmation that is submitted fails to meet the requirements of the Special Provision;
 - j. The Bidder fails to submit DBE Good Faith Effort documentation, if applicable, as required in Section 1-02.6, or if the documentation that is submitted fails to demonstrate that a Good Faith Effort to meet the Condition of Award was made;
 - k. The Bidder fails to submit a DBE Bid Item Breakdown (WSDOT Form 272-054), if applicable, as required in Section 1-02.6, or if the documentation that is submitted fails to meet the requirements of the Special Provisions;
 - l. The Bidder fails to submit DBE Trucking Credit Forms (WSDOT Form 272-058), if applicable, as required in Section 1-02.6, or if the documentation that is submitted fails to meet the requirements of the Special Provisions;
 - m. The Bid Proposal does not constitute a definite and unqualified offer to meet the material terms of the Bid invitation; or
 - n. More than one Proposal is submitted for the same project from a Bidder under the same or different names.
2. A Proposal may be considered irregular and may be rejected if:
 - a. The Proposal does not include a unit price for every Bid item;

- b. Any of the unit prices are excessively unbalanced (either above or below the amount of a reasonable Bid) to the potential detriment of the Contracting Agency;
- c. Receipt of Addenda is not acknowledged;
- d. A member of a joint venture or partnership and the joint venture or partnership submit Proposals for the same project (in such an instance, both Bids may be rejected); or
- e. If Proposal form entries are not made in ink.

1-02.14 Disqualification of Bidders

(***)**

Delete this section and replace it with the following:

A Bidder will be deemed not responsible if the Bidder does not meet the mandatory bidder responsibility criteria in RCW 39.04.350(1), as amended; or does not meet Supplemental Criteria in this Section:

The Contracting Agency will verify that the Bidder meets the mandatory bidder responsibility criteria in RCW 39.04.350(1). Evidence that the Bidder meets Supplemental Criteria shall be provided by the Bidder as stated later in this Section.

Relevant Experience & Reference Checks

A. Criterion: The Bidder shall have successfully completed (3) three public works projects of a similar size and scope within the last (5) five years. In evaluating whether the projects were “successfully completed,” the Owner may check owner references for the previous projects and may evaluate the owner’s assessment of the Bidder performance. In conducting reference checks, the Owner may include itself as a reference if the bidder has performed work for the Owner, even if the bidder did not identify the Owner as a reference. The assessment may include but is not limited to the following areas:

- a. Administration / Management / Supervision
 - i. Supervision and decision making
 - ii. Coordination and communication with subcontractors and suppliers
 - iii. Submission of documents, reports, material submittals
 - iv. Timeliness of progress schedules
 - v. Public safety and traffic control
 - vi. Compliance with laws, ordinances and regulations
 - vii. Maintenance of employee safety standards
 - viii. Coordination and cooperation with department personnel on project matters
 - ix. Relations with the general public, other agencies and/or adjacent contractors
- b. Quality of Work
 - i. Adherence to plans and specifications
 - ii. Standards of Workmanship
 - iii. Completion of final (punch list) work
- c. Progress of Work
 - i. Completion of project within allotted time
 - ii. Scheduling and execution of schedule
 - iii. Delivery of materials and supplies
 - iv. Operation and use of equipment
 - v. Use of personnel
- d. Equipment
 - i. Condition
 - ii. Maintenance
 - iii. Proper/Suitable equipment used

B. Documentation: The Bidder shall submit a list of projects to the Owner. Public work is as defined in RCW 39.04.010. For the purposes of meeting this criterion, the Owner has determined that “similar size and scope to this project” means projects that have the following characteristics: Installation of new ductile iron water main piping greater than 8-inches in diameter, installation of new PVC storm drain piping, completion or project coordination for existing well rehabilitation, and installation of new, diesel powered generators. The information about each project shall include the following:

- Contractor’s name (identify as bidder or subcontractor)
- Owner’s name and contact information for the owner’s representative;
- Contract amount;
- Date of Completion;
- A brief description of the scope of the project and how the project is similar to this project

As evidence that the Bidder meets the mandatory and supplemental responsibility criteria stated above, the apparent low Bidder must submit to the Contracting Agency by 2:30 P.M. of the second business day following the bid submittal deadline, documentation verifying that the Bidder meets all of the supplemental criteria together with supporting documentation including but not limited to that detailed above (sufficient in the sole judgment of the Contracting Agency) demonstrating compliance with all supplemental responsibility criteria. The Contracting Agency reserves the right to request such documentation from other Bidders as well, and to request further documentation as needed to assess Bidder responsibility. The Contracting Agency also reserves the right to obtain information from third-parties and independent sources of information concerning a Bidder’s compliance with the mandatory and supplemental criteria, and to use that information in their evaluation. The Contracting Agency may (but is not required to) consider mitigating factors in determining whether the Bidder complies with the requirements of the supplemental criteria.

The basis for evaluation of Bidder compliance with these mandatory and Supplemental Criteria shall include any documents or facts obtained by Contracting Agency (whether from the Bidder or third parties) including but not limited to: (i) financial, historical, or operational data from the Bidder; (ii) information obtained directly by the Contracting Agency from others for whom the Bidder has worked, or other public agencies or private enterprises; and (iii) any additional information obtained by the Contracting Agency which is believed to be relevant to the matter.

If the Contracting Agency determines the Bidder does not meet the bidder responsibility criteria above and is therefore not a responsible Bidder, the Contracting Agency shall notify the Bidder in writing, with the reasons for its determination. If the Bidder disagrees with this determination, it may appeal the determination within two (2) business days of the Contracting Agency’s determination by presenting its appeal and any additional information to the Contracting Agency. The Contracting Agency will consider the appeal and any additional information before issuing its final determination. If the final determination affirms that the Bidder is not responsible, the Contracting Agency will not execute a contract with any other Bidder until at least two business days after the Bidder determined to be not responsible has received the Contracting Agency’s final determination.

Request to Change Supplemental Bidder Responsibility Criteria Prior To Bid: Bidders with concerns about the relevancy or restrictiveness of the Supplemental Bidder Responsibility Criteria may make or submit requests to the Contracting Agency to modify the criteria. Such requests shall be in writing, describe the nature of the concerns, and propose specific modifications to the criteria. Bidders shall submit such requests to the Contracting Agency no later than five (5) business days prior to the bid submittal deadline and address the request to the Project Engineer or such other person designated by the Contracting Agency in the Bid Documents.

1-02.15 Pre-Award Information **(August 14, 2013 APWA GSP)**

Revise this section to read:

Before awarding any contract, the Contracting Agency may require one or more of these items or actions of the apparent lowest responsible bidder:

1. A complete statement of the origin, composition, and manufacture of any or all materials to be used,
2. Samples of these materials for quality and fitness tests,
3. A progress schedule (in a form the Contracting Agency requires) showing the order of and time required for the various phases of the work,
4. A breakdown of costs assigned to any bid item,
5. Attendance at a conference with the Engineer or representatives of the Engineer,
6. Obtain, and furnish a copy of, a business license to do business in the city or county where the work is located.
7. Any other information or action taken that is deemed necessary to ensure that the bidder is the lowest responsible bidder.

1-03 AWARD AND EXECUTION OF CONTRACT

1-03.3 Execution of Contract

(January 19, 2022 APWA GSP)

Revise this section to read:

Within 3 calendar days of Award date (not including Saturdays, Sundays and Holidays), the successful Bidder shall provide the information necessary to execute the Contract to the Contracting Agency. The Bidder shall send the contact information, including the full name, email address, and phone number, for the authorized signer and bonding agent to the Contracting Agency.

Copies of the Contract Provisions, including the unsigned Form of Contract, will be available for signature by the successful bidder on the first business day following award. The number of copies to be executed by the Contractor will be determined by the Contracting Agency.

Within 10 calendar days after the award date, the successful bidder shall return the signed Contracting Agency-prepared contract, an insurance certification as required by Section 1-07.18, a satisfactory bond as required by law and Section 1-03.4, and the Transfer of Coverage form for the Construction Stormwater General Permit with sections I, III, and VIII completed when provided. Before execution of the contract by the Contracting Agency, the successful bidder shall provide any pre-award information the Contracting Agency may require under Section 1-02.15.

Until the Contracting Agency executes a contract, no proposal shall bind the Contracting Agency nor shall any work begin within the project limits or within Contracting Agency-furnished sites. The Contractor shall bear all risks for any work begun outside such areas and for any materials ordered before the contract is executed by the Contracting Agency.

If the bidder experiences circumstances beyond their control that prevents return of the contract documents within the calendar days after the award date stated above, the Contracting Agency may grant up to a maximum of 10 additional calendar days for return of the documents, provided the Contracting Agency deems the circumstances warrant it.

1-03.4 Contract Bond

(July 23, 2015 APWA GSP)

Delete the first paragraph and replace it with the following:

The successful bidder shall provide executed payment and performance bond(s) for the full contract amount. The bond may be a combined payment and performance bond; or be separate payment and performance bonds. In the case of separate payment and performance bonds, each shall be for the full contract amount. The bond(s) shall:

1. Be on Contracting Agency-furnished form(s);
2. Be signed by an approved surety (or sureties) that:
 - a) Is registered with the Washington State Insurance Commissioner, and
 - b) Appears on the current Authorized Insurance List in the State of Washington published by the Office of the Insurance Commissioner,
3. Guarantee that the Contractor will perform and comply with all obligations, duties, and conditions under the Contract, including but not limited to the duty and obligation to indemnify, defend, and protect the Contracting Agency against all losses and claims related directly or indirectly from any failure:
 - a) Of the Contractor (or any of the employees, subcontractors, or lower tier subcontractors of the Contractor) to faithfully perform and comply with all contract obligations, conditions, and duties, or
 - b) Of the Contractor (or the subcontractors or lower tier subcontractors of the Contractor) to pay all laborers, mechanics, subcontractors, lower tier subcontractors, material person, or any other person who provides supplies or provisions for carrying out the work;
4. Be conditioned upon the payment of taxes, increases, and penalties incurred on the project under titles 50, 51, and 82 RCW; and
5. Be accompanied by a power of attorney for the Surety's officer empowered to sign the bond; and
6. Be signed by an officer of the Contractor empowered to sign official statements (sole proprietor or partner). If the Contractor is a corporation, the bond(s) must be signed by the president or vice president, unless accompanied by written proof of the authority of the individual signing the bond(s) to bind the corporation (i.e., corporate resolution, power of attorney, or a letter to such effect signed by the president or vice president).

1-03.7 Judicial Review **(December 30, 2022 APWA GSP)**

Revise this section to read:

All decisions made by the Contracting Agency regarding the Award and execution of the Contract or Bid rejection shall be conclusive subject to the scope of judicial review permitted under Washington Law. Such review, if any, shall be timely filed in the Superior Court of the county where the Contracting Agency headquarters is located, provided that where an action is asserted against a county, RCW 36.01.050 shall control venue and jurisdiction.

1-04 SCOPE OF THE WORK

1-04.2 Coordination of Contract Documents, Plans, Special Provisions, Specifications, and Addenda **(November 20, 2020 Lacey GSP)**

Revise the second paragraph to read:

Any inconsistency in the parts of the contract shall be resolved by following this order of precedence (e.g., 1 presiding over 2, 2 presiding over 3, 3 over 4, and so forth):

1. Contract Form,
2. Addenda (if any),
3. Proposal Form,
4. Special Provisions,
5. Technical Specifications, if included,
6. Contract Plans,
7. WSDOT Standard Specifications for Road, Bridge, and Municipal Construction,
8. City of Lacey Development Guidelines and Public Works Standards, and
9. WSDOT Standard Plans for Road, Bridge and Municipal Construction

1-04.4(1) Minor Changes **(May 30, 2019 APWA GSP)**

Delete the first paragraph and replace it with the following:

Payments or credits for changes amounting to \$15,000 or less may be made under the Bid item “Minor Change”. At the discretion of the Contracting Agency, this procedure for Minor Changes may be used in lieu of the more formal procedure as outlined in Section 1-04.4, Changes. All “Minor Change” work will be within the scope of the Contract Work and will not change Contract Time.

1-04.5 Procedure, Protest, and Dispute by the Contractor **(January 19, 2022 APWA GSP)**

Revise item 1 of the first paragraph to read:

1. Give a signed written notice of protest to the Engineer or the Engineer’s field Inspectors within 5 calendar days of receiving a change order or an Engineer’s Written Determination.

1-04.6 Variations in Estimated Quantities **(December 30, 2022 APWA GSP Option B)**

Revise the first paragraph to read:

Payment to the Contractor will be made only for the actual quantities of Work performed and accepted in conformance with the Contract. When the accepted quantity of Work performed under a unit item varies from the original Proposal quantity, payment will be at the unit Contract price for all Work unless the total accepted quantity of the Contract item, adjusted to exclude added or deleted amounts included in change orders accepted by both parties, increases or decreases by more than 25 percent from the original Proposal quantity, and if the total extended bid price for that item at time of award is equal to or greater than 10 percent of the total contract price at time of award. In that case, payment for contract work may be adjusted as described herein.

1-05 CONTROL OF WORK

1-05.4 Conformity With and Deviations from Plans and Stakes

Supplement this section with the following:

Roadway and Utility Surveys **(July 23, 2015 APWA GSP, Option 1)**

The Engineer shall furnish to the Contractor one time only all principal lines, grades, and measurements the Engineer deems necessary for completion of the work. These shall generally consist of one initial set of:

1. Slope stakes for establishing grading;
2. Curb grade stakes;
3. Centerline finish grade stakes for pavement sections wider than 25 feet; and
4. Offset points to establish line and grade for underground utilities such as water, sewers, and storm drains.

On alley construction projects with minor grade changes, the Engineer shall provide only offset hubs on one side of the alley to establish the alignment and grade.

1-05.4(2) Survey Control and Electronic Files **(August 10, 2010 Lacey GSP)**

Add the following new section:

The Contractor shall re-establish the survey control used in design by using existing survey monuments and other control points as provided by the City.

When requested by the Contractor, the City will provide an electronic version of the construction plans (drawings), for use by the Contractor at the Contractor's own risk. In all cases, the approved paper construction plans are the official contract documents. If the Contractor wishes to use the electronic version of the construction plans for the purposes of providing surveying of the proposed improvements, it shall be the Contractor's responsibility to verify that any coordinates used from the electronic file match the station and offset location given in the contract construction plans. Construction plans are diagrammatic in nature. The coordinate locations of the various graphic elements within the electronic files may not necessarily be precisely shown with respect to their coordinate position. In all cases, the location callouts in the contract construction plans shall govern.

1-05.7 Removal of Defective and Unauthorized Work **(October 1, 2005 APWA GSP)**

Supplement this section with the following:

If the Contractor fails to remedy defective or unauthorized work within the time specified in a written notice from the Engineer, or fails to perform any part of the work required by the Contract Documents, the Engineer may correct and remedy such work as may be identified in the written notice, with Contracting Agency forces or by such other means as the Contracting Agency may deem necessary.

If the Contractor fails to comply with a written order to remedy what the Engineer determines to be an emergency situation, the Engineer may have the defective and unauthorized work corrected immediately, have the rejected work removed and replaced, or have work the Contractor refuses to perform completed by using Contracting Agency or other forces. An emergency situation is any situation when, in the opinion of the Engineer, a delay in its remedy could be potentially unsafe, or might cause serious risk of loss or damage to the public.

Direct or indirect costs incurred by the Contracting Agency attributable to correcting and remedying defective or unauthorized work, or work the Contractor failed or refused to perform, shall be paid by the Contractor. Payment will be deducted by the Engineer from monies due, or to become due, the Contractor. Such direct and indirect costs shall include in particular, but without limitation, compensation for additional professional services required, and costs for repair and replacement of work of others destroyed or damaged by correction, removal, or replacement of the Contractor's unauthorized work.

No adjustment in contract time or compensation will be allowed because of the delay in the performance of the work attributable to the exercise of the Contracting Agency's rights provided by this Section.

The rights exercised under the provisions of this section shall not diminish the Contracting Agency's right to pursue any other avenue for additional remedy or damages with respect to the Contractor's failure to perform the work as required.

1-05.11 Final Inspections and Operational Testing **(October 1, 2005 APWA GSP)**

Delete this section and replace it with the following:

1-05.11(1) Substantial Completion Date

When the Contractor considers the work to be substantially complete, the Contractor shall so notify the Engineer and request the Engineer establish the Substantial Completion Date. The Contractor's request shall list the specific items of work that remain to be completed in order to reach physical completion. The Engineer will schedule an inspection of the work with the Contractor to determine the status of completion. The Engineer may also establish the Substantial Completion Date unilaterally.

If, after this inspection, the Engineer concurs with the Contractor that the work is substantially complete and ready for its intended use, the Engineer, by written notice to the Contractor, will set the Substantial Completion Date. If, after this inspection the Engineer does not consider the work substantially complete and ready for its intended use, the Engineer will, by written notice, so notify the Contractor giving the reasons therefore.

Upon receipt of written notice concurring in or denying substantial completion, whichever is applicable, the Contractor shall pursue vigorously, diligently and without unauthorized interruption, the work necessary to reach Substantial and Physical Completion. The Contractor shall provide the Engineer with a revised schedule indicating when the Contractor expects to reach substantial and physical completion of the work.

The above process shall be repeated until the Engineer establishes the Substantial Completion Date and the Contractor considers the work physically complete and ready for final inspection.

1-05.11(2) Final Inspection and Physical Completion Date

When the Contractor considers the work physically complete and ready for final inspection, the Contractor by written notice, shall request the Engineer to schedule a final inspection. The Engineer will set a date for final inspection. The Engineer and the Contractor will then make a final inspection and the Engineer will notify the Contractor in writing of all particulars in which the final inspection reveals the work incomplete or unacceptable. The Contractor shall immediately take such corrective measures as are necessary to remedy the listed deficiencies. Corrective work shall be pursued vigorously, diligently, and without interruption until physical completion of the listed deficiencies. This process will continue until the Engineer is satisfied the listed deficiencies have been corrected.

If action to correct the listed deficiencies is not initiated within 7 days after receipt of the written notice listing the deficiencies, the Engineer may, upon written notice to the Contractor, take whatever steps are necessary to correct those deficiencies pursuant to Section 1-05.7.

The Contractor will not be allowed an extension of contract time because of a delay in the performance of the work attributable to the exercise of the Engineer's right hereunder.

Upon correction of all deficiencies, the Engineer will notify the Contractor and the Contracting Agency, in writing, of the date upon which the work was considered physically complete. That date shall constitute the Physical Completion Date of the contract, but shall not imply acceptance of the work or that all the obligations of the Contractor under the contract have been fulfilled.

1-05.11(3) Operational Testing

It is the intent of the Contracting Agency to have at the Physical Completion Date a complete and operable system. Therefore, when the work involves the installation of machinery or other mechanical equipment; street lighting, electrical distribution or signal systems; irrigation systems; buildings; or other similar work it may be desirable for the Engineer to have the Contractor operate and test the work for a period of time after final inspection but prior to the physical completion date. Whenever items of work are listed in the Contract Provisions for operational testing they shall be fully tested under operating conditions for the time period specified to ensure their acceptability prior to the Physical Completion Date. During and following the test period, the Contractor shall correct any items of workmanship, materials, or equipment which prove faulty, or that are not in first class operating condition. Equipment, electrical controls, meters, or other devices and equipment to be tested during this period shall be tested under the observation of the Engineer, so that the Engineer may determine their suitability for the purpose for which they were installed. The Physical Completion Date cannot be established until testing and corrections have been completed to the satisfaction of the Engineer.

The costs for power, gas, labor, material, supplies, and everything else needed to successfully complete operational testing, shall be included in the unit contract prices related to the system being tested, unless specifically set forth otherwise in the proposal.

Operational and test periods, when required by the Engineer, shall not affect a manufacturer's guaranties or warranties furnished under the terms of the contract.

1-05.12(1) One-Year Guarantee Period **(March 8, 2013 APWA GSP)**

Add the following new section:

The Contractor shall return to the project and repair or replace all defects in workmanship and material discovered within one year after Final Acceptance of the Work. The Contractor shall start work to remedy any such defects within 7 calendar days of receiving Contracting Agency's written notice of a defect, and shall complete such work within the time stated in the Contracting Agency's notice. In case of an emergency, where damage may result from delay or where loss of services may result, such corrections may be made by the Contracting Agency's own forces or another contractor, in which case the cost of corrections shall be paid by the Contractor. In the event the Contractor does not accomplish corrections within the time specified, the work will be otherwise accomplished and the cost of same shall be paid by the Contractor.

When corrections of defects are made, the Contractor shall then be responsible for correcting all defects in workmanship and materials in the corrected work for one year after acceptance of the corrections by Contracting Agency.

This guarantee is supplemental to and does not limit or affect the requirements that the Contractor's work comply with the requirements of the Contract or any other legal rights or remedies of the Contracting Agency.

1-05.14 Cooperation with Other Contractors

(August 3, 2015 Lacey GSP)

Supplement this section with the following:

The Contractor shall coordinate residential refuse and recycling pick-up with Pacific Disposal (360) 923-0111. Construction activities shall be planned so that there is no interruption of services.

1-05.15 Method of Serving Notices

(December 30, 2022 APWA GSP)

Revise the second paragraph to read:

All correspondence from the Contractor shall be directed to the Project Engineer. All correspondence from the Contractor constituting any notification, notice of protest, notice of dispute, or other correspondence constituting notification required to be furnished under the Contract, must be in paper format, hand delivered or sent via mail delivery service to the Project Engineer's office. Electronic copies such as e-mails or electronically delivered copies of correspondence will not constitute such notice and will not comply with the requirements of the Contract.

1-05.16 Water and Power

(October 1, 2005 APWA GSP)

Add the following new section:

The Contractor shall make necessary arrangements, and shall bear the costs for power and water necessary for the performance of the work, unless the contract includes power and water as a pay item.

1-05.18 Record Drawings

(April 2, 2018 Lacey GSP Option B)

Add the following new section:

The Contractor shall maintain one set of full size plans for Record Drawings, updated with clear and accurate red-lined field revisions on a daily basis, and within 2 business days after receipt of information that a change in Work has occurred. The Contractor shall not conceal any work until the required information is recorded.

This Record Drawing set shall be used for this purpose alone, shall be kept separate from other Plan sheets, and shall be clearly marked as Record Drawings. These Record Drawings shall be kept on site at the Contractor's field office, and shall be available for review by the Contracting Agency at all times. The Contractor shall bring the Record Drawings to each progress meeting for review.

The preparation and upkeep of the Record Drawings is to be the assigned responsibility of a single, experienced, and qualified individual. The quality of the Record Drawings, in terms of accuracy, clarity, and completeness, is to be adequate to allow the Contracting Agency to modify the computer-aided drafting (CAD) Contract Drawings to produce a complete set of Record Drawings for the Contracting Agency without further investigative effort by the Contracting Agency.

The Record Drawing markups shall document all changes in the Work, both concealed and visible. Items that must be shown on the markups include but are not limited to:

- Actual dimensions, arrangement, and materials used when different than shown in the Plans.

- Changes made by Change Order or Field Order.
- Changes made by the Contractor.
- Accurate locations of storm sewer, sanitary sewer, water mains and other water appurtenances, structures, conduits, light standards, vaults, width of roadways, sidewalks, landscaping areas, building footprints, channelization and pavement markings, etc. Include pipe invert elevations, top of castings (manholes, inlets, etc.).

If the Contract calls for the Contracting Agency to do all surveying and staking, the Contracting Agency will provide the elevations at the tolerances the Contracting Agency requires for the Record Drawings.

When the Contract calls for the Contractor to do the surveying/staking, the applicable tolerance limits include, but are not limited to the following:

	Vertical	Horizontal
As-built sanitary & storm invert and grate elevations	± 0.01 foot	± 0.01 foot
As-built monumentation	± 0.01 foot	± 0.01 foot
As-built waterlines, inverts, valves, hydrants	± 0.01 foot	± 0.01 foot
As-built ponds/swales/water features	± 0.01 foot	± 0.01 foot
As-built buildings (fin. Floor elev.)	± 0.01 foot	± 0.01 foot
As-built gas lines, power, TV, Tel, Com	± 0.01 foot	± 0.01 foot
As-built signs, signals, etc.	N/A	± 0.01 foot

Making Entries on the Record Drawings:

Use erasable colored pencil (not ink) for all markings on the Record Drawings, conforming to the following color code:

Additions - Red
 Deletions - Green
 Comments - Blue
 Dimensions - Graphite

Provide the applicable reference for all entries, such as the change order number, the request for information (RFI) number, or the approved shop drawing number.

Date all entries.

Clearly identify all items in the entry with notes similar to those in the Contract Drawings (such as pipe symbols, centerline elevations, materials, pipe joint abbreviations, etc.).

The Contractor shall certify on the Record Drawings that said drawings are an accurate depiction of built conditions, and in conformance with the requirements detailed above. The Contractor shall submit final Record Drawings to the Contracting Agency. Contracting Agency acceptance of the Record Drawings is one of the requirements for achieving Physical Completion.

A lump sum price of \$5,000 has been included in the Proposal for this work. Any additional costs anticipated or incurred by the Contractor for the work shall be included in the various lump sum unit price bid items as found in the Proposal. Payment for this item will be made once Record Drawings have been submitted and approved.

1-06 CONTROL OF MATERIAL

1-06.1 Approval of Materials Prior to Use

(***) (January 4, 2016 Lacey GSP)**

The second sentence of first paragraph is revised to read:

The Contractor shall use the Qualified Product List (QPL), the Aggregate Source Approval (ASA) Database, or the City of Lacey Request for Approval of Material (COL RAM) form.

1-06.1(2) Request for Approval of Material (RAM)

The first paragraph is revised to read:

The COL RAM shall be used with all submittals. The COL RAM shall be prepared by the Contractor in accordance with the instructions and submitted to the engineer for approval before the material is incorporated into the Work..

Supplement this section with the following:

The Contractor shall submit sufficient information that describes the materials proposed as defined and described in these specifications and plans as described below.

The City of Lacey has identified the following items as long lead items.

1. Generator
2. Control panels and electrical equipment
3. Well pump

Long lead items shall be submitted within 45 calendar days of Notice to Proceed. The list above may not include all long lead items. The contractor is responsible for identifying all items and shall notify the Engineer of any additional items.

The Contractor shall submit one electronic of catalog cuts, shop drawings, and a material testing sample, as required for all items to be used in this contract for approval. The Contractor shall circle or highlight products and materials that are specific to this project, and cross out items that are not for this project.

All items not in exact compliance with the specifications must be noted as a change. The Contractor shall include an explanation, product specifications, sample articles, and any other items that will aid the Engineer in approving an item not in exact accordance with the specifications.

All submittals shall be submitted in Adobe Acrobat format and submittals that exceed 10 pages shall include a table of contents. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format. The form and the submittal shall be sent in the same e-mail. Submittals that exceed 30 MB shall either be provided on a CD, a flash drive or via an internet link.

The Engineer will review submittals within 10 working days. The Contractor may request additional working days if approval or disapproval is not received in 10 working days. The Contractor may not request additional working days for failure to submit sufficient information to approve an item, or for rejection of an item not in accordance with the specifications.

Resubmittals shall be submitted within 21 calendar days from City transmittal, to the Contractor, of the Engineer reviewed submittal. If the submittal is "Rejected", the contractor shall resubmit the entire

submittal. If the submittal is marked “Revise and Resubmit”, the contractor shall submit items that are identified in the Engineer’s comments.

Any material purchased or labor performed prior to such approval shall be at the Contractor's risk. The Contractor must receive all material approvals before the materials will be allowed on the project.

1-07 LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC

1-07.1 Laws to be Observed

(October 1, 2005 APWA GSP)

Supplement this section with the following:

In cases of conflict between different safety regulations, the more stringent regulation shall apply.

The Washington State Department of Labor and Industries shall be the sole and paramount administrative agency responsible for the administration of the provisions of the Washington Industrial Safety and Health Act of 1973 (WISHA).

The Contractor shall maintain at the project site office, or other well-known place at the project site, all articles necessary for providing first aid to the injured. The Contractor shall establish, publish, and make known to all employees, procedures for ensuring immediate removal to a hospital, or doctor’s care, persons, including employees, who may have been injured on the project site. Employees should not be permitted to work on the project site before the Contractor has established and made known procedures for removal of injured persons to a hospital or a doctor’s care.

The Contractor shall have sole responsibility for the safety, efficiency, and adequacy of the Contractor’s plant, appliances, and methods, and for any damage or injury resulting from their failure, or improper maintenance, use, or operation. The Contractor shall be solely and completely responsible for the conditions of the project site, including safety for all persons and property in the performance of the work. This requirement shall apply continuously, and not be limited to normal working hours. The required or implied duty of the Engineer to conduct construction review of the Contractor’s performance does not, and shall not, be intended to include review and adequacy of the Contractor’s safety measures in, on, or near the project site.

1-07.2 State Sales Tax

(June 27, 2011 APWA GSP)

Delete this section, including its sub-sections, in its entirety and replace it with the following:

The Washington State Department of Revenue has issued special rules on the State sales tax. Sections 1-07.2(1) through 1-07.2(3) are meant to clarify those rules. The Contractor should contact the Washington State Department of Revenue for answers to questions in this area. The Contracting Agency will not adjust its payment if the Contractor bases a bid on a misunderstood tax liability.

The Contractor shall include all Contractor-paid taxes in the unit bid prices or other contract amounts. In some cases, however, state retail sales tax will not be included. Section 1-07.2(2) describes this exception.

The Contracting Agency will pay the retained percentage (or release the Contract Bond if a FHWA-funded Project) only if the Contractor has obtained from the Washington State Department of Revenue a certificate showing that all contract-related taxes have been paid (RCW 60.28.051). The Contracting

Agency may deduct from its payments to the Contractor any amount the Contractor may owe the Washington State Department of Revenue, whether the amount owed relates to this contract or not. Any amount so deducted will be paid into the proper State fund.

1-07.2(1) State Sales Tax — Rule 171

WAC 458-20-171, and its related rules, apply to building, repairing, or improving streets, roads, etc., which are owned by a municipal corporation, or political subdivision of the state, or by the United States, and which are used primarily for foot or vehicular traffic. This includes storm or combined sewer systems within and included as a part of the street or road drainage system and power lines when such are part of the roadway lighting system. For work performed in such cases, the Contractor shall include Washington State Retail Sales Taxes in the various unit bid item prices, or other contract amounts, including those that the Contractor pays on the purchase of the materials, equipment, or supplies used or consumed in doing the work.

1-07.2(2) State Sales Tax — Rule 170

WAC 458-20-170, and its related rules, apply to the constructing and repairing of new or existing buildings, or other structures, upon real property. This includes, but is not limited to, the construction of streets, roads, highways, etc., owned by the state of Washington; water mains and their appurtenances; sanitary sewers and sewage disposal systems unless such sewers and disposal systems are within, and a part of, a street or road drainage system; telephone, telegraph, electrical power distribution lines, or other conduits or lines in or above streets or roads, unless such power lines become a part of a street or road lighting system; and installing or attaching of any article of tangible personal property in or to real property, whether or not such personal property becomes a part of the realty by virtue of installation.

For work performed in such cases, the Contractor shall collect from the Contracting Agency, retail sales tax on the full contract price. The Contracting Agency will automatically add this sales tax to each payment to the Contractor. For this reason, the Contractor shall not include the retail sales tax in the unit bid item prices, or in any other contract amount subject to Rule 170, with the following exception.

Exception: The Contracting Agency will not add in sales tax for a payment the Contractor or a subcontractor makes on the purchase or rental of tools, machinery, equipment, or consumable supplies not integrated into the project. Such sales taxes shall be included in the unit bid item prices or in any other contract amount.

1-07.2(3) Services

The Contractor shall not collect retail sales tax from the Contracting Agency on any contract wholly for professional or other services (as defined in Washington State Department of Revenue Rules 138 and 244).

1-07.6 Permits and Licenses

(February 14, 2023 Lacey GSP)

Section 1-07.6 is supplemented with the following:

The Contractor shall be responsible for obtaining the permits listed below. The Contractor shall obtain any additional permits as necessary. All costs to obtain and comply with permits shall be included in the applicable Bid items for the Work involved.

NAME OF DOCUMENT	PERMITTING AGENCY
Electrical	City of Lacey

1-07.15(1) Spill Prevention, Control, and Countermeasures Plan

(February 14, 2023 Lacey GSP)

The Contractor shall prepare a project-specific spill prevention, control, and countermeasures plan (SPCC Plan), and shall implement the plan for the duration of the project. No on-site construction activities may commence until the Contracting Agency accepts a SPCC Plan for the project. An SPCC Plan template and guidance information is available at <https://wsdot.wa.gov/engineering-standards/environmental-guidance/stormwater-water-quality>.

The SPCC Plan shall address all fuels, petroleum products, hazardous materials, and other materials defined in Chapter 447 of the WSDOT Environmental Manual M 31-11. Occupational safety and health requirements that may pertain to SPCC Plan implementation are contained in, but not limited to, WAC 296-824 and WAC 296-843. The SPCC Plan shall address conditions that may be required by Section 3406 of the current International Fire Code, or as approved by the local Fire Marshal.

Implementation Requirements

The Contractor shall update the SPCC Plan throughout project construction so that the written plan reflects actual site conditions and practices. The Contractor shall update the SPCC Plan at least annually and maintain a copy of the updated SPCC Plan on the project site. The Contractor shall fully implement the SPCC Plan, as accepted and updated, at all times.

SPCC Plan Element Requirements

The SPCC Plan shall set forth the following information in the following order:

1. Responsible Personnel – Identify the names, titles, and contact information for the personnel responsible for implementing and updating the plan and for responding to spills.
2. Spill Reporting – List the names and telephone numbers of the Federal, State, and local agencies the Contractor shall notify in the event of a spill as referenced in the abovementioned template.
3. Spill Prevention – Describe the following items:
 - a. The contents and locations of spill response kits that the Contractor shall supply and maintain that are appropriately stocked, located in close proximity to hazardous materials and equipment, and immediately accessible.
 - b. Security measures for potential spill sources to prevent accidental spills and vandalism.
 - c. Site inspection procedures and frequency.
4. Spill Response – Outline the response procedures the Contractor shall follow for each scenario listed below, indicating that if hazardous materials are encountered or spilled during construction, the Contractor shall do everything possible to control and contain the material until appropriate measures can be taken. Include a description of the actions the Contractor shall take and the specific on-site spill response equipment that shall be used to assess the spill, secure the area, contain and eliminate the spill source, clean up spilled material, decontaminate equipment, and dispose of spilled and contaminated material:
 - a. A spill of each type of hazardous material present.
 - b. Stormwater that has come into contact with hazardous materials.
 - c. A release or spill of any unknown preexisting contamination and contaminant sources (such as buried pipes or tanks) encountered during project Work.

Payment

If no bid item for “SPCC Plan” is included in the proposal, any work described in this section shall be incidental to the project.

1-07.18 Public Liability and Property Damage Insurance

Delete this section in its entirety, and replace it with the following:

1-07.18 Insurance

(December 30, 2022 APWA GSP)

1-07.18(1) General Requirements

A. The Contractor shall procure and maintain the insurance described in all subsections of section 1-07.18 of these Special Provisions, from insurers with a current A. M. Best rating of not less than A-: VII and licensed to do business in the State of Washington. The Contracting Agency reserves the right to approve or reject the insurance provided, based on the insurer’s financial condition.

B. The Contractor shall keep this insurance in force without interruption from the commencement of the Contractor’s Work through the term of the Contract and for thirty (30) days after the Physical Completion date, unless otherwise indicated below.

C. If any insurance policy is written on a claims made form, its retroactive date, and that of all subsequent renewals, shall be no later than the effective date of this Contract. The policy shall state that coverage is claims made, and state the retroactive date. Claims-made form coverage shall be maintained by the Contractor for a minimum of 36 months following the Completion Date or earlier termination of this Contract, and the Contractor shall annually provide the Contracting Agency with proof of renewal. If renewal of the claims made form of coverage becomes unavailable, or economically prohibitive, the Contractor shall purchase an extended reporting period (“tail”) or execute another form of guarantee acceptable to the Contracting Agency to assure financial responsibility for liability for services performed.

D. The Contractor’s Automobile Liability, Commercial General Liability and Excess or Umbrella Liability insurance policies shall be primary and non-contributory insurance as respects the Contracting Agency’s insurance, self-insurance, or self-insured pool coverage. Any insurance, self-insurance, or self-insured pool coverage maintained by the Contracting Agency shall be excess of the Contractor’s insurance and shall not contribute with it.

E. The Contractor shall provide the Contracting Agency and all additional insureds with written notice of any policy cancellation, within two business days of their receipt of such notice.

F. The Contractor shall not begin work under the Contract until the required insurance has been obtained and approved by the Contracting Agency

G. Failure on the part of the Contractor to maintain the insurance as required shall constitute a material breach of contract, upon which the Contracting Agency may, after giving five business days’ notice to the Contractor to correct the breach, immediately terminate the Contract or, at its discretion, procure or renew such insurance and pay any and all premiums in connection therewith, with any sums so expended to be repaid to the Contracting Agency on demand, or at the sole discretion of the Contracting Agency, offset against funds due the Contractor from the Contracting Agency.

H. All costs for insurance shall be incidental to and included in the unit or lump sum prices of the Contract and no additional payment will be made.

1-07.18(2) Additional Insured

All insurance policies, with the exception of Workers Compensation, and of Professional Liability and Builder's Risk (if required by this Contract) shall name the following listed entities as additional insured(s) using the forms or endorsements required herein:

- The Contracting Agency and its officers, elected officials, employees, agents, and volunteers

The above-listed entities shall be additional insured(s) for the full available limits of liability maintained by the Contractor, irrespective of whether such limits maintained by the Contractor are greater than those required by this Contract, and irrespective of whether the Certificate of Insurance provided by the Contractor pursuant to 1-07.18(4) describes limits lower than those maintained by the Contractor.

For Commercial General Liability insurance coverage, the required additional insured endorsements shall be at least as broad as ISO forms CG 20 10 10 01 for ongoing operations and CG 20 37 10 01 for completed operations.

1-07.18(3) Subcontractors

The Contractor shall cause each Subcontractor of every tier to provide insurance coverage that complies with all applicable requirements of the Contractor-provided insurance as set forth herein, except the Contractor shall have sole responsibility for determining the limits of coverage required to be obtained by Subcontractors.

The Contractor shall ensure that all Subcontractors of every tier add all entities listed in 1 07.18(2) as additional insureds, and provide proof of such on the policies as required by that section as detailed in 1-07.18(2) using an endorsement as least as broad as ISO CG 20 10 10 01 for ongoing operations and CG 20 37 10 01 for completed operations.

Upon request by the Contracting Agency, the Contractor shall forward to the Contracting Agency evidence of insurance and copies of the additional insured endorsements of each Subcontractor of every tier as required in 1-07.18(4) Verification of Coverage.

1-07.18(4) Verification of Coverage

The Contractor shall deliver to the Contracting Agency a Certificate(s) of Insurance and endorsements for each policy of insurance meeting the requirements set forth herein when the Contractor delivers the signed Contract for the work. Failure of Contracting Agency to demand such verification of coverage with these insurance requirements or failure of Contracting Agency to identify a deficiency from the insurance documentation provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

Verification of coverage shall include:

1. An ACORD certificate or a form determined by the Contracting Agency to be equivalent.
2. Copies of all endorsements naming Contracting Agency and all other entities listed in 1 07.18(2) as additional insured(s), showing the policy number. The Contractor may submit a copy of any blanket additional insured clause from its policies instead of a separate endorsement.
3. Any other amendatory endorsements to show the coverage required herein.
4. A notation of coverage enhancements on the Certificate of Insurance shall not satisfy these requirements – actual endorsements must be submitted.

Upon request by the Contracting Agency, the Contractor shall forward to the Contracting Agency a full and certified copy of the insurance policy(s). If Builders Risk insurance is required on this Project, a full and certified copy of that policy is required when the Contractor delivers the signed Contract for the work.

1-07.18(5) Coverages and Limits

The insurance shall provide the minimum coverages and limits set forth below. Contractor's maintenance of insurance, its scope of coverage, and limits as required herein shall not be construed to limit the liability of the Contractor to the coverage provided by such insurance, or otherwise limit the Contracting Agency's recourse to any remedy available at law or in equity.

All deductibles and self-insured retentions must be disclosed and are subject to approval by the Contracting Agency. The cost of any claim payments falling within the deductible or self-insured retention shall be the responsibility of the Contractor. In the event an additional insured incurs a liability subject to any policy's deductibles or self-insured retention, said deductibles or self-insured retention shall be the responsibility of the Contractor.

1-07.18(5)A Commercial General Liability

Commercial General Liability insurance shall be written on coverage forms at least as broad as ISO occurrence form CG 00 01, including but not limited to liability arising from premises, operations, stop gap liability, independent contractors, products-completed operations, personal and advertising injury, and liability assumed under an insured contract. There shall be no exclusion for liability arising from explosion, collapse or underground property damage.

The Commercial General Liability insurance shall be endorsed to provide a per project general aggregate limit, using ISO form CG 25 03 05 09 or an equivalent endorsement.

Contractor shall maintain Commercial General Liability Insurance arising out of the Contractor's completed operations for at least three years following Substantial Completion of the Work.

Such policy must provide the following minimum limits:

\$1,000,000	Each Occurrence
\$2,000,000	General Aggregate
\$2,000,000	Products & Completed Operations Aggregate
\$1,000,000	Personal & Advertising Injury each offence
\$1,000,000	Stop Gap / Employers' Liability each accident

1-07.18(5)B Automobile Liability

Automobile Liability shall cover owned, non-owned, hired, and leased vehicles; and shall be written on a coverage form at least as broad as ISO form CA 00 01. If the work involves the transport of pollutants, the automobile liability policy shall include MCS 90 and CA 99 48 endorsements.

Such policy must provide the following minimum limit:

\$1,000,000	Combined single limit each accident
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1-07.18(5)C Workers' Compensation

The Contractor shall comply with Workers' Compensation coverage as required by the Industrial Insurance laws of the State of Washington.

1-07.23 Public Convenience and Safety

1-07.23(1) Construction Under Traffic

[\(May 2, 2017 APWA GSP\)](#)

Revise the third sentence of the second paragraph to read:

Accessibility to existing or temporary pedestrian push buttons shall not be impaired; if approved by the Contracting Agency activating pedestrian recall timing or other accommodation may be allowed during construction.

1-07.24 Rights of Way **(July 23, 2015 APWA GSP)**

Delete this section and replace it with the following:

Street Right of Way lines, limits of easements, and limits of construction permits are indicated in the Plans. The Contractor's construction activities shall be confined within these limits, unless arrangements for use of private property are made.

Generally, the Contracting Agency will have obtained, prior to bid opening, all rights of way and easements, both permanent and temporary, necessary for carrying out the work. Exceptions to this are noted in the Bid Documents or will be brought to the Contractor's attention by a duly issued Addendum.

Whenever any of the work is accomplished on or through property other than public Right of Way, the Contractor shall meet and fulfill all covenants and stipulations of any easement agreement obtained by the Contracting Agency from the owner of the private property. Copies of the easement agreements may be included in the Contract Provisions or made available to the Contractor as soon as practical after they have been obtained by the Engineer.

Whenever easements or rights of entry have not been acquired prior to advertising, these areas are so noted in the Plans. The Contractor shall not proceed with any portion of the work in areas where right of way, easements or rights of entry have not been acquired until the Engineer certifies to the Contractor that the right of way or easement is available or that the right of entry has been received. If the Contractor is delayed due to acts of omission on the part of the Contracting Agency in obtaining easements, rights of entry or right of way, the Contractor will be entitled to an extension of time. The Contractor agrees that such delay shall not be a breach of contract.

Each property owner shall be given 48 hours notice prior to entry by the Contractor. This includes entry onto easements and private property where private improvements must be adjusted.

The Contractor shall be responsible for providing, without expense or liability to the Contracting Agency, any additional land and access thereto that the Contractor may desire for temporary construction facilities, storage of materials, or other Contractor needs. However, before using any private property, whether adjoining the work or not, the Contractor shall file with the Engineer a written permission of the private property owner, and, upon vacating the premises, a written release from the property owner of each property disturbed or otherwise interfered with by reasons of construction pursued under this contract. The statement shall be signed by the private property owner, or proper authority acting for the owner of the private property affected, stating that permission has been granted to use the property and all necessary permits have been obtained or, in the case of a release, that the restoration of the property has been satisfactorily accomplished. The statement shall include the parcel number, address, and date of signature. Written releases must be filed with the Engineer before the Completion Date will be established.

1-08 PROSECUTION AND PROGRESS

Add the following new section:

1-08.0 Preliminary Matters
(May 25, 2006 APWA GSP)

Add the following new section:

1-08.0(1) Preconstruction Conference
(October 10, 2008 APWA GSP)

Prior to the Contractor beginning the work, a preconstruction conference will be held between the Contractor, the Engineer, and such other interested parties as may be invited. The purpose of the preconstruction conference will be:

To review the initial progress schedule;
To establish a working understanding among the various parties associated or affected by the work;
To establish and review procedures for progress payment, notifications, approvals, submittals, etc.;
To establish normal working hours for the work;
To review safety standards and traffic control; and
To discuss such other related items as may be pertinent to the work.

The Contractor shall prepare and submit at the preconstruction conference the following:

A breakdown of all lump sum items;
A preliminary schedule of working drawing submittals; and
A list of material sources for approval if applicable.

1-08.0(2) Hours of Work
(December 8, 2014 APWA GSP)

Except in the case of emergency or unless otherwise approved by the Engineer, the normal working hours for the Contract shall be any consecutive 8-hour period between 7:00 a.m. and 6:00 p.m. Monday through Friday, exclusive of a lunch break. If the Contractor desires different than the normal working hours stated above, the request must be submitted in writing prior to the preconstruction conference, subject to the provisions below. The working hours for the Contract shall be established at or prior to the preconstruction conference.

All working hours and days are also subject to local permit and ordinance conditions (such as noise ordinances).

If the Contractor wishes to deviate from the established working hours, the Contractor shall submit a written request to the Engineer for consideration. This request shall state what hours are being requested, and why. Requests shall be submitted for review no later than 5 prior to the day(s) the Contractor is requesting to change the hours.

If the Contracting Agency approves such a deviation, such approval may be subject to certain other conditions, which will be detailed in writing. For example:

1. On non-Federal aid projects, requiring the Contractor to reimburse the Contracting Agency for the costs in excess of straight-time costs for Contracting Agency representatives who worked during such times. (The Engineer may require designated representatives to be present during the work. Representatives who may be deemed necessary by the Engineer include, but are not limited to: survey crews; personnel from the Contracting Agency's material testing lab; inspectors; and other Contracting Agency employees or third party consultants when, in the opinion of the Engineer, such work necessitates their presence.)

2. Considering the work performed on Saturdays, Sundays, and holidays as working days with regard to the contract time.
3. Considering multiple work shifts as multiple working days with respect to contract time even though the multiple shifts occur in a single 24-hour period.
4. If a 4-10 work schedule is requested and approved, the non-working day for the week will be charged as a working day.
5. If Davis Bacon wage rates apply to this Contract, all requirements must be met and recorded properly on certified payroll

1-08.0(2)A Lacey Hours of Work

(*****)

Add the following new section:

Lacey Municipal Code (LMC) Chapter 14.38.010, prohibits outside construction activities between the hours of 9:00 p.m. and 7:00 a.m. in or adjacent to residential zones of the City. A waiver to this ordinance will not be allowed, except in case of emergency, or where operations are necessary during such hours in order to promote the safety of the traveling public as shown in these specifications or as determined by the Engineer.

1-08.1(7)A Subcontracting (December 30, 2022 APWA GSP)

Delete the ninth paragraph, beginning with “On all projects, the Contractor shall certify...”.

1-08.3(2)A Type A Progress Schedule (December 30, 2022 APWA GSP)

Revise this section to read:

The Contractor shall submit five (5) copies of a Type A Progress Schedule no later than at the preconstruction conference, or some other mutually agreed upon submittal time. The schedule may be a critical path method (CPM) schedule, bar chart, or other standard schedule format. Regardless of which format used, the schedule shall identify the critical path. The Engineer will evaluate the Type A Progress Schedule and approve or return the schedule for corrections within 15 calendar days of receiving the submittal.

1-08.4 Prosecution of Work (July 23, 2015 APWA GSP)

Delete this section in its entirety, and replace it with the following:

1-08.4 Notice to Proceed and Prosecution of Work

Notice to Proceed will be given after the contract has been executed and the contract bond and evidence of insurance have been approved and filed by the Contracting Agency. The Contractor shall not commence with the work until the Notice to Proceed has been given by the Engineer. The Contractor shall commence construction activities on the project site within ten days of the Notice to Proceed Date, unless otherwise approved in writing. The Contractor shall diligently pursue the work to the physical completion date within the time specified in the contract. Voluntary shutdown or slowing of operations

by the Contractor shall not relieve the Contractor of the responsibility to complete the work within the time(s) specified in the contract.

When shown in the Plans, the first order of work shall be the installation of high visibility fencing to delineate all areas for protection or restoration, as described in the Contract. Installation of high visibility fencing adjacent to the roadway shall occur after the placement of all necessary signs and traffic control devices in accordance with 1-10.1(2). Upon construction of the fencing, the Contractor shall request the Engineer to inspect the fence. No other work shall be performed on the site until the Contracting Agency has accepted the installation of high visibility fencing, as described in the Contract.

1-08.5 Time for Completion

(March 13, 1995 WSDOT GSP 1-08.5OPT7.FR1)

This project shall be physically completed within 150 working days.

1-08.5 Time for Completion

(December 30, 2022 APWA GSP Option A)

Revise the third and fourth paragraphs to read:

Contract time shall begin on the first working day following the Notice to Proceed Date.

Each working day shall be charged to the contract as it occurs, until the contract work is physically complete. If Substantial Completion has been granted and all the authorized working days have been used, charging of working days will cease. Each week the Engineer will provide the Contractor a statement that shows the number of working days: (1) charged to the contract the week before; (2) specified for the Physical Completion of the contract; and (3) remaining for the Physical Completion of the contract. The statement will also show the nonworking days and any partial or whole day the Engineer declares as unworkable. The statement will be identified as a Written Determination by the Engineer. If the Contractor does not agree with the Written Determination of working days, the Contractor shall pursue the protest procedures in accordance with Section 1-04.5. By failing to follow the procedures of Section 1-04.5, the Contractor shall be deemed as having accepted the statement as correct. If the Contractor is approved to work 10 hours a day and 4 days a week (a 4-10 schedule) and the fifth day of the week in which a 4-10 shift is worked would ordinarily be charged as a working day then the fifth day of that week will be charged as a working day whether or not the Contractor works on that day.

Revise the sixth paragraph to read:

The Engineer will give the Contractor written notice of the Completion Date of the Contract after all the Contractor's obligations under the Contract have been performed by the Contractor. The following events must occur before the Completion Date can be established:

1. The physical Work on the project must be complete; and
2. The Contractor must furnish all documentation required by the Contract and required by law, to allow the Contracting Agency to process final acceptance of the contract. The following documents must be received by the Project Engineer prior to establishing a Completion Date:
 - a. Certified Payrolls (per Section 1-07.9(5)).
 - b. Material Acceptance Certification Documents
 - c. Monthly Reports of Amounts Credited as DBE Participation, as required by the Contract Provisions.
 - d. Final Contract Voucher Certification
 - e. Copies of the approved "Affidavit of Prevailing Wages Paid" for the Contractor and all Subcontractors

f. A copy of the Notice of Termination sent to the Washington State Department of Ecology (Ecology); the elapse of 30 calendar days from the date of receipt of the Notice of Termination by Ecology; and no rejection of the Notice of Termination by Ecology. This requirement will not apply if the Construction Stormwater General Permit is transferred back to the Contracting Agency in accordance with Section 8-01.3(16).

g. Property owner releases per Section 1-07.24

1-08.6 Suspension of Work **(February 15, 2023 Lacey GSP)**

Contract time may be suspended for procurement of critical materials (Procurement Suspension). In order to receive a Procurement Suspension, the Contractor shall within 21 calendar days after execution by the Contracting Agency, place purchase orders for all materials deemed critical by the Contracting Agency for physical completion of the contract. The Contractor shall provide copies of purchase orders for the critical materials. Such purchase orders shall disclose the purchase order date and estimated delivery dates for such critical material.

The Contractor shall show procurement of the materials anticipated to be critical materials as activities in the Progress Schedule. If approved Progress Schedule indicates that the materials procurement are critical activities, and if the Contractor has provided documentation that purchase orders are placed for the critical materials within the prescribed 21 calendar days, then contract time will be suspended upon physical completion of all critical work except that work dependent upon the critical materials. Items anticipated to be critical materials include but are not limited to:

1. Generator
2. Control Panels and Electrical Equipment
3. Well Pump

Charging of contract time will resume upon delivery of the critical materials to the Contractor.

1-08.9 Liquidated Damages **(March 3, 2021 APWA GSP, Option B)**

Revise the second and third paragraphs to read:

Accordingly, the Contractor agrees:

1. To pay (according to the following formula) liquidated damages for each working day beyond the number of working days established for Physical Completion, and
2. To authorize the Engineer to deduct these liquidated damages from any money due or coming due to the Contractor.

Liquidated Damages Formula

$$LD=0.15C/T$$

Where:

LD = liquidated damages per working day (rounded to the nearest dollar)

C = original Contract amount

T = original time for Physical Completion

When the Contract Work has progressed to Substantial Completion as defined in the Contract, the Engineer may determine the Contract Work is Substantially Complete. The Engineer will notify the Contractor in writing of the Substantial Completion Date. For overruns in Contract time occurring after the date so established, the formula for liquidated damages shown above will not apply. For overruns in Contract time occurring after the Substantial Completion Date, liquidated damages shall be assessed on the basis of direct engineering and related costs assignable to the project until the actual Physical Completion Date of all the Contract Work. The Contractor shall complete the remaining Work as promptly as possible. Upon request by the Project Engineer, the Contractor shall furnish a written schedule for completing the physical Work on the Contract.

1-09 MEASUREMENT AND PAYMENT

1-09.2(1) General Requirements for Weighing Equipment **(December 30, 2022 APWA GSP, Option 2)**

Revise item 4 of the fifth paragraph to read:

4. Test results and scale weight records for each day's hauling operations are provided to the Engineer daily. Reporting shall utilize WSDOT form 422-027, Scaleman's Daily Report, unless the printed ticket contains the same information that is on the Scaleman's Daily Report Form. The scale operator must provide an AM and PM tare weight for each truck on the printed ticket.

1-09.2(5) Measurement **(December 30, 2022 APWA GSP)**

Revise the first paragraph to read:

Scale Verification Checks – At the Engineer's discretion, the Engineer may perform verification checks on the accuracy of each batch, hopper, or platform scale used in weighing contract items of Work.

1-09.6 Force Account **(October 10, 2008 APWA GSP)**

Supplement this section with the following:

The Contracting Agency has estimated and included in the Proposal, dollar amounts for all items to be paid per force account, only to provide a common proposal for Bidders. All such dollar amounts are to become a part of Contractor's total bid. However, the Contracting Agency does not warrant expressly or by implication, that the actual amount of work will correspond with those estimates. Payment will be made on the basis of the amount of work actually authorized by Engineer.

1-09.9 Payments **(December 30, 2022 APWA GSP)**

Section 1-09.9 is revised to read:

The basis of payment will be the actual quantities of Work performed according to the Contract and as specified for payment.

The Contractor shall submit a breakdown of the cost of lump sum bid items at the Preconstruction Conference, to enable the Project Engineer to determine the Work performed on a monthly basis. A

breakdown is not required for lump sum items that include a basis for incremental payments as part of the respective Specification. Absent a lump sum breakdown, the Project Engineer will make a determination based on information available. The Project Engineer's determination of the cost of work shall be final.

Progress payments for completed work and material on hand will be based upon progress estimates prepared by the Engineer. A progress estimate cutoff date will be established at the preconstruction conference.

The initial progress estimate will be made not later than 30 days after the Contractor commences the work, and successive progress estimates will be made every month thereafter until the Completion Date. Progress estimates made during progress of the work are tentative, and made only for the purpose of determining progress payments. The progress estimates are subject to change at any time prior to the calculation of the final payment.

The value of the progress estimate will be the sum of the following:

1. Unit Price Items in the Bid Form — the approximate quantity of acceptable units of work completed multiplied by the unit price.
2. Lump Sum Items in the Bid Form — based on the approved Contractor's lump sum breakdown for that item, or absent such a breakdown, based on the Engineer's determination.
3. Materials on Hand — 100 percent of invoiced cost of material delivered to Job site or other storage area approved by the Engineer.
4. Change Orders — entitlement for approved extra cost or completed extra work as determined by the Engineer.

Progress payments will be made in accordance with the progress estimate less:

1. Retainage per Section 1-09.9(1), on non FHWA-funded projects;
2. The amount of progress payments previously made; and
3. Funds withheld by the Contracting Agency for disbursement in accordance with the Contract Documents.

Progress payments for work performed shall not be evidence of acceptable performance or an admission by the Contracting Agency that any work has been satisfactorily completed. The determination of payments under the contract will be final in accordance with Section 1-05.1.

Failure to perform obligations under the Contract by the Contractor may be decreed by the Contracting Agency to be adequate reason for withholding any payments until compliance is achieved.

Upon completion of all Work and after final inspection (Section 1-05.11), the amount due the Contractor under the Contract will be paid based upon the final estimate made by the Engineer and presentation of a Final Contract Voucher Certification to be signed by the Contractor. The Contractor's signature on such voucher shall be deemed a release of all claims of the Contractor unless a Certified Claim is filed in accordance with the requirements of Section 1-09.11 and is expressly excepted from the Contractor's certification on the Final Contract Voucher Certification. The date the Contracting Agency signs the Final Contract Voucher Certification constitutes the final acceptance date (Section 1-05.12).

If the Contractor fails, refuses, or is unable to sign and return the Final Contract Voucher Certification or any other documentation required for completion and final acceptance of the Contract, the Contracting Agency reserves the right to establish a Completion Date (for the purpose of meeting the requirements of RCW 60.28) and unilaterally accept the Contract. Unilateral final acceptance will occur only after the Contractor has been provided the opportunity, by written request from the Engineer, to voluntarily submit such documents. If voluntary compliance is not achieved, formal notification of the impending establishment of a Completion Date and unilateral final acceptance will be provided by email with delivery confirmation from the Contracting Agency to the Contractor, which will provide 30 calendar days for the Contractor to submit the necessary documents. The 30 calendar day period will begin on the

date the email with delivery confirmation is received by the Contractor. The date the Contracting Agency unilaterally signs the Final Contract Voucher Certification shall constitute the Completion Date and the final acceptance date (Section 1-05.12). The reservation by the Contracting Agency to unilaterally accept the Contract will apply to Contracts that are Physically Completed in accordance with Section 1-08.5, or for Contracts that are terminated in accordance with Section 1-08.10. Unilateral final acceptance of the Contract by the Contracting Agency does not in any way relieve the Contractor of their responsibility to comply with all Federal, State, tribal, or local laws, ordinances, and regulations that affect the Work under the Contract.

Payment to the Contractor of partial estimates, final estimates, and retained percentages shall be subject to controlling laws.

1-09.9 Payments

(November 20, 2020 Lacey GSP)

Section 1-09.9 is supplemented with the following:

Progress payments and the Final Contract Voucher Certification (FCVC) will be transmitted electronically to the Contractor for signature. The Contractor shall apply all signatures electronically using the software provided by the Contracting Agency. Within 21 days of execution of the Contract, the Contractor shall submit the names, email addresses, and text-message capable phone numbers for the authorized signers and shall bear the name, phone number and email of the officer providing this authorization. Delegation of authority to sign progress payments and the FCVC shall be by the officer authorized to sign the Contract.

1-09.11(3) Time Limitation and Jurisdiction

(December 30, 2022 APWA GSP)

Revise this section to read:

For the convenience of the parties to the Contract it is mutually agreed by the parties that all claims or causes of action which the Contractor has against the Contracting Agency arising from the Contract shall be brought within 180 calendar days from the date of final acceptance (Section 1-05.12) of the Contract by the Contracting Agency; and it is further agreed that all such claims or causes of action shall be brought only in the Superior Court of the county where the Contracting Agency headquarters is located, provided that where an action is asserted against a county, RCW 36.01.050 shall control venue and jurisdiction. The parties understand and agree that the Contractor's failure to bring suit within the time period provided, shall be a complete bar to all such claims or causes of action. It is further mutually agreed by the parties that when claims or causes of action which the Contractor asserts against the Contracting Agency arising from the Contract are filed with the Contracting Agency or initiated in court, the Contractor shall permit the Contracting Agency to have timely access to all records deemed necessary by the Contracting Agency to assist in evaluating the claims or action.

1-09.13(1) General

(January 19, 2022 APWA GSP)

Revise this section to read:

Prior to seeking claims resolution through arbitration or litigation, the Contractor shall proceed in accordance with Sections 1-04.5 and 1-09.11. The provisions of Sections 1-04.5 and 1-09.11 must be complied with in full as a condition precedent to the Contractor's right to seek claim resolution through binding arbitration or litigation.

Any claims or causes of action which the Contractor has against the Contracting Agency arising from the Contract shall be resolved, as prescribed herein, through binding arbitration or litigation.

The Contractor and the Contracting Agency mutually agree that those claims or causes of action which total \$1,000,000 or less, which are not resolved by mediation, shall be resolved through litigation unless the parties mutually agree in writing to resolve the claim through binding arbitration.

The Contractor and the Contracting Agency mutually agree that those claims or causes of action in excess of \$1,000,000, which are not resolved by mediation, shall be resolved through litigation unless the parties mutually agree in writing to resolve the claim through binding arbitration.

1-09.13(3)A Arbitration General **(January 19, 2022 APWA GSP)**

Revise the third paragraph to read:

The Contracting Agency and the Contractor mutually agree to be bound by the decision of the arbitrator, and judgment upon the award rendered by the arbitrator may be entered in the Superior Court of the county in which the Contracting Agency's headquarters is located, provided that where claims subject to arbitration are asserted against a county, RCW 36.01.050 shall control venue and jurisdiction of the Superior Court. The decision of the arbitrator and the specific basis for the decision shall be in writing. The arbitrator shall use the Contract as a basis for decisions.

1-09.13(4) Venue for Litigation **(December 30, 2022 APWA GSP)**

Revise this section to read:

Litigation shall be brought in the Superior Court of the county in which the Contracting Agency's headquarters is located, provided that where claims are asserted against a county, RCW 36.01.050 shall control venue and jurisdiction of the Superior Court. It is mutually agreed by the parties that when litigation occurs, the Contractor shall permit the Contracting Agency to have timely access to all records deemed necessary by the Contracting Agency to assist in evaluating the claims or action.

1-10 TEMPORARY TRAFFIC CONTROL

1-10.1 General **(January 3, 2017 Lacey GSP)**

Supplement this section with the following:

Delays to traffic shall be held to a minimum. There shall be no restrictions or interruptions to traffic on Saturdays, Sundays or Holidays. In addition, there shall be no restrictions or interruptions to traffic after 12:00 noon on the day prior to a holiday or holiday weekend.

There shall be no delay to medical, fire, police, or other emergency vehicles with flashing lights or sirens. The Contractor shall alert all flaggers and personnel of this requirement.

The Contractor shall be responsible for removing the permanent traffic signs, as deemed necessary by the Engineer, and shall install and maintain any temporary signs necessary for the safety of the public.

The Contractor shall maintain pedestrian access at all times, without having pedestrians enter the travel lane.

All lane restrictions shall be held to a minimum time and length. Lane closures shall comply with the traffic control plans and these specifications. If the Contractor wishes to deviate from the plans, the Contractor shall submit a traffic control plan to the Engineer, at no additional cost, that complies with the MUTCD, and the Traffic Control Plans, for approval by the Engineer within (5) five working days before the proposed lane closure. If the Engineer determines that lane restrictions are causing congestion, the Contractor will be required to open any lanes, as determined by the Engineer, until the congestion is eliminated.

During non-working hours, Saturdays, Sundays, and Holidays, the Contractor shall keep all lanes open to traffic throughout the limits of the project with the lane and sidewalk area completely clear of all material, tools, personnel, and equipment as directed by the Engineer.

2-01 CLEARING, GRUBBING, AND ROADSIDE CLEANUP

2-01.1 Description

(October 16, 2009 Lacey GSP)

Supplement this section with the following:

The City of Lacey is a Tree City USA, and has deemed it necessary to protect all trees to the best of their ability. Only the trees that are evaluated by a certified Arborist as being diseased or detrimental to the project shall be removed as shown in the plans. The Contractor shall conduct a site review noting all trees within the construction zone prior to submitting a bid. Ease of construction, spoils, or stockpiling needs shall not justify tree removal.

A high visibility fence shall be installed around all trees and vegetation as required by the Engineer prior to beginning work. The Contractor shall be responsible for installing, maintaining and removing the high visibility fence as required.

Disposal of all organic waste shall be by Disposal Method No. 2. Disposal Method No. 1 and No. 3 will not be permitted in this contract. The City of Lacey encourages recycling of organic material at a certified organic recycling center.

The Contractor shall take all precautions necessary to protect the public, property, trees, and natural vegetation from harm. Any damage to utilities or other structures on public right-of-way or private property shall be restored by the Contractor or authorized agent at the Contractor's expense.

2-01.5 Payment

(October 16, 2009 Lacey GSP)

Modify this section with the following:

The unit contract price per acre or lump sum for "Clearing and Grubbing" shall be full pay for all work described in this section including "Roadside Cleanup". If no bid item for "Clearing and Grubbing" or "High Visibility Fence" is included in the proposal, any work described in this section shall be incidental to the project.

2-02 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

2-02.1 Description

(***** Lacey)

Supplement this section with the following:

The following items plus all materials resulting from incidental work including clearing; grubbing and roadside cleanup shall be removed from the job site, disposed of in a waste site or when noted on the plans, delivered to the City.

This work consists of but shall not be limited to the following items:

Pavement
Sidewalk
Concrete
Curb and Gutter
Fencing
Catch Basins
Storm Sewer Pipe
Refuse
Water Pipe
Fire Hydrants
Water Valves and Fittings
Valve Boxes
Meter Boxes
Silt Fence
Roadside Cleanup
Rocks and Stumps

The Contractor shall notify property owners/residents prior to all grading, clearing, and fence removal on newly acquired right-of-way a minimum of 3 days before any work.

The Contractor shall provide the temporary fencing immediately upon removal of the existing fence and will maintain the temporary fence until the permanent fence is installed.

2-02.2 Video

(March 3, 2022 Lacey GSP)

Add the following new section:

The Contractor shall provide pre-construction video of the existing conditions for the construction area including all easements, streets, alleys, and driveways within the project area. Further, video shall include existing drainage, driveways, sidewalks, and other frontage improvements. The Contractor shall also provide pre-construction video of the existing conditions of each face of an existing structure (houses, garages, sheds, fences, etc.), within 30 feet of the construction area.

The Contractor shall provide a copy of the video, in electronic format, to the City prior to any construction.

All costs for providing and furnishing the pre-construction video shall be considered incidental to the Project and no other payment will be allowed.

2-02.3 Construction Requirements

(*** Lacey GSP)**

Supplement this section with the following:

Unless otherwise noted, catch basins and manholes shall be removed entirely.

Where shown on the plans, catch basins, manholes, and inlets may be removed to a point 5 feet below the subgrade and the cavity filled with gravel borrow compacted to 95% of maximum density.

The removal of an existing hydrant assembly shall consist of turning off the gate valve, removing the existing hydrant assembly, valve box and anything else that is within 2' of the finished grade. Cap or plug the existing valve after the existing hydrant assembly has been removed. The Contractor shall return the existing fire hydrant assembly to the City. If the existing hydrant is damaged due to the Contractor's negligence, the Contractor shall replace the hydrant with a new hydrant.

The Contractor shall use due care and caution during removal and transportation of the salvaged material so that no damage occurs to the salvaged material. Any damage caused by the Contractor shall be deducted from the amount due.

2-02.3(3) Removal of Pavement, Sidewalks, Curbs, and Gutters

(October 16, 2016 Lacey GSP)

Supplement this section with the following:

In removing pavement, sidewalks, and curbs, the Contractor shall:

1. Mark all cut lines in the field and have the Engineer approve them prior to commencing cutting operations. The Engineer reserves the right to adjust removal to the nearest construction joint.
2. Make a vertical saw cut between any existing pavement, sidewalk, or curb that is to remain and the portion to be removed.
3. All sawcuts shall be continuous and made with saws designed specifically for this purpose; no skip cutting, wheel cutting, or jack hammering will be allowed unless given prior approval by the Engineer.
4. Replace at no expense to the Contracting Agency any pavement designated to remain that is damaged during the removal of other pavement. All damaged sidewalks and curbs shall be replaced to the nearest existing joint.
5. Haul all broken-up pieces of pavement, sidewalks, and curbs to an off-project disposal site.

All transitions to existing asphalt or cement concrete driveways, parking lots, curb and gutter and walkways shall be vertically sawcut full-depth with straight, uniform edges. Existing asphalt pavement roadway edge may be cut with a wheel, provided the wheel cut is full depth and no damage occurs to the pavement which is to remain. Neither impact tools nor pavement breakers may be used for trench crossing of existing pavement. Trench crossing of existing pavement shall be vertically sawcut.

When sawcutting the existing roadway is needed to widen the road to perform excavation, the Contractor shall take extra precaution to make a neat, uniform cut, and shall sawcut pavement to full depth, regardless of number of passes necessary. Compaction of asphalt near the sawcut is critical and a vertical, neat line sawcut is required. If in the opinion of the Engineer, the cut is not satisfactory due to

Contractor's workmanship or equipment, or if the sawcut becomes damaged and irregular, the Contractor shall fix the problem to the satisfaction of the Engineer, at Contractor's own expense.

The Contractor may grind the existing pavement in lieu of excavation and haul. Spoils from grinding can be stockpiled and used and paid for per sections 4-04.3(12), 4-04.4 and 4-04.5. If the Contractor elects to grind and stockpile the existing pavement, all costs and expenses necessary to furnish all labor, equipment, tools and materials shall be incidental to other bid items and no additional compensation will be allowed.

2-02.5 Payment

(March 18, 2015 Lacey GSP)

Delete this section and replace with the following:

"Removal of Structures and Obstructions", lump sum.

"Special Removal of Structures and Obstructions", lump sum.

The lump sum contract price for these bid items shall be full compensation for all labor, equipment and materials necessary to complete the requirements of this section.

2-05 TRENCH SAFETY SYSTEM

(October 16, 2009 Lacey GSP)

Add the following new section:

2-05.1 Description

This work consists of furnishing, utilizing, moving, and maintaining a trench safety system.

2-05.3 Construction Requirements

The Contractor shall comply with all applicable state laws, OSHA, WISHA requirements, and Department of Labor and Industries regulations governing trench excavation and pipe laying.

If extra excavation is used in lieu of, or in addition to shoring, cribbing, trench shields, or trench boxes, and select backfill material is required in the trench zone, then select backfill shall be used in the extra excavation zone.

2-05.4 Measurement

Trench safety system shall be paid for per lump sum regardless of the type, size and quantity used.

2-05.5 Payment

The lump sum contract price for "Trench Safety System" shall be full compensation for all labor, tools, equipment, and materials necessary to comply with the requirements stated above.

2-07 WATERING

2-07.3 Construction Requirements

(October 16, 2009 Lacey GSP)

Supplement this section with the following:

If the Contractor anticipates the use of City water, the Contractor shall apply for a water meter through the City of Lacey. Any damage rendered to the meter shall be repaired or replaced by the Contracting Agency and those costs deducted from monies due to the Contractor. All water used shall be metered and used sparingly for the entire length of the project. The Contractor will not be charged for water used on the project. The meter shall be returned promptly at the end of the project.

The Contractor is responsible for complying with backflow prevention requirements, which may include but are not limited to providing a certified air gap or reduced pressure backflow assembly (RPBA).

The Contractor shall use the water to keep the project site clean and to control dust during and after construction hours as determined by the Engineer.

2-07.4 Measurement

(October 16, 2009 Lacey GSP)

Delete and replace this section with the following:

The Contractor shall apply for a construction meter through the Contracting Agency. All water used shall be measured with the Contracting Agency supplied meter.

2-07.5 Payment

(February 14, 2023 Lacey GSP)

Delete and replace this section with the following:

The Contractor will not be charged for water used on this project. A construction meter will also be provided for a deposit and can be obtained at the City of Lacey Maintenance Service Center. Any costs to repair meters damaged by the Contractor shall be recovered from monies due the Contractor.

All costs to use or apply water as directed by the Engineer, including but not limited to supplying tank trucks, reduced pressure backflow assemblies (RPBA), and certification of approved backflow prevention methods, shall be considered incidental to the project and no other payment will be allowed.

2-08 DUST CONTROL

(October 16, 2009 Lacey GSP)

Add the following new sections:

2-08.1 Description

This work consists of furnishing and applying Magnesium Chloride solution for dust control as the Engineer requires.

2-08.2 Materials

Magnesium Chloride compound shall be combined with water per the manufacturer's specifications for dust control applications.

2-08.3 Construction Requirements

The Contractor shall apply magnesium chloride solution by means of tank trucks equipped with spray bars. Spray controls shall ensure that the solution flows evenly and in the amounts required by the manufacturer's recommendation and directed by the Engineer.

2-08.4 Measurement

"Dust Control" per MGAL, shall be measured by tanks or tank trucks of known capacity or by meters approved by the Engineer. The Contractor shall supply and install any meters at no expense to the Contracting Agency.

2-08.5 Payment

"Dust Control", per MGAL.

The unit contract price per MGAL for "Dust Control" shall be full pay for all labor, materials, tools, and equipment necessary to furnish, haul, and apply the magnesium chloride solution.

2-09 STRUCTURE EXCAVATION

2-09.3(1)E Backfilling

[\(October 16, 2009 Lacey GSP\)](#)

Modify this section with the following:

Controlled Density Fill shall meet the following requirements:

1750# Sand,
1750# Pea Gravel,
230# Water,
141# Portland Cement,
6 ounces Water Reducing Agent per 100 lbs. cement.

The Controlled Density Fill will require 24 hours of cure time, or as directed by the Engineer. Prior to backfill, all appurtenances shall be covered with 11 mill plastic as directed by the Engineer. The Contractor shall have a steel plate cover placed and anchored over the trench until the Engineer determines the mixture is sufficiently cured, so that a temporary or permanent patch can be placed. This process shall be coordinated so that there will be minimum inconvenience to the public.

2-09.5 Payment

[\(October 16, 2009 Lacey GSP\)](#)

Modify this section with the following:

Structure Excavation Including Haul, and Shoring or Extra Excavation shall be incidental to the structure to be constructed unless a bid item is provided.

4-04 BALLAST AND CRUSHED SURFACING

4-04.3(12) Asphalt Grindings

[\(April 2, 2018 Lacey GSP\)](#)

Add the following new section:

The Contractor may grind the existing pavement in lieu of excavation and haul. Spoils from the grinding can be stockpiled and used in any locations that require Crushed Surfacing Base Course, as approved by the Engineer. Grindings must be well ground and free of debris. Any large pieces 4" or greater of asphalt will be removed and disposed of at the Contractor's expense.

All grindings shall be proof rolled the entire length and width of the roadway with a truck weighing a minimum of 40,000 lb. Offset each trip of the roller by at most 2 tires width. Operate rollers at a speed between 2 and 6 miles per hour, as directed. Proof rolling shall be done in the presence of the Engineer.

The Engineer will visually inspect the asphalt grindings. If the Contractor elects to grind and stockpile the existing pavement, all costs and expenses necessary to furnish all labor, equipment, tools and materials shall be incidental to other bid items and no additional compensation will be allowed.

4-04.4 Measurement

(January 3, 2017 Lacey GSP)

Supplement this section with the following:

Asphalt Grindings will be measured by the cubic yard. Measurement by cubic yard will be made in the hauling vehicle and multiplied 2 tons/cy to convert asphalt grindings into tons. The asphalt grindings used on the project will be paid as Crushed Surfacing Base Course..

7-04 STORM SEWERS

7-04.1 Description

(January 3, 2017 Lacey GSP)

Supplement this section with the following:

This work shall consist of constructing debris barriers, trash racks, special fittings, joint materials, dewatering, bypass pumping, and testing.

7-04.2 Materials

(October 29, 2010 Lacey GSP)

Delete the first paragraph of this section and replace with the following:

Pipe used in this project shall meet the requirements of the following sections:

Solid Wall PVC Storm Sewer Pipe 9-05.12(1)

7-04.4 Measurement

(October 30, 2018 Lacey GSP)

Supplement this section with the following:

"Connect to Existing Storm Main" will be measured per each location called out in the plans

7-04.5 Payment

(October 30, 2018 Lacey GSP)

Delete this section and replace with the following:

“Connect to Existing Storm Main”, per each.

The unit contract price for "Connect to Existing Storm Main" shall be full pay for providing all labor, tools, equipment, and materials necessary to connect to the existing main. For purposes of payment, there will be no distinction made for the difficulty of connecting to the existing main or the quantity of connecting pipes or other materials needed. If no such item exists all costs shall be incidental to the project and no additional compensation shall be allowed.

“ ___ Inch Diameter Storm Sewer Pipe”, per linear foot.

The unit contract price per linear foot for “ ___ Inch Diameter Storm Sewer Pipe”, shall be full compensation for all labor, material, and equipment to furnish, place, assemble, and install storm sewer line, complete in place, including all wyes, tees, caps, plugs, trash racks, debris barriers, special fittings, joint materials, commercial concrete, adjustment of inverts to manholes, dewatering, bypass pumping, and testing. Further, all excavation, hauling, disposal, compaction, temporary patching and other required earthwork shall be included.

7-05 MANHOLES, INLETS, CATCH BASINS, AND DRYWELLS

7-05.4 Measurement

(October 30, 2018 Lacey GSP)

Supplement this section with the following:

“Catch Basin Type ___ – ___ In. Diam. w/Oil Water Baffle” will be measured per each.

“Connect to Existing Manhole” will be measured per each location called out in the plans.

“Manhole Treatment” will be measured per each.

7-05.5 Payment

(October 30, 2018 Lacey GSP)

Supplement this section with the following:

“Connect to Existing Manhole”, per each.

The unit contract price per each for “Connect to Existing Manhole” shall be full pay for furnishing all labor, tools, equipment, and materials required to connect to existing manhole in place, including concrete, concrete collars and sealants. Further, all excavation, haul, backfill, testing, and accessories shall be included in the unit contract price. For purposes of payment, there will be no distinction made for the difficulty of connecting to the existing manhole or the quantity of pipes connecting to the manhole. Items not specifically identified on the plans but necessary to properly connect to manhole shall be considered incidental and no other compensation shall be allowed.

7-08 GENERAL PIPE INSTALLATION REQUIREMENTS

7-08.1 Description

(December 31, 2014 Lacey GSP)

This section is revised to read:

This work includes installing culverts, storm sewers, sanitary sewers, and water mains. The contractor shall also follow Section 7-02, 7-04, 7-09 or 7-17 as it applies to the specific kind of Work.

7-08.2 Materials

(October 16, 2009 Lacey GSP)

Supplement this section with the following:

Bank Run Gravel for Trench Backfill shall be in accordance with Section 9-03.19.
Controlled Density Fill shall be in accordance with Section 2-09.3(1)E.
Imported Pipe Bedding shall be in accordance with Section 9-03.16.

7-08.3 Construction Requirements

7-08.3(1) Excavation and Preparation of Trench

(October 30, 2018 Lacey GSP)

Supplement this section with the following:

The contractor shall locate and preserve all existing utilities per RCW 19.122. Utility locations shown on the plans depict the physical features that were visible at the time of the survey. The City of Lacey is not responsible for the location of underground utilities that are marked or not marked in the field by other utility providers. Utility service laterals are not typically shown on plans or locatable and the contractor shall anticipate such services. The City will locate the meters and the mains. For service laterals, pursuant to RCW 19.122.030, the City will indicate a presence of an un-locatable service lateral and if requested can meet with the contractor or provide copies of available records. The Contractor shall have a crimping tool available during excavation to crimp any broken water services. Before commencing work, the contractor shall coordinate with One-Call services to determine the location of all utilities.

The Contractor shall pothole all apparent conflicts between existing utilities and proposed construction as approved by the Engineer. The Contractor shall notify Engineer of location and approximate time to complete prior to potholing. The Contractor shall notify the Engineer of any conflicts with the existing utilities and proposed work at least 3 days prior to proceeding with work. Potholing of the utilities shall be completed a minimum distance of 300 feet in front of pipe laying operations. No adjustment to the contract price or time will be made if the contractor fails to follow this specification. Potholing for Utility Crossings and Connections shall be performed by the Contractor using vacuum excavation truck or other device approved by the Engineer. If the Contractor potholes prior to approval no compensation shall be made for the potholing.

The Contractor shall deflect pressurized pipe at the joints no greater than the maximum allowable deflection as determined by the pipe or fitting manufacturer to avoid conflicts with crossing utilities. Vertical bends and vertical thrust blocking shall be avoided by deflecting pipe either upwards or downwards prior to the utility crossing.

7-08.3(1)A Trenches

(December 31, 2014 Lacey GSP)

Section 7-08.3(1)A is supplemented with the following to the fourth paragraph:

All material excavated from trenches shall not be piled on the roadway.

7-08.3(1)C Bedding the Pipe
(February 25, 2015 Lacey GSP)

Section 7-08.3(1)C is supplemented with the following

If native material meets the requirements of 7-08.2 the Contractor shall use all suitable native material prior to using imported pipe bedding or bank run gravel. All material shall be approved by the Engineer prior to placement. If the Contractor places imported material prior to approval, no compensation shall be made for the imported material.

7-08.3(3) Backfilling
(October 30, 2018 Lacey GSP)

Supplement this section with the following:

For backfilling trenches for longitudinal runs of pipe, the Contractor shall use all suitable native material prior to using bank run gravel and/or controlled density fill. All native backfill material shall be approved by the Engineer prior to placement. If the Contractor places imported material prior to approval, no compensation shall be made for the imported material. All backfill material shall be compacted and tested according to Section 2-03.3(14)D.

For transverse runs of pipe including the service lines within the roadway prism, the Contractor shall use controlled density fill unless approved otherwise by the Engineer. All native material shall be excavated, hauled and disposed of offsite. All exceptions shall be approved by the Engineer.

At the end of each workday, the Contractor shall install a lift of temporary asphalt cold mix on top of the trench backfill, flush with the existing pavement. No trench excavation shall be exposed to traffic without a temporary asphalt cold mix sealing the existing pavement surface. If approved by the Engineer, the Contractor may choose to use HMA for Pavement Repair Cl. ½" PG 64-22 for permanent pavement repair if a bid item for this work has been included in the Proposal. All costs associated with providing and removal of temporary asphalt cold mix shall be incidental to the bid item for the pipe being installed and no other compensation will be allowed.

7-08.3(3)A Controlled Density Fill
(December 31, 2014 Lacey GSP)

Section 7-08.3(3)A is added with the following:

The Contractor shall use controlled density fill (CDF) as shown in the Plans or directed by the Engineer.

Controlled Density Fill shall meet the following requirements:

1750# Sand,
1750# Pea Gravel,
230# Water,
141# Portland Cement,
6 ounces Water Reducing Agent per 100 lbs. cement.

The Controlled Density Fill will require 24 hours of cure time, or as directed by the Engineer. Prior to backfill, all appurtenances shall be covered with 11 mill plastic as directed by the Engineer.

7-08.3(3)B Steel Plating for Pipe Trench
(February 25, 2015 Lacey GSP)

Section 7-08.3(3)B is added with the following:

The Contractor shall install steel plating over the trench per the plans to allow for CDF to fully cure and allow vehicle traffic to pass during non-working hours. The steel plating shall remain complete over the trench until the pavement repair is complete. This process shall be coordinated so that there will be minimum inconvenience to the public. All costs for all labor, materials, and equipment to furnish, place, assemble, install, maintain and remove the steel plates and associated materials shall be included in the unit contract price per foot of pipe installed and no additional compensation shall be allowed.

7-08.3(5) Pipe Abandonment
(***)(February 14, 2023 Lacey GSP)**

Add the following new section:

The Contractor shall abandon pipes where shown on the Plans or directed by the Engineer. For abandonment, removal, handling and disposal of asbestos cement piping, refer to Section 7-09.3(19)D of these Special Provisions. All abandonments shall be done after all new utility mains and service connections are installed unless authorized by the Engineer. Abandonments shall include all excavation, pipe cutting and removal, fittings, concrete plugging, and backfilling. Some abandonments require specific fittings as indicated on the Plans. All fittings required to complete the abandonment shall be included in the cost for the abandonment. Potholing per 7-08.3(1) to verify required fittings shall be done as directed by the Engineer. The valve shall not be abandoned in place, the valve shall be removed and a blind flange installed. Pipe abandonments shall be completed in cooperation with the engineer in order to minimize disruption of utility service to the residents. If water services will be interrupted follow the requirements of 7-09.3(19)B.

In the case of an abandonment associated with a connection to an existing main, no payment shall be made for the bid item "Pipe Abandonment". The Contractor shall include all costs with these associated abandonments under the "Connect to Existing Water Main", "Connect to Existing Reclaimed Water Main", "Connect to Existing Gravity Sewer Main", or "Connect to Existing Sanitary Sewer Main" pay item. In addition, payment for "Pipe Abandonment" will only be paid for the locations and quantities called out on the plans or as directed by the Engineer.

7-08.3(6) Water Main/Sanitary Sewer Service Crossings
(February 25, 2015 Lacey GSP)

Add the following new section:

Notify the Engineer if the waterline is less than 18 inches above sanitary sewer. The minimum cover as shown on the plans may be reduced as approved by the Engineer to maintain minimum vertical separation.

The Contractor shall install the longest standard length of water pipe so that the joints will fall an equal distance from any sewer crossing. In some cases where minimum separation cannot be maintained, it may be necessary to encase the water main as directed by the Engineer. No concrete shall be installed unless specifically directed by the Engineer.

Costs to cut and place water pipe as specified shall be incidental to the water pipe line and no other pay will be allowed.

7-08.3(8) Detectable Marking Tape **(January 4, 2016 Lacey GSP)**

Add the following new section:

All pipeline installed under this contract will be identified by a continuous color coded tracer marker. For pressure lines it shall be buried 12 inches to 18 inches below finished grade, and for sewer lines it shall be buried 24 inches to 30 inches below finished grade. The marker shall be imprinted every 30 to 40 inches in permanent black ink indicating the type of line buried below and shall also have the word "Caution" prominently shown.

The tracer marker shall be plastic non-biodegradable and have a metallic core or backing which can be detected by a standard metal detector.

In addition to the detectable marking tape a U.S.E coated 12 gauge tracer wire shall be taped to all mains and service lines. The wire shall be brought up and tied to all valves and meter boxes. The tracer wire shall be looped up into all valve boxes per the plans. A low voltage grease-type splice kits, or better shall be used on all tracer wire connection points. After the wire nut is used to connect the wire together an overhand knot shall be tied just outside the connection to prevent it from coming apart. All service and mainline tracer wires shall be properly connected. A tracer wire magnesium anode shall be installed at all dead ends of the tracer / locate system. On long stretches of pipe anodes may be required at a minimum spacing of 1000'. The anode type shall be Copperhead Anode Part# ANO-14, 1.5# x 1.315"Dx18.5"L or approved equal. When connecting a new main or a new service to an existing main, the new tracer wire shall be connected to the existing tracer wire if available.

Special high strength locate wire may be required for directional drilling where the wire is allowed to be pulled in with the pipe or conduit. High strength wire shall be Neptco Trace-Safe 1800 lb. strength or approved equal and shall be connected with the wire manufacturer's connections.

Continuity or locate testing of the wire will be done by the City. The contractor shall give 72 hours notice for continuity testing by the City. The testing shall be conducted prior to paving or final restoration of landscape areas. The locating device will be connected to the tracer wire at any or all Gate Valves and Services and tracer wire shall transmit an acceptable signal strength as determined by the City for a minimum of 300 feet. Contractor will locate and repair any failed connections. The wire shall be furnished and installed by the Contractor.

Color coding of tape and wire shall be as follows:

- a) Water – Blue
- b) Sewer – Green
- c) Reclaimed – Purple
- d) Electrical conduits – Red
- e) Communication Conduits - Orange

Installation of the pipeline tracer marker and 12 gauge coated copper wire is considered incidental to the construction of the pipe and conduits and no other compensation will be allowed.

7-08.3(9) Concrete Thrust Blocking **(February 25, 2015 Lacey GSP)**

Add the following new section:

Install thrust blocking at bends, tees, dead ends, and crosses and as shown in the plans and as directed by the Engineer. Thrust Blocking shall be commercial concrete poured against undisturbed earth. An 11 mil

plastic barrier shall be placed between all thrust blocks and fittings. The calculations for thrust blocking are as follows:

Thrust at fittings in pounds at 225 pounds per square inch of water pressure.

Pipe Diameter	90° Bend	45° Bend	22-1/2° Bend	11-1/4° Bend	Dead End or Tee
4"	3,600	2,000	1,000	500	2,600
6"	8,000	4,400	2,300	1,200	5,700
8"	14,300	7,700	4,000	2,000	10,100
10"	22,300	12,100	6,200	3,100	15,800
12"	32,000	17,400	8,900	4,500	22,700
14"	43,600	23,600	12,100	6,100	30,800
16"	57,000	30,800	15,700	7,900	40,300
18"	72,000	39,000	19,900	10,000	51,000

SAFE SOIL BEARING LOADS:

Soil	Pounds per Square Foot
Muck, Peat	0,000
Soft clay	1,000
Sand	2,000
Sand and gravel	3,000
Sand and gravel cemented with clay	4,000

Ecology blocks may be used for thrust blocking if approved by the Engineer.

Installation of thrust blocking is considered incidental to the construction of the pipe and no other compensation will be allowed.

7-08.4 Measurement

(October 30, 2018 Lacey GSP)

Supplement this section with the following:

“Imported Pipe Bedding” will be measured per ton.

“Bank Run Gravel for Trench Backfill” will be measured per ton.

“Utility Potholing”, will be measured per hour.

“Pipe Abandonment” will be measured per each, for each section called out on the Plans.

“Controlled Density Fill” will be measured by the cubic yard for the quantity of material placed.

“Connect to Existing Water Main” will be measured per each location called out in the plans.

“ _____ Inch Pipe Encasement” shall be measured by the linear foot of pipe casing actually installed.

7-08.5 Payment

(October 30, 2018 Lacey GSP)

Supplement this section with the following:

“Bank Run Gravel for Trench Backfill” per ton and “Imported Pipe Bedding” per ton.

The unit contract price per ton for "Bank Run Gravel for Trench Backfill" and “Imported Pipe Bedding” shall be full compensation for all labor, material and equipment to furnish, place and compact the backfill.

Native material used for backfill shall be considered incidental to the pipe installation and no additional compensation shall be allowed.

Payment shall be based on actual amount of imported bedding or bank run gravel for trench backfill used. The Engineer reserves the right to adjust the bid proposal quantity as required.

There will be no additional compensation made for the removal and wasting of trench excavation that is unsuitable for backfill.

If no bid item for "Bank Run Gravel for Trench Backfill" or "Imported Pipe Bedding" is included, any work described in these sections shall be included in the unit contract price per foot of pipe installed and no additional compensation shall be allowed.

"Utility Potholing", per hour shall be full compensation for all labor, material and equipment necessary to excavate, backfill, and restore the utility location(s) required by the Engineer and determine its vertical and horizontal location. Utility potholing will only be paid for work approved by the Engineer in advance.

If no bid item for "Utility Potholing" is included, any work described in this section shall be incidental to the project.

"Pipe Abandonment", per each.

The unit contract price per each for "Pipe Abandonment" shall be full pay for providing all labor, tools, equipment and materials necessary to abandon the specified piping including the plug material.

If no bid item for "Pipe Abandonment" is included, any work described in this section shall be incidental to the project.

"Controlled Density Fill", per cubic yard.

If no bid item for "Controlled Density Fill" is included, any work described in this section shall be incidental to the project.

"Connect to Existing Water Main", per each.

The unit contract price for "Connect to Existing Water Main" shall be full pay for providing all labor, tools, equipment, and materials necessary to connect to the existing main. For purposes of payment, there will be no distinction made for the difficulty of connecting to the existing main or the quantity of connecting pipes or other materials needed. If no such item exists all costs shall be incidental to the project and no additional compensation shall be allowed.

The unit contract price per linear foot of "_____ Inch Pipe Encasement" shall be full compensation for all labor, material, tools and equipment to furnish, place, assemble, and install pipe casement, complete in place, including but not limited to pipe, all fittings including casing spacers, end seals and other fittings not shown on the Plans, joint materials, special requirements, commercial concrete or controlled density fill, and dewatering.

7-09 WATER MAINS

7-09.1 Description

(January 3, 2017 Lacey GSP)

Supplement this section with the following:

Various transition couplings, flanged coupling adapters, transition couplings with follower flanges and gaskets, and other miscellaneous couplings and fittings may be required for performance under this project.

It shall be the Contractor's responsibility to determine what specific couplings, adapters, and fittings that will be used to make connections shown on the plans. The Engineer has shown specific existing material types, and nominal sizes using the best information available. The Engineer has not determined the specific dimensions of existing materials. The Contractor shall submit a sketch showing configuration and materials of the proposed connection for review and approval.

Where vertical bends or pipe ends are required, the pipe and fittings shall be restrained on each side of the bend for a distance as recommended by the manufacturer.

7-09.2 Materials

(February 14, 2023 Lacey GSP)

Supplement this section with the following:

All pipe for water mains shall have flexible gasket joints and shall comply with one of the following two types unless otherwise specified on the plans:

Ductile iron pipe shall conform to AWWA C 151 Standard Thickness Class 52 and have a cement mortar lining conforming to AWWA C 104. All push-on joints shall be made using rubber gaskets conforming to AWWA C 111. Push-on pipe joints shall be un-restrained, except where identified on the plans or when used in conjunction with vertical bends, unless directed otherwise by the engineer.

PVC pipe shall conform to AWWA C900 and to the latest revision of the following standards, PVC Compound ASTM D1784 Class 12454B, Gasket ASTM F477, Manufacturing ASTM D2241. Pipe for potable water use shall be certified NSF 6, have a Dimension Ratio of 14, and be blue or white in color. Push-on pipe joints shall be un-restrained, except where identified on the plans or when used in conjunction with vertical bends, unless directed otherwise by the engineer.

All pipe, 12 inches or larger in diameter shall be ductile iron pipe unless PVC is approved by the Engineer.

PE Pipe: All 2 inch and smaller diameter pipe shall be NSF Approved, PE3408 blue polyethylene pipe manufactured from virgin materials. Pipe shall meet the following specifications:

- ANSI/AWWA C901
- ASTM D1248, ASTM D 3350, ASTM D 2239, ASTM D 3035 and ASTM D 2737,
- Pressure Class 200, SIDR - 7(Standard Inside Dimension Ration-Pressure Rated),
- Cell classification 345464C,

Pipe shall be manufactured by Interstate Plastics, Philips Driscopipe, Eagle Pacific, Superlon Plastics, U.S. Poly or approved equal.

Pipe restraints shall not be used as a substitute for thrust blocking unless approved by the engineer.

Where restrained joint pipe is identified on the plans the pipe and all associated fittings must be restrained by an approved pipe restraint system within the areas noted. Where vertical bends are used a minimum of 2 pipe joints or 25 lineal feet either side of the fitting (90°, tee, etc.), or as directed by the engineer, shall be restrained using an approved pipe restraint system.

Joint restraints for push-on joint ductile iron pipe shall be “Field Lok” type gaskets rated to 350 p.s.i and tested in accordance with ANSI/AWWA C111/A21.11, TR Flex as furnished by U.S. Pipe , Piranha as furnished by Romac, or Gripper Gasket LLC.

Joint restraints for push-on joint PVC pipe shall be Certa-Lok by CertainTeed Corporation, Eagle Loc 900 by JM Eagle, Diamond Lok-21 by Diamond Plastics, or RieberLok gasket. Bell restraint devices may be used where approved by the engineer. Bell restraint devices for PVC pipe shall have a working pressure of at least 200 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc., MEGALUG series 2800, Uni-Flange Series 1390, Romac Industries, Inc., U.S. Gripper, or approved equal.

All fittings for ductile iron pipe or PVC pipe shall be ductile iron compact fittings conforming to AWWA C 153 or conforming to AWWA C 110 and C 111. All shall be cement mortar lined conforming to AWWA C 104. Plain end fittings shall be ductile iron if mechanical joint retainer glands are installed on the plain ends. All fittings shall be flanged or mechanical joint.

All mechanical joint fittings shall be equipped with a mechanical joint restraint device consisting of wedges or lugs integral to the retaining gland. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc., MEGALUG, Ford Uni-Flange Series 1400, Romac Industries, Inc., U.S. Gripper, or approved equal.

All pipe shall be new and in good condition with no visible signs of UV damage, fading or other defects.

7-09.3(19)B Maintaining Service

(February 14, 2023 Lacey GSP)

Supplement this section with the following:

Where existing water services must be interrupted, the Contractor shall notify the Engineer as to the date, time and duration of the interruption, a minimum of 72 hours (3 working days) prior to the interruption. The Contractor shall field verify pipe diameter and fittings prior to requesting a service interruption. The City will notify customers involved or affected by the water service interruption. The Contractor shall make every effort to schedule water main construction with a minimum interruption of water service. Water service can not be interrupted before 8:00 am. Existing pipe shall be cut and connection ready to be made by 11:00 am or the shutdown must be rescheduled unless otherwise approved by the Engineer.

7-09.3(19)D Asbestos Cement Water Main

(February 14, 2023 Lacey GSP)

Add the following new section:

Cutting, tapping, connecting to, or abandoning an Asbestos Cement Water Main shall be in accordance with the rules and regulations set forth by the Washington State Department of Labor and Industries, and as directed by the Engineer. All costs of complying with current regulations shall be included in the unit contract price for “Connect to Existing Water Main”, “Pipe Abandonment”, and “_____ Inch Tapping Valve With Tapping Sleeve” as applicable.

Remove Asbestos Cement Water Pipe

The Contractor shall remove asbestos cement water pipe from the site as shown in the Plans. Costs for removal of any fittings and appurtenances attached to the AC pipe shall be incidental to the pay item “Remove Asbestos Cement Water Pipe”. State certified hazardous removal specialists or sub-contractor must be hired to perform the removal. The Contractor shall notify Department of Labor and Industries and ORCAA and acquire all required permits, and shall coordinate with the Engineer, prior to beginning

the removal work. It shall be the Contractor's responsibility to furnish all necessary safety equipment and protective clothing and to protect the adjacent environment in accordance with applicable environmental and safety laws and regulations. Removed pipe, conduits and debris shall be properly handled, transported, and disposed. The Contractor shall submit to the Engineer documentation from certified hazard disposal site showing the chain of custody where asbestos cement pipe is disposed.

Abandon Asbestos Cement Water Pipe

Asbestos Cement Pipe with more than 2 feet of cover from finished grade or where shown on the plans or as directed by the Engineer shall be abandoned in-place per 7-08.3(5).

Asbestos Handling and Disposal

Prior to performance of any contract work, the Contractor shall obtain all permits from, and provide notification to, the Washington State Department of Labor and Industries, the U.S. EPA, the local air pollution control agency, and other permitting and regulatory agencies with jurisdiction over the work involving asbestos as the law requires.

Prior to commencing asbestos related work, the Contractor shall provide the Engineer with written verification of approvals and notifications that have been given and/or obtained from the required jurisdictional agencies, and the Contractor's schedule for all work involving asbestos removal. The schedule shall include the sequencing and scheduling of asbestos related work, and coordination with subcontractors. The Contractor shall notify the Engineer when all approvals have been received and notifications have been made, as required by the agencies involved.

The Contractor shall ensure the safety of all workers, visitors to the site, and the general public in accordance with all applicable laws, rules, and regulations.

The Contractor shall designate a Washington State Certified Asbestos Supervisor (CAS) to personally supervise the asbestos removal and to ensure that the handling and removal of asbestos is accomplished by certified asbestos workers, pursuant to Washington State Department of Labor and Industries standards. The Contractor shall ensure that the removal and disposal of asbestos meets the requirements of EPA regulation 40 CFR Part 61, local health department regulations, and all other applicable regulations.

7-09.3(24) Disinfection of Water Mains

(February 14, 2023 Lacey GSP)

Modify this section with the following:

The Contractor shall provide extra safeguards to prevent contamination, rocks, sand or foreign matter from accumulating in the pipe.

Unless otherwise approved by the Engineer, the method for disinfecting water mains shall be by dry Calcium Hypochlorite conforming to ANSI/ AWWA B300 and NSF/ANSI 61 as defined in Section 7-09.3(24)D of the WSDOT Standard Specifications and AWWA C651-14 Sec. 4.1.3 and Sec. 4.3. If adhesives are used to secure chlorine tablets to the pipe interior, they must meet the requirements of NSF/ANSI 61 and AWWA C651-14 Sec. 4.3.3.

Pipe and fittings used in connections to existing mains shall be less than one pipe length (generally less than 20 ft), and spray disinfected, swabbed or immersed for disinfection as per AWWA C651-14 Sec. 4.10 and 4.11 (1% chlorine solution).

Bacteriological testing shall be done by the City per AWWA C651-14 Sec. 5.1 Option A or B. Option B may not be able to be used if the pressure in the line is too low to allow the sample tap to run continuously for 15 minutes without opening the system valve. Bacteriological testing must be scheduled with the Engineer at least 3 days in advance. Any samples needed on a Friday must be completed prior to 10:00 AM. Results are typically provided within four (4) working days but may take up to (7) working days. If the samples fail to produce acceptable results, the main shall be re-chlorinated by the continuous-feed or slug method until satisfactory results are obtained per AWWA C651-14.

The Contractor shall flush the new main. Flushing mains shall require the assistance of City utility personnel and shall be coordinated with the Engineer 3 working days in advance.

7-09.3(24)A Flushing

(December 31, 2014 Lacey GSP)

Modify this section by deleting the first sentence of the fourth paragraph and replacing it with the following:

The Contractor shall be responsible for disposal of treated water flushed from mains and shall neutralize the wastewater for protection of aquatic life in the receiving water and their associated surface and ground water tributaries, before disposal into any natural drainage channel, i.e., receiving water, waters of the State, including wetlands.

7-09.4 Measurement

(April 30, 2015 Lacey GSP)

Supplement this section with the following:

“Blow-off Assembly for Extendable Main” shall be measured per each.

“Remove Asbestos Cement Water Pipe” shall be measured per linear foot.

7-09.5 Payment

(October 30, 2018 Lacey GSP)

Supplement this section with the following:

The pay item in quotes is revised to read, “_____ Inch Water Main.”

The unit contract price for “_____ Inch Water Main” per linear foot shall be full pay for furnishing all labor, materials, tools and equipment, necessary to install the water main, complete in-place, including but not limited to pipe, couplings, adaptors, crosses, tees, bends, reducers, caps, plugs, restrained joint fittings, bend markers, and other fittings not specifically identified on the plans. Further, all excavation, bedding, backfilling with native material, compacting, temporary patching, formed thrust blocking, testing, flushing, and disinfecting shall also be included in the unit contract price. Items not specifically identified on the plans but necessary to properly install the water main shall be considered incidental to the water main and no other compensation shall be allowed.

“Blow-Off Assembly for Extendable Main”, per each.

The unit contract price per each for “Blow-Off Assembly for Extendable Main” shall be full pay for furnishing all labor, materials, tools and equipment, necessary to the cap on the new water main, thread and install required valves, valves boxes, brass pipe, bends, couplings and other fittings not specifically called out on the plans.

Temporary blow-off assembly required for temporary or permanent release of air, chlorination or flushing purposes shall be provided by the Contractor as a part of the new water main. The unit contract price for “__ inch Water Main” shall be full pay for providing all labor, tools, equipment, and materials necessary to abandon the pipe including temporary blow-off assembly.

The payment for bid item “Remove Asbestos Cement Water Pipe” shall be full pay for disposal, certified labor, materials, tools, equipment, including safety and protective equipment to protect labor necessary to remove, transport, and dispose of asbestos cement water pipe, fitting and appurtenances to an approved disposal site. The cost of all permits required for the removal and disposal of this material is included in this bid item.

7-12 VALVES FOR WATER MAINS

7-12.2 Materials

(February 14, 2023 Lacey GSP)

Supplement this section with the following:

All valves shall be non-rising stem, resilient wedge gate valves conforming to AWWA C515 unless otherwise specified and shall be American AVK, Clow, EJ Flowmaster, Kennedy, M & H, Mueller, Waterous Series 2500. The minimum cover over the valve, measured from the valve operator nut to finished grade, shall be 20 inches. Gate valves 14 inches and larger that are unable to provide 20 inches of cover over the valve shall be factory equipped with a bevel gear actuator for horizontal installation as directed by the engineer. The bevel gear actuator shall be rated for buried installations.

Butterfly valves shall meet all the requirements of AWWA C504 Class 150B and shall be Allis Chalmers, Kennedy, Linseal III, M&H, Mueller, Pratt Groundhog.

Valves shall be bolted to the tee and the cross with flanged ends. Joint materials for flanges shall be 1/8 inch thick one piece, cloth inserted rubber gaskets conforming to AWWA C107-78.

Bolts for all flanged and mechanical joints shall be high strength, low alloy steel bolts only, meeting the current provisions of American National Standard ANSI/AWWA C111/A 21.11 for rubber gasket joints for cast iron or ductile iron pipe and fittings.

Valve boxes shall be East Jordan Iron Works #248 or Olympic Foundry VB-950, 6-3/4 inch OD with recessed handle type iron cover marked "CITY OF LACEY WATER."

Tapping sleeves shall be stainless steel with ductile iron flange and shall be Romac "SST" or approved equal.

Two inch air and vacuum release valve shall be a two inch ARI D-040. Fiberglass enclosure shall be Vent Guard Model No. AVG1824, Beige in color, manufactured by Hot Box, Inc. (800) 736-0238. An insulation pouch shall be placed over the air release assembly. The 18" x 24" insulation pouch shall be beige in color with the opening on the 18" side, and manufactured by DeKorra Products LLC

Valve insertions shall be Romac InsertaValve or Hydra-Stop Insta-Valve Plus and be completed by an experienced installer.

7-12.3(3) Raise Valve Box to Grade

(November 20, 2020 Lacey GSP)

Add the following new section:

Where shown on the plans or where directed by the Engineer, existing valve boxes shall be raised to the grade as staked or otherwise designated by the Engineer. The Contractor shall supply and install new valve boxes and covers as part of raising valve boxes to grade. The finished installation shall conform to the detail shown in plans.

All new and existing valve boxes located in any unpaved area shall have a concrete pad poured or placed entirely around each valve box. The pad shall be a minimum of 36 inches by 36 inches for each valve box. The concrete shall be commercial concrete or better with a minimum thickness of 8 inches.

Maximum distance allowed from edge of iron ring or frame of appurtenance to outside edge of pavement restoration is 18 inches. Patches larger than this or clean misses (e.g. where the Contractor excavates in the new pavement mat and does not find the iron appurtenance to raise) shall result in a credit from the Contractor to the City of \$1000 for each occurrence. Further, the Contractor shall repair the pavement patch as directed by the Engineer.

See Section 5-04.3(26) Utility Access for additional requirements.

7-12.3(4) Valve Insertion **(December 31, 2014 Lacey GSP)**

Add the following new section:

The valve insertions shall be a Romac InsertaValve or Hydra-Stop Insta-Valve Plus Valve Assembly and Sleeve. The water main material type is FILL IN TYPE. Prior to valve insertion, the Contractor shall ensure that there is enough cover over the pipe for a valve box to be installed flush to existing surface. No interruption of water service shall be allowed.

7-12.3(4) Tapping Concrete Cylinder Pipe (CCP) **(December 31, 2014 Lacey GSP)**

Add the following new section:

The following materials shall be minimally required to perform the tap on the concrete cylinder pipe:

- 3/8" steel saddle cylinder cut to radius/curve of pipe to be tapped
- 150lb steel flange follower
- 3/16" steel collar follower plate
- 1/4" pipe thread fitting attached to collar follower plate for air test of weld
- 1/4" pipe plug

The following procedure shall be followed when tapping the concrete cylinder pipe:

1. Pre weld 150lb flange collar to square end of 3/8" steel saddle cylinder.
2. Chip away concrete outer layer to expose steel water pipe and steel wire wrap.
3. Tack weld steel wire wrap rods to steel water main pipe prior to cutting and bending back.
4. Clean and mark area for weld.
5. Weld on 3/8" steel saddle with 3 rows of weld.
6. Weld on 3/16" steel follower plate with 3 rows of weld on each seam.
7. Air test weld through 1/4" pipe fitting on follower plate
8. Bend back and weld down steel wrap rods to pipe and follower plate evenly.
9. Bolt on flanged tapping valve and perform tap.
10. Repair/finish concrete on water main with cement mortar.

7-12.5 Payment

(April 2, 2018 Lacey GSP)

Supplement this section with the following:

“Raise Valve Box to Grade,” per each.

"_____ Inch Gate Valve," per each.

The payment for the various items specified above shall be full pay for furnishing all labor, materials, tools, and equipment necessary to install the unit complete in place on the water main, including trenching, concrete pads and concrete or asphalt restoration of adjacent areas, disinfecting, testing, blocking of valve, valve box and marker post.

"_____ Inch Air and Vacuum Release Valve," per each.

The unit contract price for per each for “_____ Inch Air and Vacuum Release Valve” shall be full pay for furnishing all labor, materials, tools and equipment, necessary to install the air/vacuum release valve, complete in-place, including but not limited to pipe, valves, couplings, adaptors, bends, reducers, box and concrete foundation, and other fittings not specifically identified on the plans.

"_____ Inch Tapping Valve with Tapping Sleeve," per each.

"_____ Inch Tapping Valve with Tapping Sleeve on CCP," per each.

The payment for the various items specified above shall be full pay for furnishing all labor, materials, tools, and equipment necessary to install the unit complete in place on the water main, including any size tapping sleeve required for the connection, trenching, jointing, welding, preparation, concrete pads, disinfecting, testing, blocking of valve, valve box and marker post.

"_____ Inserted Valve,” per each.

The unit contract price per each for “_____ Inserted Valve” shall be full pay for furnishing all labor, materials, tools and equipment, necessary to install the inserted valve, complete in-place, including but not limited to the pipe sleeve, pipe tap, valve, valve box, excavation and backfill, including concrete pads and other materials required to install the inserted valve not specifically identified in the plans.

Restoration of asphalt for "_____ Inch Tapping Valve with Tapping Sleeve", "_____ Inch Tapping Valve with Tapping Sleeve on CCP" and "_____ Inserted Valve” will be measured and paid as “HMA for Pavement Repair Cl. ___ PG ___” in accordance with the provisions of Section 5-04.

Restoration of concrete for "_____ Inch Tapping Valve with Tapping Sleeve", "_____ Inch Tapping Valve with Tapping Sleeve on CCP" and "_____ Inserted Valve” will be measured and paid as “Cement Conc. Sidewalk” in accordance with the provisions of Section 8-14.

“Lift Station Wash Down Hydrant Reconnection”, per each.

The unit contract price for the above bid item shall be full compensation for all labor, material, and equipment to reconnect the existing wash down hydrant service complete up to the existing RPBA device including, but not be limited to, service saddle, tapping the pipe, 6” threaded brass nipple, 2” threaded gate valve, valve box, service line, and all miscellaneous couplings, fittings, and adapters to install the service line and connect to the existing setup.

7-26 WATER WELL REHABILITATION

(March 3, 2022 Lacey GSP)

Add the following new section:

7-26.1 Description

(March 3, 2022 Lacey GSP)

This Work consists of rehabilitating groundwater production wells to improve well performance and lifespan. This Work shall conform to Chapter 173-160 WAC (*Minimum Standards for Construction and Maintenance of Wells*).

7-26.2 Materials

(March 3, 2022 Lacey GSP)

All materials used during rehabilitation shall meet the requirements of the various applicable sections of the Specifications.

The Contractor is responsible for supplying their own source of power to complete the Work.

Potable water is available at the site to complete the Work. Contractor shall coordinate with City maintenance staff.

All reactive chemicals introduced into the well shall be NSF/ANSI Standard 60 certified and approved by the City.

7-26.3 Construction Requirements

7-26.3(1) Rehabilitation Steps

(***)(March 3, 2022 Lacey GSP)**

The rehabilitation activities to be conducted under these Specifications includes the following items:

- CITY will perform the pre-rehabilitation step-rate test using the CITY'S existing pump. During pre-rehabilitation testing, HYDROGEOLOGIST will collect pre-rehabilitation water quality samples.
- CITY will disconnect the well from the City's electrical and conveyance infrastructure.
- CONTRACTOR shall mobilize to the well site.
- CONTRACTOR shall remove the existing pump and appurtenant infrastructure.
- CITY will perform pre-rehabilitation video inspection.
- CONTRACTOR shall install a temporary test pump and perform pre-rehabilitation step-rate testing.
- CONTRACTOR shall brush screens for three 8-hour days.
- CONTRACTOR shall hydropuls® screens for two 8-hour days.
- CONTRACTOR shall treat the well with liquid carbon dioxide.
- CONTRACTOR shall perform the post-rehabilitation pumping test using the CONTRACTOR'S temporary pump. HYDROGEOLOGIST will collect post-rehabilitation water quality samples.
- CITY will perform post-rehabilitation video inspection.
- CONTRACTOR shall re-install the new pumping equipment.
- CONTRACTOR will reconnect the well to the City's electrical and conveyance infrastructure.
- CONTRACTOR shall perform well disinfection and purging; including de-chlorination of purge water, if necessary.
- CONTRACTOR shall restore the site.

7-26.3(2) Personnel and Equipment

(March 3, 2022 Lacey GSP)

The Contractor shall supply capable and experienced personnel to perform the Work, and shall furnish all equipment, complete with all necessary tools and appurtenances, of adequate capacity to perform the work as specified. All equipment shall be in good operative conditions. All site work and equipment shall comply with all applicable federal, state, county, and local safety regulations. The Contractor shall provide and follow the Contractor's own health and safety plan.

7-26.3(3) Licenses and Regulations **(March 3, 2022 Lacey GSP)**

The Contractor shall have a valid Washington State Well Construction Operator's License in accordance with Chapter 173-162 WAC, and shall acquire at its own expense all permits, certificates, and licenses required for execution of the Work.

7-26.3(4) Submittals **(*****)(March 3, 2022 Lacey GSP)**

All submittals shall be submitted to the City as one document, and shall be approved by the City. All submittals shall conform to the templates provided in Appendix A.

7-26.3(4)A Rehabilitation Plan **(March 3, 2022 Lacey GSP)**

Prior to initial mobilization, the Contractor shall submit a written plan for rehabilitation based on the steps identified in Section 7-26.3(1) Rehabilitation Steps. The plan shall include specification of equipment to be used, the operating curve of the temporary test pump, and a proposed schedule that includes the amount of time each task is expected to require. The rehabilitation plan shall be approved in advance by the City. Any additional method(s) of rehabilitation shall also be negotiated and approved in advance by the City. If conditions warrant, the Hydrogeologist or the City may specify additional development method(s).

After review of the pre-rehabilitation pumping test and video inspections, the Contractor shall propose in writing any suggested updates to the Rehabilitation Plan in consultation with the Hydrogeologist for approval by the City.

7-26.3(4)B Estimate of Chemical Quantities **(March 3, 2022 Lacey GSP)**

If the rehabilitation effort requires chemical treatment, the Contractor shall submit a written estimate of the quantities of reactive chemicals necessary to be released into the well to perform the Work for approval by the City prior to mobilization of the chemicals to the Site. The Estimate of Chemical Quantities shall also include plans for neutralization of chemical treatments, if required, and an estimate of the amount of time and effort until the chemical concentrations within the well will be restored to pre-rehabilitation levels. Safety data sheets (SDS) and NSF compliance information shall also be included for each chemical.

7-26.3(4)C Disinfection Plan **(March 3, 2022 Lacey GSP)**

The Disinfection Plan shall consist of a narrative and any applicable plan sheets that describe the Contractor's procedures for disinfection, purging, and de-chlorination of the well following rehabilitation. The Disinfection Plan shall include specification of equipment and chemicals to be used during the

disinfection. The Disinfection Plan shall meet the standards described in AWWA Standard 654 *Disinfection of Wells*.

7-26.3(4)D Rehabilitation Derived Waste Management Plan

(March 3, 2022 Lacey GSP)

The Rehabilitation Derived Waste (RDW) Plan shall consist of a narrative and any applicable plan sheets that describe the Contractor's procedures for collection, storage, handling, and acceptable disposal of waste products generated during rehabilitation activities. The RDW Plan shall identify disposal locations for all RDW. RDW materials may include, but are not limited to:

Sediment and other solids removed from the well
Groundwater obtained through well rehabilitation, development, and purging
Chemicals and cleaning fluids such as spent solvents and wash water
Disposable equipment and related items

The Contractor shall submit the RDW Plan to the City prior to mobilization. Prior to disposal of any RDW not described in the Plan, Contractor shall submit a RDW Plan Addendum to the to describe any new RDW and plans for disposal. The RDW plan shall also include a spill prevention, control, and countermeasures plan (SPCC).

7-26.3(5) Site Information

(***)(March 3, 2022 Lacey GSP)**

Source 10 is located at 5701 Parkside Drive, Southeast, Lacey, Washington, 98503. Access to the site is via paved surface streets. Maps showing the site are included as Appendix B.

The Contractor shall coordinate with the City to prevent site work from interfering with the scheduled pumping of other wells.

7-26.3(6) Well Information

(***)(March 3, 2022 Lacey GSP)**

Well logs are provided in Appendix C.

Source 10 is 210 feet deep with 16-inch steel casing. Additional information on screens, depths, and appurtenances is provided on the Contract Plans. It should be noted that the well is known to have both "kinks" and is out of vertical alignment.

Source 10 is located in a CMU wellhouse with access through the roof. The well was last rehabilitated in 2018-2020 and achieved a production rate of 1,300 gallons per minute with a specific capacity of 20.7 gallons per minute per foot. The new well equipment is designed to deliver up to the maximum instantaneous water right of 1,200 gpm.

7-26.3(7) Site and Well Protection

(March 3, 2022 Lacey GSP)

The Contractor shall, upon completion of the work, restore the site as nearly as possible to its original condition. The Contractor shall use all reasonable measures to prevent erosion, sedimentation, or contamination of soils, surface water, or groundwater

The Contractor shall maintain a clean worksite at all times. The Contractor shall avoid any contamination of the well or well site by fuel, oil, grease, solvents, soil, or other contaminants. All tooling and well equipment inserted into the well shall be steam cleaned then rinsed with a 100 parts per million chlorine solution prior to insertion in the well. Tooling and well equipment shall not be stored in direct contact with soil or vegetation.

7-26.3(8) Pumping Test Using Contractor-Supplied Temporary Pump

(***)(March 3, 2022 Lacey GSP)**

The Contractor shall provide, install, and operate a temporary pump and discharge system with a check valve. The pump shall be capable of producing an adjustable flow rate of up to 1,200 gallons per minute with the pump set at approximately 150 feet below the top of the casing. The minimum total dynamic head at that depth is 340 feet plus friction losses in the discharge piping.

A calibrated, in-line flow meter, orifice manometer, or other approved device for discharge measurements shall be supplied and installed by the Contractor. A check valve shall be installed to prevent draining of the column pipe at the termination of pumping. A sampling port with regulating valve shall be installed in the discharge system for water sampling during the pumping test.

The temporary pump assembly shall be clean and shall have been steam cleaned prior to installation. The pump shall be powered by a generator supplied by the Contractor. The pump and motor specifications, including the pump operating curve, shall be approved by the City prior to mobilization for the test.

Discharge shall be controlled as described in Section 7-26.3(12).

Test procedures will be specified by the City and are expected to include a pre-test monitoring period of at least 12 hours; a step-drawdown test of up to 4 hours; and a post-pumping recovery period of at least 24 hours. The pump and discharge line shall be left in the well during the recovery period.

Unless otherwise approved by the City, one 1-inch and one 1¼-inch pipe size Schedule 40 sounding tubes shall be installed with the test pump to allow a water-level indicator and a pressure transducer to pass to a depth approximately 10 feet above the pump intake. During the test, periodic measurements of water level, flow rate, and turbidity shall be recorded at intervals specified by the City. Measurements shall be made and recorded by the Contractor at the pumped well and any other observation well(s) identified by the City. The City will instruct the Contractor as to operation of instruments and documentation of measurements, and will provide necessary equipment to obtain the measurements.

The pumping rate shall be held constant during each test step and not vary more than 5 percent. In the event that the pump or other equipment malfunction(s) cause the discharge to stop or vary unacceptably, the test shall be considered terminated. The water level will then be allowed to recover to at least 90% of the initial static water level, and the test will be restarted and run for the complete duration without credit for the aborted period.

7-26.3(9) Pumping Test Using City Pump

(***)(March 3, 2022 Lacey GSP)**

The pre-rehabilitation and post-rehabilitation pumping tests shall be performed by the City using the City's pump and controls. The City shall perform the pre-rehabilitation pumping test prior to the Contractor mobilizing to the Site. The Contractor may be present during the pre-rehabilitation pumping test at their own cost. The City shall perform the post-rehabilitation pumping test following the well rehabilitation and redevelopment. Results of each test will be provided to the Contractor in electronic format within 3 working days of the completion of the test. Turbidity shall be measured by the Hydrogeologist during the tests.

7-26.3(10) Pump Removal

(***)(March 3, 2022 Lacey GSP)**

The Contractor shall provide at least 2 working days' notice to the City to disconnect well wiring from the Site's power. After the City has disconnected the well wiring, the Contractor shall remove the existing motor, pump, wiring, and column pipe from the well. Equipment shall be steam cleaned by the Contractor then inspected by the Contractor, Hydrogeologist, and City. Samples of scale or slime on the pump may be collected by the Hydrogeologist. During removal, any flowing water shall be controlled by the Contractor. After removal, the wellhead shall be closed with existing fittings. Existing equipment that will be reused, including pump, wiring, and column pipe, shall be salvaged by the Contractor and stored onsite in a safe place. Stored equipment shall not be stored in direct contact with soil or plant life, and shall be covered and protected. Existing equipment that will not be reused, listed in Section 2-02.1 or as directed by the City, shall be removed by the Contractor and disposed of in accordance with local, state, and federal regulations. Pump plate shall be salvaged and provided to the City.

7-26.3(11) Video Inspection

(March 3, 2022 Lacey GSP)

The City shall perform video inspections of the well to verify well construction, and to document and examine the condition of the well. The Contractor shall provide the City with at least 2 working days' advance notice of when the well will be ready for City to perform video inspection. The Contractor may be present during testing at their option. The City will provide the Contractor with a short, written summary of conditions observed on the video inspection to inform the rehabilitation. An electronic copy of the video will be provided to the Contractor upon request.

The Contractor shall perform a video inspection of the well to verify well construction and to document and examine the well condition. The equipment shall be a color, side-scan video camera capable of accessing the 7-inch ID screen, with a calibrated depth indicator that reads in feet below ground surface. A weighted tape may be inserted by the Hydrogeologist during the inspection to accurately determine the depth to well features. The interior well casing and screen walls shall be clearly visible in the video. If turbid water obscures visibility, the Contractor shall pump the well or flush the well with potable water until a clear image can be obtained and then repeat the video. One digital copy of the video recording shall be provided to the City via USB drive or other means of digital file transfer.

7-26.3(12) Control of Rehabilitation Derived Waste

(***)(March 3, 2022 Lacey GSP)**

The Contractor shall properly control and dispose of all RDW documented in the RDW plan and approved by the City, as described in Section 7-26.3(4)D. The Contractor shall clarify, if necessary, and dispose of water generated during rehabilitation and testing of the well. The Contractor shall prevent discharge water from flowing uncontrolled, flooding or saturating ground surface outside of designated water control structures approved for use by the City, eroding soils, damaging vegetation or sensitive habitats, and obstructing access across the Site.

Water may be disposed of on-site using the existing catch basins and new storm piping. The Contractor shall record and report the daily quantity of water discharged to the system in a daily report. The Contractor shall monitor the turbidity of discharge water and shall not discharge any water measuring greater than 50 NTU to the basin. Turbid water shall be clarified to less than 50 NTU using the methods described in the RDW plan prior to discharge into the stormwater infiltration basin. No permits are required for discharge to the stormwater infiltration basin.

The Contractor shall control, separate, and dispose of solid RDW including garbage and natural solids generated during rehabilitation. The Contractor shall safely store all solid RDW in areas approved by the

City, to not obstruct access across the Site, pose a safety hazard, or damage the Site or the well. The Contractor shall safely and legally dispose of all solid RDW.

Solid RDW may be stored within the project limits for the duration of the Work provided it does not hinder or block access to the site or any buildings. Non-hazardous soils removed during rehabilitation may be disposed of at an appropriate waste handling facility.

7-26.3(13) Well Rehabilitation

7-26.3(13)A Brushing of Well Casing and Screen

(March 3, 2022 Lacey GSP)

Prior to brushing, all debris shall be removed from the bottom of the well and the well depth sounded. Wire brushes shall be sized for a touch fit to the inside diameters of the casing and the screen and shall be capable of vertical and rotational movement. Plastic or fiber brushes may be used if conditions warrant and if approved by the City. After brushing is complete, all debris shall be removed, and the well depth sounded.

7-26.3(13)B Redevelopment Using Surging, Bailing, Pumping, and/or Simultaneous Surging/Pumping

(March 3, 2022 Lacey GSP)

Surging, bailing, pumping, and/or simultaneous surging/pumping methods shall be used to redevelop the well as proposed by the Contractor and approved by the City. Use of double surge blocks set at close spacing and simultaneous pumping methods are preferred. The Contractor shall furnish and operate an Imhoff cone for sediment monitoring during the redevelopment process. After redevelopment is complete, the well depth shall be sounded.

7-26.3(13)C Jetting

(March 3, 2022 Lacey GSP)

Jetting may be used if conditions warrant and/or if suggested by the Contractor. Tooling and technique shall be approved by the City. Any sediment shall be removed from the jetting fluid before use, or continuously removed if the jetting fluid is recirculated. After jetting is complete, all debris shall be removed, and the well depth sounded.

7-26.3(13)D High-Pressure Inert Gas Impulse

(March 3, 2022 Lacey GSP)

High-pressure inert gas impulse methods, sometimes known as fluid percussive methods, may be used if conditions warrant and/or if suggested by the Contractor. Tooling, technique, and gas composition shall be approved by the City. Operational parameters, such as working pressure and gas composition, shall be appropriate for and compatible with the well materials and conditions. After impulse generation is complete, all debris shall be removed, and the well depth sounded.

7-26.3(13)E hydropuls® Method

(March 3, 2022 Lacey GSP)

hydropuls® is a patented gas- or liquid-based impulse generation method that may be used if conditions warrant and/or if suggested by the Contractor and approved by the City. The Contractor shall only use hydropuls®-specific equipment, where applicable, while performing this method. Operational parameters, such as working pressure and fluid composition, shall be appropriate for and protective of the well

materials and conditions. After hydropuls® is complete, all debris shall be removed, and the well depth sounded.

7-26.3(13)F Carbon Dioxide Injection

(March 3, 2022 Lacey GSP)

Injection of liquid or gaseous carbon dioxide into the well may be used if conditions warrant and/or if suggested by the Contractor. The Contractor shall safely and effectively contain the treated section of the well during the injection and reaction phases to derive the maximum benefit of increased pressure from the technique. Tooling and technique shall be approved by the City. Introduction of solid carbon dioxide into the well, commonly known as dry ice, shall be approved by the City. After carbon dioxide injection is complete, all debris shall be removed, and the well depth sounded.

7-26.3(13)G Detonation

(March 3, 2022 Lacey GSP)

Detonation of an explosive device within the well may be used if conditions warrant and/or if suggested by the Contractor and approved by the City. The Contractor shall obtain all necessary permits and the detonation shall be performed by a competent person. The Contractor shall give the City at least 2 working days' advance notice of the date and approximate time the explosive device will be detonated. The explosive device shall be stored off-site and safely transported to the Site no sooner than the day that it will be detonated. The explosive device shall be safe for use within potable water wells and shall not introduce, generate, or leave behind any harmful byproducts. The explosive yield and shape of the charge shall be appropriate for and protective of well and aquifer conditions, shall not harm or pose a nuisance to neighboring properties, nearby above ground and underground infrastructure, the general public, sensitive or protected fauna, or sensitive or protected environments. After detonation is complete, all debris shall be removed, and the well depth sounded.

7-26.3(13)H Chemical Treatment

(March 3, 2022 Lacey GSP)

Chemical treatments may be used if conditions warrant and/or if suggested by the Contractor and approved by the City. All chemical treatments shall be NSF/ANSI Standard 60 certified and shall be compatible with well and aquifer formation materials. Chemical treatments shall include adequate agitation of the water column to evenly disperse the chemicals and adequate chemical residence times for effective treatment. Chemical treatments shall be adequately neutralized and/or flushed at the conclusion of the treatment. After chemical treatment is complete, all debris shall be removed, and the well depth sounded.

Chemical treatments include, but are not limited to:

Acids (such as phosphoric acid, hydrochloric [muriatic] acid, citric acid, hydroxyacetic acid, acetic acid, glycolic acid, sulfamic acid)

Oxidizers (such as sodium/calcium hypochlorite, hydrogen peroxide)

Chlorine

Surfactants

Dispersants (such as polyphosphate salts)

Estimates of chemical quantities, mixing requirements, method of introduction to the well, and the amount of time for purging and/or neutralization to restore water quality to levels suitable for normal operation of the well, shall be approved by the City per Section 7-26.3(4)B.

7-26.3(14) Pump Installation

(March 3, 2022 Lacey GSP)

The Contractor shall provide the City with at least 2 working days' advance notice prior to installing the pump. All equipment shall be steam cleaned and disinfected prior to insertion in the well. The pump shall be installed to the depth directed by the City. No portion of the pump, wiring, column pipe, sounding tubes, or other fixtures shall be allowed to contact the well screen or end cap. Disposable fittings and fittings in poor condition shall be identified and replaced upon approval by the City. Equipment and fittings damaged due to Contractor error, failure of the Contractor's equipment, or improper storage shall be replaced by the Contractor at the Contractor's cost.

Once placement of the pump and fitting is complete, the City will re-connect electrical equipment, such as level transmitter and motor, as needed. Contractor shall connect the pump to a temporary discharge line and pump the well for no less than 30 minutes to confirm successful installation and normal operation.

7-26.3(15) Well Disinfection

(March 3, 2022 Lacey GSP)

Well disinfection shall be performed per the most recent AWWA C654 *Disinfection of Wells* and WAC 173-160-371. The well shall be thoroughly cleaned of any scum, cement, oil, or other foreign substances prior to disinfecting. The quantity of chlorine compound used for disinfection shall be sufficient to produce a residual of 50 parts per million available chlorine in solution when mixed with the total volume of water in the well. The disinfectant shall be left in the well for at least 24 hours and a minimum of 1 part per million of chlorine residual shall remain in the water after 24 hours. The quantity of chlorine used shall be approved by the City. The disinfectant shall be uniformly applied throughout the entire water column, including within the screen assembly.

The Contractor shall submit a method of disinfecting the well for approval by the City as per Section 7-26.3(4)C.

Directly after treatment, the well shall be flushed free of chlorine and discharged according to the Contractor's RDW plan. Chlorine and other disinfectants shall not be allowed to sit in the well longer than necessary. The discharge shall be treated to reduce the total chlorine residual to 0.0 mg/L at the point of discharge. The method of treatment and amount of the chemical shall be approved by the City. The Contractor shall provide chlorine monitoring equipment sensitive to 0.02 mg/L. For reference, the toxic substances criterion for total chlorine residual in freshwater is 0.02 mg/L (acute, 1-hour average per WAC 173-201A-240).

7-26.3(16) Post-Disinfection Bacterial Sampling and Tests

(March 3, 2022 Lacey GSP)

Bacterial tests shall be performed by the City once turbidity is less than 0.3 NTU and the total chlorine residual is 0.0 mg/L. If the bacterial tests fail, the Contractor shall disinfect the well again at the Contractor's expense until subsequent bacterial tests pass.

To comply with procedures for bacterial sampling, the City will only take bacterial samples on days that the City laboratory will accept them, typically Monday through Thursday. Sample results are expected approximately 2 working days after the sample has been taken. Results of the bacterial tests will be shared with the Contractor within 1 working day of receipt of the results.

7-26.3(17) Sealing the Well

(March 3, 2022 Lacey GSP)

Following disinfection, purging, and dechlorination, the Contractor shall seal the well shut by bolting down a clean steel or wooden plate across the top of the well casing using the existing bolt holes. The

plate shall be bolted in manner that covers and secures the well, and in a manner that allows the plate to be removed at a later date for installation of the operating pump without damaging the well.

7-26.3(18) Standby Time

(March 3, 2022 Lacey GSP)

Standby time will be credited only for unexpected periods during which work is stopped at the direction of the Hydrogeologist or the City. Idle time required for maintenance or failure of equipment shall not be considered standby time. Standby time covers only the time lost during an 8-hour working shift while unanticipated activities delay the Contractor's work, regardless of the Contractor's operating schedule. Standby time does not include normal delays or lag time in the well rehabilitation and testing, such as a normal period for the City to complete a video inspection, while waiting for results of bacterial tests, or while waiting on delivery of a pump from a pump vendor. Standby time will not be paid for non-working days including but not limited to Saturdays, Sundays, or holidays observed by the City.

7-26.3(19) Records

(March 3, 2022 Lacey GSP)

The Contractor shall provide a daily report for each day in which work is performed. The daily report shall be submitted to the Hydrogeologist for approval. Approval of each daily report shall be a condition of payment.

The daily report shall contain a detailed description of the work done each day, including:

Dates and times of activities.

Number of hours on the job.

Activities performed.

Equipment used.

Quantities, types, and manufacturers of all materials used.

Number of hours shut down and the reason(s).

Any discharges to surface water, any erosion, or any spills.

Full description of rehabilitation activities, including but not limited to:

Duration of brushing.

Duration and rates of surging, jetting, and pumping.

Volumes of water added or removed.

Application and quantities of any chemicals used.

Sediment production as measured by bottom soundings.

Other information as requested by the Hydrogeologist or the City.

7-26.4 Measurement

(***)(March 3, 2022 Lacey GSP)**

“Contractor-Supplied Temporary Pump”, lump sum.

50 percent shall be payable upon completion of the well development and the remaining 50 percent shall be payable upon final removal of the temporary pump.

“Pumping Test”, per hour.

“Pump Removal”, per each.

“Video Inspection”, per each.

“Control of Rehabilitation Derived Waste”, lump sum/force account.

“Well Rehabilitation, Brushing”, per hour.

“Well Rehabilitation, Redevelopment”, per hour.

“Well Rehabilitation, Jetting”, per hour.

“Well Rehabilitation, High-Pressure Gas Impulse”, per hour.

“Well Rehabilitation, hydropuls Method”, per hour.

“Well Rehabilitation, Carbon Dioxide Injection”, per hour.

“Well Rehabilitation, Detonation,” per each.

“Well Rehabilitation, Chemical Treatment”, force account.

“Pump Installation”, per each.

“Well Disinfection”, per each.

Payable once laboratory analysis of post-rehabilitation bacterial samples indicates the well is free of bacterial contamination.

“Standby Time”, per hour.

7-26.5 Payment

(March 3, 2022 Lacey GSP)

Payment will be made in accordance with Section 1-04.1, for each of the following bid items that are included in the proposal.

The “Contractor-Supplied Temporary Pump” shall be used for well development and pumping tests. The lump sum shall include procurement, installation, operation, and removal of the pump as required by the rehabilitation plan. In the event of equipment failure or inability to meet pumping requirements, the Contractor shall replace the temporary pump at Contractor’s expense.

“Pumping Test” per hour shall include operation of the contractor-supplied temporary pump and collection of measurements during pumping tests. In the event that the test is terminated due to equipment failure or operator error, no payment will be made during recovery and during the time taken to return to the portion of the test when the equipment failure or operator error occurred. For bid purposes, this step is assumed to require a minimum of four hours.

“Pump Removal”, per each shall include successful removal of a pump from the well, safe on-site storage of any well equipment identified by the City for re-use or salvage, and disposal of any equipment identified by the City for disposal. Removal of the Contractor-supplied temporary pump is included in the Contractor-supplied temporary pump item and is not part of this item. Additional removals of the existing pump at each well beyond the first removal shall be at the Contractor’s expense, unless directed by the City. Failed attempts to remove an existing pump due to equipment failure or operator error shall be at the Contractor’s expense. Failed attempts to remove an existing pump due to pre-existing and unforeseen conditions at and within the well shall be measured and compensated at the direction of the City.

“Video Inspections”, per each includes each successful video inspection. Videos that do not meet the visibility requirements or cannot be viewed due to recording error shall be repeated at the Contractor’s expense. Additional successful videos at each well beyond the first successful pre-rehabilitation video inspection and the first successful post-rehabilitation video inspection shall be at the Contractor’s expense, unless directed by the City.

“Control of Rehabilitation Derived Waste”, lump sum/by force account as provided in Section 1-09.6, covers procurement, installation, operation, and removal of equipment necessary to control and dispose of RDW as required by the RDW plan. This includes labor and equipment to clarify and discharge development and discharge water; and safely store, separate, remove, and dispose of solid RDW. Any permits, if any, required to discharge or dispose of RDW are also included in this item.

“Well Rehabilitation, Brushing”, per hour includes setup, brushing of the well casing and screen, removal of debris, and sounding of well depth upon completion of the brushing.

“Well Rehabilitation, Redevelopment”, per hour includes setup and using surging, bailing, pumping, and/or simultaneous surging and pumping techniques to mobilize, remove debris from the well, and sounding of well depth. For bid purposes, this step is assumed to require 2 hours per foot of screen.

“Well Rehabilitation, Jetting”, per hour includes the labor, equipment, and materials to setup and perform fluid jetting on the well casing and screen, the removal of debris, and sounding of well depth upon completion of the jetting.

“Well Rehabilitation, High-Pressure Gas Impulse”, per hour includes the labor, equipment, and materials to setup and perform managed release of compressed gases within the well casing and screen, removal of debris, and sounding of well depth upon completion of the method.

“Well Rehabilitation, hydropuls Method”, per hour includes the labor, equipment, and materials to setup and perform the patented hydropuls® method using hydropuls®-specific tooling, where applicable; removal of debris; and sounding of well depth upon completion of the method. Impulse generation methods that do not conform to the patented hydropuls® method using hydropuls®-specific tooling are not included in this item, but shall instead be included in the “Well Rehabilitation, High-Pressure Gas Impulse Generation”, per hour item.

“Well Rehabilitation, Carbon Dioxide Injection”, per hour includes the labor, equipment, and materials to setup and inject carbon dioxide into the well screen and casing, neutralization, removal of debris, and sounding of well depth upon completion of the carbon dioxide injection.

“Well Rehabilitation, Detonation”, per each includes the labor, equipment, materials, and any necessary permits to setup and detonate an explosive device within the well. This item also includes removal of debris and sounding of well upon completion of the detonation.

“Well Rehabilitation, Chemical Treatment”, by force account as provided in Section 1-09.6, includes the labor, equipment, and materials to setup and apply the chemical(s) to the well, circulate and disperse it within the well, remove or neutralize it, and measure its concentration within the well. This item also includes removal of debris, and sounding of well depth upon completion of the treatment. This item does not include chlorine, chlorinated compounds, or similar chemical treatments for the purpose of well disinfection as described in Section 7-23.3(15).

“Pump Installation”, per each includes the successful installation of a pump, motor, sounding tubes, and all other equipment and materials to provide a complete and operating well pump. It also includes the labor, equipment, and materials to seal the well shut after completion of rehabilitation, when there is a delay in acquiring pump and materials. Installation of the Contractor-supplied temporary pump is included in the Contractor-supplied temporary pump item and is not part of this item. Additional

installations of the pump beyond the first installation shall be at the Contractor's expense, unless directed by the City. Failed attempts to install a pump due to equipment failure or operator error shall be at the Contractor's expense. Failed attempts to install the pump due to damage to the pump caused by improper storage of the pump shall be at the Contractor's expense. Equipment and fittings damaged due to Contractor error, failure of the Contractor's equipment, or improper storage shall be replaced by the Contractor at the Contractor's cost.

"Well Disinfection", per each includes well disinfection, purging, and dechlorination. It shall be considered a single item measured per each successful disinfection of a well. Disinfection shall be considered successful if laboratory analysis of post-disinfection bacterial samples taken per Section 7-26.3(16) are free of bacterial contamination. Post-disinfection bacterial sampling and tests completed by the City are not pay items.

"Standby Time" per hour shall be measured for only that part of a regular 8-hour shift during which the Contractor is directed by the Hydrogeologist or the City to suspend work.

8-01 EROSION CONTROL AND WATER POLLUTION CONTROL

8-01.3 Construction Requirements

8-01.3(1) General

[\(May 28, 2020 WSDOT GSP\)](#)

Section 8-01.3(1) is supplemented with the following:

The Contractor shall identify the ESC Lead at the preconstruction discussions and in the TESC Plan. The ESC Lead shall have, for the life of the Contract, a current Certificate of Training in Construction Site Erosion and Sediment Control from a course approved by the Washington State Department of Ecology. The ESC Lead must be onsite or on call at all times throughout construction. The ESC Lead shall be listed on the Emergency Contact List required under Section 1-05.13(1).

The ESC Lead shall implement the TESC Plan. Implementation shall include, but is not limited to:

1. Installing, adaptively managing, and maintaining temporary erosion and sediment control BMPs to assure continued performance of their intended function. Damaged or inadequate BMPs shall be corrected immediately.
2. Updating the TESC Plan to reflect current field conditions.
3. Inspecting and reporting on all areas disturbed by construction activities, all on-site erosion and sediment control BMPs, and all storm water discharge points every calendar week and within 24 hours of runoff events in which storm water discharges from the site or as directed by the Engineer.
4. Submit to the Engineer no later than the end of the next working day following the inspection a TESC Inspection Report that includes:
 - a. When, where, and how BMPs were installed, maintained, modified, and removed.
 - b. Observations of BMP effectiveness and proper placement.

c. Recommendations for improving future BMP performance with upgraded or replacement BMPs when inspections reveal TESC BMP deficiencies.

d. Identify for each discharge point location whether there is compliance with state water quality standards in WAC 173-201A for turbidity and pH.

Inspection of temporarily stabilized, or inactive sites may be reduced to once every calendar month if allowed by the Engineer.

8-01.3(9)A2 Silt Fence

(October 16, 2014 Lacey GSP)

Supplement this section with the following:

If the Engineer determines that site conditions dictate additional silt fence throughout the duration of the project, the Contractor shall immediately install additional silt fence as directed by the Engineer.

8-01.3(9)D Inlet Protection

(November 20, 2020 Lacey GSP)

Delete the first paragraph and replace with the following:

All catch basins and inlets within 500 ft of the project limits, downstream or affected by construction activities shall have inlet protection and as required by the Engineer. Inlet protection devices shall be installed prior to beginning clearing, grubbing, or earthwork activities.

8-01.4 Measurement

(April 30, 2015 Lacey GSP)

Supplement this section with the following:

All items required for erosion control shall be included in the lump sum bid item "Erosion/Water Pollution Control" unless a specific bid item is included in the proposal.

Modify this section with the following:

No specific unit of measure shall apply to the lump sum item "ESC Lead"

8-01.5 Payment

(November 20, 2020 Lacey GSP)

Modify this section with the following:

"Silt Fence", per linear foot.

"High Visibility Silt Fence", per linear foot

The unit contract price per linear foot shall be full pay for all equipment, labor and materials to install, maintain, remove and dispose of the silt fence as shown in the Plans and as directed by the Engineer.

The lump sum contract price for "ESC Lead" shall be full compensation for all labor, material, tools, and equipment necessary to meet the requirements of Section 8-01.3(1)B to include conduct site inspections, stormwater sampling, report preparation, report submittal, lab work, and personnel certification.

Delete "Erosion/Water Pollution Control", by force account and add the following bid item:

“Erosion/Water Pollution Control”, lump sum.

The lump sum contract price for “Erosion/Water Pollution Control” shall be full compensation for all labor, material, and equipment necessary to implement, install, maintain and remove all erosion and water pollution control items including removal and disposal of sediment, stabilization and rehabilitation of soil disturbed by these activities, and any additional Work deemed necessary by the Engineer to control erosion and water pollution. The requirements for the ESC Lead shall also be included in this lump sum bid item if no bid item is included in the proposal. The Contractor shall bear full responsibility for erosion/water pollution control in all sources of material, disposal sites, and haul roads.

8-02 ROADSIDE RESTORATION

8-02.3(4) Topsoil

[\(November 20, 2020 Lacey GSP\)](#)

Supplement this section with the following:

The Contractor shall thoroughly scarify the subgrade by tilling, disking or harrowing after the subgrade elevation has been established as indicated on the Plans. If the construction includes a roundabout, the Contractor shall scarify the existing subgrade a minimum of 24 inches deep in the center island of the roundabout to break up the base material of the existing road prior to installation of the topsoil.

Topsoil shall be placed at 12” depth in planter strips, and 18” depth in medians, and a minimum of 42” inches below the top of curb in the roundabout island unless otherwise shown in the Plans.

Final grading shall include raking, floating, dragging, and rolling to remove all surface irregularities and to provide a firm, smooth surface with positive drainage. Imported topsoil shall not be placed more than 3 days prior to permanent seeding.

8-02.3(5) Roadside Seeding, Lawn and Planting Area Preparation

[\(November 20, 2020 Lacey GSP\)](#)

Section 8-02.3(5) is supplemented with the following:

Planting area preparation will be required in all landscaped areas. Planting area preparation shall include removal of existing vegetation, construction debris, all visible rocks or other detrimental material from planter strips located within the project limits before adding soil amendments to the imported topsoil for the roadside planting areas, uniformly tilling the soil amendments into the top 8”-12” of soil, using a rototiller or similar machine, grading the blended soils, and then thoroughly watering down.

Planting area preparation in the roadside includes preserving and protecting existing trees. Where noted on plan, Engineer shall identify and mark existing trees to be saved. Following marking, Contractor shall provide and place Engineer approved high visibility orange plastic fence around critical root zones of each marked tree or tree groupings. Do not begin construction activity on the roadsides until all plastic mesh fencing is in place, and approved by the Engineer.

Identify existing trees that are to be removed, that were not removed during roadway construction, prior to starting planting. Obtain approval to remove existing trees from Engineer. Contractor to provide, install and maintain tree protection throughout project duration.

All planting area preparation shall be conducted under favorable weather conditions only. Soil shall not be worked when excessively dry or wet. Engineer reserves the right to stop any work taking place when conditions are considered detrimental to soil structure or plant growth.

All planting areas shall be weed free and approved by the Engineer before starting rototilling (with soil amendments distributed over designated surface areas) and after rototilling has been completed. All beds shall then be approved by the Engineer for fine grading, before starting any planting operations.

All planting surface areas shall be left with a firm, uniform surface, free of weeds and undulations or other irregularities. Remove all rocks, clods, and debris from all planting surfaces, unless otherwise specified on the plans or directed by the Engineer.

Preliminary grading shall be done in such a manner as to anticipate the finished grades after placement of topsoil, soil amendments and bark mulch (if specified). Excess soil shall be removed or redistributed before application of soil mix, fertilizer, and mulch. Where soil is to be replaced by plants and mulch, allowance shall be made so that when finish grading has begun, there shall be no deficiency in the specified depth of mulched planting beds.

The Contractor shall bear final responsibility for proper surface drainage of the site and the features thereon. Any discrepancy in the drawings or specifications, obstructions on the site, or prior work done by another party which the Contractor feels precludes establishing proper drainage, shall be brought immediately to the attention of the Engineer in writing for correction or relief of said responsibility.

8-02.3(7) Layout of Planting, Lawn and Seeding Areas **(January 3, 2017 Lacey GSP)**

Delete this section and replace with the following:

All location layout and staking will be the responsibility of the Contractor.

Tree and plant locations shown shall be considered approximate unless otherwise noted or shown with specific distance. Tree locations may be adjusted, with prior Engineer approval, so that the tree does not interfere with sightline requirements, street signs, irrigation, overhead utilities, or any other apparatuses such as utilities.

Do not locate or plant any tree within 15 feet of a streetlight. Do not locate or plant any tree within 3 feet of a utility vault, 2.5 feet of back-of-sidewalks or back-of-curbs, and 15 feet of a fire hydrant.

In mixed planting areas, trees shall be planted first, followed by the larger shrubs, low shrubs, and then groundcover material.

The Contractor shall layout all trees and plants in the approximate location for approval by the Engineer. All coordination shall be done with the Engineer.

8-02.3(8) Planting **(March 3, 2022 Lacey GSP)**

Supplement this section with the following:

The Contractor shall make required field adjustments as directed by the Engineer without additional cost and to avoid obstructions. Plants not properly planted or temporarily heeled-in will be rejected and shall be removed from the site.

Maintenance shall begin following the installation of each plant and shall continue until project acceptance. Work includes, but is not limited to, watering, weeding, cultivating, tightening, and repairing guys, removal of dead materials, resetting plants to proper grades or upright positions and other operations necessary to ensure proper growth and survival of all plant material.

If it is discovered that Common horsetail (*Equisetum Arvense*) has been imported with plant material, the Contractor shall remove the tree or shrub in its entirety including the rootball and surrounding soil, and replace the tree or shrub in-kind.

Before excavation, plants to be installed shall be placed as indicated on Planting Plan. The Engineer shall check locations of all plants in the field and shall indicate the exact position before actual planting operation proceeds.

Set trees and shrubs in center of pits, plumb and straight. Plant at such a level that after settlement, the crown of the plant will be slightly above finish grade.

Set plants in backfill mixture to such depth that the top of the plant ball will be slightly above finished grade. Backfill the remainder of the hole and soak thoroughly. Water the backfill until saturated to the full depth of the hole.

A mound of earth shall be formed as directed around each tree and shrub so as to produce a shallow basin to retain water, the diameter to exceed the diameter of the root spread at planting. Plants shall be watered in place during and after backfilling.

Prune plants only at time of planting and according to standard horticultural practice to preserve the natural character of the plant. All pruning shall be done under supervision of Engineer. Remove all dead wood, suckers, and broken or badly bruised branches, unless plants are deemed to be unacceptable and rejected by the Engineer. Use only clean, sharp tools.

Immediately after planting operations are complete, all planting beds and plant pits shall be dressed off so as to achieve a neat and presentable appearance. Planting operations shall be identical for all plants to be planted. Refer to Plans, specifications and directions from Engineer.

If applicable, Contractor shall plant trees, shrubs, and groundcover material in non-irrigated areas between October 1, and January 31.

Plant bare root and live cutting material during winter dormancy (November 30 and February 1) unless otherwise directed by the Engineer. Install live cuttings the same day as harvest or cutting from parent material.

Notify the Engineer a minimum of 48-hours before beginning any roadside planting-related work.

8-02.3(9) Seeding, Fertilizing and Mulching **(November 20, 2020 Lacey GSP)**

Supplement this section with the following:

The Contractor shall provide water or irrigation to all seeded areas as often as conditions dictate depending on weather and soil conditions. Water will be provided as described in Section 2-07.

Seed shall be broadcast with approved hydraulic seeding equipment, in combination with wood cellulose fiber mulch, soil stabilizer and fertilizer distributed uniformly over designated areas. Half of seed shall be sown with sower moving in one direction, the other half with sower moving at right angles to first

sowing. Hydroseeding operator shall remove all seed mulch in its entirety from adjoining paving, structures and plants

Fertilizer shall be applied over the surface of plant basin. Install fertilizer tablets as specified.

All trees shall have an application of beneficial mycorrhizal fungi applied at time of planting in accordance with the manufacturer's recommendations.

8-02.3(9)A Dates For Application of Seed

(November 20, 2020 Lacey GSP)

Delete the second paragraph of this section and replace with the following:

In areas receiving automatic irrigation, seeding may occur between May 15 and September 1. Actual planting shall be performed only when weather and soil conditions are suitable and in accordance with locally accepted practice and/or approved by the Engineer.

8-02.4 Measurement

(April 4, 2016 Lacey GSP)

Supplement this section with the following:

Topsoil, compost and mulch will be measured by the cubic yard.

Tree stakes, fertilizer, headers, planting area preparation, planting area weed control, and tree protection will be incidental to the "unit costs" of plantings as specified.

The measurements for each plant will be made for the size and type of plant shown in the plans.

"Pond Liner" shall be measured per cubic yard.

8-02.5 Payment

(October 16, 2016 Lacey GSP)

This section with the following:

Payment will be per each for all plant bid items included in the bid proposal under the Botanical and Common Name for each plant. The unit contract price per each for each plant shall be for full compensation for all labor, material and equipment necessary to install and maintain all items as specified complete. Price shall also include but not be limited to preparation, delivery, planting, protecting, pruning, rebar ties, tree stakes, guying, wrapping, rubber tree tie, fertilizer, pre-emergent and post-emergent herbicides, and geotextile root control system as shown in the Plans.

Excavation for the roadside planting areas will be considered incidental to the bid item for topsoil placement.

The following bid items shall be full pay for furnishing all labor, materials, tools and equipment, necessary to scarify the subgrade, install, rake, remove debris such as rocks and organic material and shape the material as shown in the plans:

"Topsoil Type A", per cubic yard,
"Fine Compost", per cubic yard,
"Medium Compost", per cubic yard,

“Coarse Compost”, per cubic yard,
“Soil Amendment”, per cubic yard,
“Bark or Wood Chip Mulch” per cubic yard.

The unit contract price per acre for "Seeding, Fertilizing, and Mulching", shall be full compensation for all labor, material, tools and equipment necessary to place, protect, irrigate and maintain all items as specified.

The Contractor shall receive payment of 60 percent of the unit contract price, per acre, upon the completion of the initial hydroseeding. Payment shall be increased to 100 percent of the unit contract price, per acre, upon the point where the first mowing is required, as determined by the Engineer. All partial payments shall be limited to the actual area of weed free healthy vigorous growth.

Partial payments shall not constitute acceptance of the area, nor shall the ownership or title transfer to the Contracting Agency. Areas found not acceptable at any stage shall be rejected and replaced at the Contractor's expense. Previous partial payments made for areas rejected will be deducted from future payments due the Contractor.

8-04 CURBS, GUTTERS, AND SPILLWAYS

8-04.3 Construction Requirements

[\(October 16, 2009 Lacey GSP\)](#)

Supplement this section with the following:

This work shall be constructed as shown in the plans. Gutter Pans at catch basin grates shall meet WSDOT Standard Plan F-10.16-00 Cement Concrete Curb and Gutter Pan.

8-04.4 Measurement

[\(October 16, 2009 Lacey GSP\)](#)

Supplement this section with the following:

Cement concrete valley gutters will be measured per linear foot.
Modified cement concrete traffic curbs will be measured per linear foot.
Extruded Curb will be measured per linear foot.
Concrete Scupper shall be measured per each.

8-04.5 Payment

[\(October 16, 2009 Lacey GSP\)](#)

Supplement this section with the following:

“Cement Concrete Valley Gutter”, per linear foot.
“Modified Cement Concrete Traffic Curb”, per linear foot.
“Extruded Curb”, per linear foot.
“Concrete Scupper” shall be measured per each

The unit contract per linear foot price for shall be full pay for all labor, equipment and materials to construct the items in accordance with the Plans.

8-05 LAWN AND LANDSCAPE RESTORATION

(October 16, 2014 Lacey GSP)

Add the following new section:

8-05.1 Description

The Contractor shall take every precaution to preserve and protect existing lawn and landscape areas. Only those landscaped areas necessary for construction shall be disturbed. All lawn areas and landscaping damaged or removed shall be repaired as directed by the Engineer. Lawn areas damaged or removed shall be restored with sod as directed by the Engineer.

8-05.3 Construction Requirements

The Contractor shall repair any vegetation, fencing, culverts, ditch sections, or any other objects or structures that are not covered by a specific bid item. Restoration shall return anything damaged by construction to their original condition or to a condition superior to the original condition. The Contractor shall be responsible to evaluate the site prior to bidding this project to determine the areas to be affected by the particular construction method or machinery proposed to be used.

8-05.4 Measurement

No unit of measure shall apply to the lump sum price for Lawn and Landscape Restoration.

8-05.5 Payment

“Lawn and Landscape Restoration”, lump sum.

The lump sum contract price for “Lawn and Landscape Restoration” shall be full pay for all labor, materials, and equipment to restore the project site to condition equal to, or superior to the original condition.

If no bid item for “Lawn and Landscape Restoration” is included, any work described in this section shall be incidental to the project.

8-14 CEMENT CONCRETE SIDEWALKS

8-14.1 Description

(March 31, 2015 Lacey GSP)

Supplement this section with the following:

Where applicable in this section “concrete sidewalks” shall read “concrete sidewalks and driveways” unless a bid item is provided. Depth shall be as shown in the Plans. The minimum driveway depth shall be 6 inches. The Contractor shall match color, texture, and material of existing sidewalks and driveways.

All ADA requirements will be strictly enforced including ramps and slopes as shown in the plans. Sidewalk and Bus Pads shall not exceed 2% cross slope.

If a sign is to be installed in concrete, the Contractor shall place a breakaway sleeve in the concrete as shown on the Plans and as directed by the Engineer. The sleeve shall be cleared of all debris. The sign shall be installed by others.

8-14.4 Measurement

(April 2, 2018 Lacey GSP)

Supplement this section with the following:

Cement concrete sidewalks shall be measured by the square yard of finished surface outside of the ramp pay limits and will not include the surface area of the curb ramps (i.e. the sidewalk quantities indicated on the Plans are for informational purposes only and include the ramp area). Cement Concrete sidewalks shall include cement concrete bike ramps, and bus pads.

8-14.5 Payment

(April 2, 2018 Lacey GSP)

Supplement this section with the following:

The unit contract price for “Cement Conc. Sidewalk” per square yard shall be full pay for furnishing all materials, equipment, and labor to construct the sidewalk, and bus pads complete in-place, to include forms, and concrete. Further, the Contractor shall make all excavations including haul and disposal, regardless of depth required, for constructing the sidewalk to the lines and grades shown, and shall include all costs associated with maintaining pedestrian access through the construction area with crushed surfacing top course or other material as approved by the Engineer.

8-40 ARC FLASH STUDY

(February 14, 2023 Lacey GSP)

Add the following new section:

8-40.1 Description

(February 14, 2023 Lacey GSP)

This Work consists of a short circuit, protective device coordination, and arc flash hazard study per the requirements set forth in this specification for the following City of Lacey facility(ies):

1. *Insert facility name(s) and address(es)*


8-40.2 Materials

(February 14, 2023 Lacey GSP)

The Contractor shall provide arc flash labels for all equipment in the system. Provide two (2) labels per equipment/bus. The labels shall be 3” x 3.75” high-quality UV-resistant vinyl labels (white with orange warning strip and black letters) with self-adhesive backs conforming to ANSI-Z535. The labels shall be generated directly from the power system software utilized for the study. Labels shall include the following information:

1. Equipment name
2. Shock hazard (voltage)
3. Arc flash boundary
4. Incident energy
5. Available fault current
6. Protective device clearing time
7. Date analysis was performed
8. Name of the firm providing the analysis

An example label is provided below that demonstrates the above requirements.

 WARNING	
Arc Flash and Shock Risk	
Appropriate PPE Required	
480 VAC	Shock Hazard when cover is removed
65 in	Flash Hazard Boundary
9.35 cal/cm²	Flash Hazard at 18 in
Review NFPA 70E for recommended PPE	
20.23 kA	Available Fault Current
0.291 sec	Clearing Time
Analysis Performed: 06/11/2022	
Location: MOTOR CONTROL CENTER	

8-40.3 Construction Requirements

8-40.3(1) Arc Flash Study

(February 14, 2023 Lacey GSP)

The scope of the study shall encompass all new and existing electrical equipment at the facility.

Contractor shall hire a qualified and experienced firm to perform the arc flash study. The firm shall have performed at least five (5) prior, successful arc flash studies to be considered qualified to conduct the study.

An electrical arc flash hazard analysis shall be performed on the facility(ies) electrical system(s) to determine incident energy, arc flash protection boundaries, and required PPE for all electrical equipment in the facility. The calculations shall comply with NFPA 70E and IEEE-1584. The Contractor shall provide an electrical arc flash hazard analysis, including:

1. The development of an up-to-date electrical system one-line diagram and model to provide staff members with an accurate representation of the installed electrical system.
2. Short circuit and equipment duty study to verify that equipment is rated to safely handle short circuit currents without creating hazardous conditions.
3. Protective device coordination study and review to help ensure proper electrical system reliability and to determine if arc flash hazard energy levels can be reduced.
4. Arc flash hazard study to determine maximum incident energy levels, arc flash boundaries, and Personal Protective Equipment (PPE).
5. Arc flash hazard labeling displaying the worst-case arc hazard values for each equipment in the facility.

The study shall consist of the following:

1. Field data collection.

2. Data entry and system one-line modeling in commercially available power system software.
3. Short Circuit and equipment verification study.
4. Protective device coordination study.
5. Arc flash hazard study.
6. Detailed report and findings of the analysis.
7. Electronic copies of the Project Report and the System Modeling File.
8. Hard copy of the project report
9. Arc Flash Hazard Labels

8-40.3(1)A Software Requirements

(February 14, 2023 Lacey GSP)

The software shall provide complete integration of the one-line, database, short circuit, protective device coordination and arc flash functions. Software using separate short circuit, protective device coordination, time-current curves (TCC), or arc flash programs is not allowed. Spreadsheet calculations are not allowed. The purpose of this section is to ensure that the arc flash hazard calculations comply with NFPA 70E and IEEE-1584, and that the calculations are programmed with necessary requirements to help eliminate possible errors in the arc flash calculations.

1. Arc flash calculations shall be performed with enhanced IEEE-1584 equations, which eliminate voltage discontinuities and the non-conservative/average results of the standard equations. The purpose of this requirement is to ensure that the calculated incident energies are closer to actual test results ensuring a conservative calculation minimizing personnel risk.
2. Arc flash calculations shall be based on the fastest clearing upstream protective device protecting the equipment for single sources and the slowest upstream protective device for multiple sources. The calculations shall automatically compare all series and parallel upstream protective devices in the system to determine the fastest series device or a conservative parallel clearing time. The algorithm shall incorporate a traversing routine that can search back an unlimited number of buses/nodes and consider all series and parallel branches in the comparison to ensure accurate answers and to prevent hazards associated with incorrect results.
3. The power system software shall provide the following capabilities:
 - a. Calculates shock hazards, shock hazard boundaries, arc flash boundaries, incident energies, PPE requirements, etc. for power systems.
 - b. Program shall support creation of arc flash labels.
 - c. Program shall also have customizable output that includes one-line printing, text report creation, etc.
 - d. Program shall be Windows based and shall use Windows conventions.
 - e. Program shall be capable of being installed on standalone personal computers or on networked systems and shall be compatible with all systems operating on Windows 2000 or higher operating systems.
4. SKM Power Tools for Windows, EasyPower, and ETAP are the only acceptable software. Substitutions shall be submitted for approval.

The study shall comply with the following industry recognized standards and recommended practices.

1. IEEE Standard 141-1993, Recommended Practice for Electrical Power Distribution for Industrial Plants.
2. IEEE Standard 242-2001, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
3. IEEE Standard 399-1997, Recommended Practice for Industrial and Commercial Power Systems Analysis.
4. IEEE Standard 1584-2018, Guide for Performing Arc-Flash Hazard Calculations.
5. NFPA 70: National Electrical Code, latest edition.
6. NFPA 70E: Standard for Electrical Safety in the Workplace, latest edition.
7. Washington Administrative Code, 296-46B, latest revision.

8-40.3(1)B Data Collection **(February 14, 2023 Lacey GSP)**

The Contractor shall collect and furnish all equipment information and data as required by the study, including, but not limited to:

1. Motor nameplate information for all three-phase motors.
2. Transformer nameplate information for all three-phase transformers.
3. Standby generator manufacturer and model number for all standby generators.
4. Circuit breaker manufacturer, model number, and existing settings including trip unit size (if applicable) for all three-phase circuit breakers.
5. Overcurrent relay manufacturer, type, style, trip device, and actual settings for all overcurrent relays.
6. Fuse manufacturer and model number for all fuses for three-phase circuits.
7. Conductor size and length for all three-phase circuits.
8. Equipment interrupting current ratings.
9. All available electrical as-builts and record drawings.

The Contractor shall coordinate with the local utility or relevant electric service provider to obtain specific utility equipment information and fault current contribution at the facility. Equipment information and values shall be specific to the equipment installed at the facility. This information includes, but is not limited to:

1. Available fault current contribution at the primary side of the utility transformer:
 - a. Single line-to-ground short circuit current and X/R ratio
 - b. Three phase line-to-ground short circuit current and X/R ratio
2. Primary fuse size, manufacturer, and model number.
3. Utility transformer size, primary and secondary voltages, connection type, impedance, and X/R ratio.

The Contractor shall review and comply with all facility safety requirements while collecting on-site equipment information.

Equipment shall be visually inspected to collect the necessary nameplate data used in the analysis. The Contractor is responsible for visual verification of this data, including transformers, switchgear and breakers, relays, direct-acting trip units, etc. Data that may not be readily

accessible or may not have nameplate data such as conductors, busway, etc. shall be taken from drawings.

The City of Lacey shall provide qualified personnel to show the Contractor equipment location and to open all equipment doors, locks, etc. necessary to collect nameplate data.

8-40.3(1)C Modeling the Electrical System

(February 14, 2023 Lacey GSP)

1. The system model shall be developed using a commercially available, fully integrated software package that meets the performance specifications developed in this Section. To ensure compliance with the latest edition of NFPA 70E, ANSI, and IEEE Standards, and OSHA mandates, no exceptions or substitutions to the performance specification are allowed.
2. The system model shall be laid out in a single drawing/view and in a manner that provides for easy viewing of all analysis results.
3. All one-line symbols shall be evenly spaced to aid in ease of viewing.
4. Equipment names used in the modeling software shall be identical to the equipment and naming convention shown on the existing facility drawings and equipment unless conflicts exist. The Contractor shall bring all naming convention conflicts or deficiencies to the attention of City of Lacey staff members for clarification.
5. The facility may have multiple operating conditions, including, but not limited to, generation on/off, shutdown, bus-ties, start-up, emergency operation, etc. The Contractor shall discuss facility operation with City of Lacey staff to determine the normal operating modes of the system to be modeled.
6. Lumped motor groups for MCC's shall be modeled per IEEE standards using groups >50 Hp, and <50 Hp. Where motor list data is not available, single lumped groups may be modeled per IEEE-141.
7. Medium voltage motors greater than 1.0 kV shall be modeled individually on their respective buses including all protective phase and ground overcurrent relays and fuses.
8. All low voltage power circuit breaker (LVPCB), insulated case (ICCB), molded case (MCCB) and fuse data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.
9. All relay data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.
10. All overcurrent relay types for the distribution system shall be modeled on the one-line diagram to establish a complete and detailed system model where protective device data can be easily modified and updated by the facility and all data is available for a comprehensive protective device coordination study if required in the future.
11. All equipment modeling must have a corresponding one-line diagram symbol. This means that there can be no hidden database models. The purpose is for the facility to easily see all equipment, its associated data, to be able to link documents to the equipment as a data repository, etc.

12. All system modeling shall conform to accepted modeling practices as outlined in IEEE-399. The Contractor may provide more advanced modeling techniques where compliance with the specification is maintained.

(February 14, 2023 Lacey GSP)

1. A short circuit study shall be performed to verify all equipment duties in the system. The calculations shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The short circuit study shall verify the system electrical equipment is properly rated to withstand and interrupt the expected bolted and arcing faults in the system. Improperly rated and applied equipment may not protect personnel against arc flash hazards even if properly applied PPE is used. The software program must comply with the above standards in order to properly verify equipment installed in North America. No substitutions will be allowed.
2. The equipment duty verification shall determine both the line side and load side fault current through each equipment and use the highest current to verify equipment ratings. Standard bus faults are not acceptable for protective devices in that they do not accurately model the current through the device and consequently they provide erroneous results. For solidly grounded systems, both three-phase and single-line-to-ground faults shall be modeled. For other grounding configurations only a three-phase fault is required.
3. Equipment duty results shall be provided in tabular report format.
4. The results of the equipment duty verification tabular format report shall provide the following data:
 - a. Equipment name and kV
 - b. Manufacturer, type, style, and ratings of the device
 - c. Actual line or load side currents through the device
 - d. Flag for the device showing VIOLATION or WARNING level for visual identification

8-40.3(1)E Protective Device Coordination Study

(February 14, 2023 Lacey GSP)

A protective device coordination study shall be performed in order to determine if the system protection characteristics are sufficient to provide reliable power to the facility. The protective device coordination study will also determine if the existing settings entered in the software will provide proper personnel protection in the arc flash portion of this study. For facilities where the main distribution is low voltage (under 600 volts) and only instantaneous breakers or fuses are used, this section may not apply.

The protective device coordination study shall consist of selecting major system feeders and plotting the TCCs to verify proper selective operation of the protective devices. The study shall also determine if the settings can be enhanced to provide increased personnel/equipment protection without sacrificing selective coordination. The Contractor shall determine in conjunction with City of Lacey staff the systems to be studied. It is expected that the protective device coordination include all substation equipment and major distribution and major equipment feeders.

The Contractor shall notify City of Lacey staff of any potential problems in the protective device settings that affect either selective operation and reliability or personnel protection and shall provide recommendations for changes to the settings in writing before continuing with the study. City of Lacey staff may then opt to utilize existing settings or to change the settings before continuing with the arc flash study.

The Contractor shall contact the serving utility and obtain protective device settings for all service entrance overcurrent devices in series with the facility and affecting coordination with the facility's distribution system.

TCC Specifics: The TCCs shall graphically illustrate on log-log paper that adequate time separation exists between series devices. The specific time current characteristics of each protective device shall be plotted in such a manner that sufficient upstream devices will be clearly depicted on one sheet to prove selective coordination.

1. TCCs shall include protective device coordination curves for each device in the selected area. The TCC shall be printed in color on 8 ½ x 11" paper – full size portrait mode, using a log-log scale.
2. For low voltage systems, TCCs shall be developed for both phase and ground protective devices. The TCC shall show the largest feeder/motor protective device in the MCC or panel up through the switchgear/switchboard feeder breaker, transformer secondary main, and utility primary fuse. For secondary switchboards serving large loads or a wide variety of loads that may affect upstream coordination, additional TCCs may be required.
3. The following specific information shall also be shown on the TCCs:
 - a. Device identification.
 - b. Voltage and current ratio for curves.
 - c. Transformer three phase and single-line-to-ground ANSI damage curves.
 - d. Transformer inrush points.
 - e. Minimum melting and clearing curves for fuses.
 - f. Motor starting locked rotor curves, and if available the motor locked rotor damage point.
 - g. Each protective device curve shall be terminated at a point reflecting maximum symmetrical or asymmetrical fault current through the device.
 - h. Identify the device associated with each curve by manufacturer type, function, and setting – i.e. tap, time delay, and instantaneous, pickup, etc.

A setting table shall be provided to summarize the settings for the protective devices. The table shall include the following:

1. Device identification.
2. For low voltage breakers, the circuit breaker manufacturer, type and style, long time, short time, instantaneous settings, time bands, and any other settings. For breakers with ground fault capability, the pickup and time delay.
3. Protective relay manufacturer, type, style, function (51, 50, 67, etc.) pickup, current multiplier, time dial, and delay. For multi-function units, list all devices being used. Include the CT and/or PT ratios for each function.

The software shall provide complete integration of the one-line, database, short circuit, protective device coordination and arc flash analysis functions to provide accurate calculations and avoid errors and inefficiencies associated with multiple data entry programs. Programs using separate protective device coordination or TCC plotting packages are not allowed. Complete protective device coordination integration is defined as the following:

1. TCCs shall be developed by simply selecting (highlighting) with the mouse the one-line area to be coordinated. The TCC shall automatically be plotted for the selected area.

2. Programs requiring the user to build a separate TCC one-line are not integral with system short circuit calculations and do not automatically update as the system one-line changes, requiring additional one-line development and are consequently prone to errors as the system changes. These types of programs shall not be considered for the study.
3. The software model shall provide a detailed library for the most common protective devices available in North America. The library shall be user definable.

8-40.3(1)F Arc Flash Study **(February 14, 2023 Lacey GSP)**

A detailed arc flash study shall be performed to determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protective equipment (PPE) for all energized electrical system equipment tasks for the electrical system studied. The calculations shall comply with the latest edition of NFPA 70E and IEEE-1584. Bolted short circuit calculations used in the above standards shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The purpose of this study is to determine arc flash hazards in conformance with NFPA 70E. The software program used in this study shall comply with the above standards. No substitutions in calculation methods will be allowed.

The arc flash study shall determine the following results the system. The results shall be provided in spreadsheet format. The spreadsheet results table shall be capable of providing its output directly to arc flash hazard labels. The spreadsheet results shall include:

1. Equipment name and voltage.
2. Upstream equipment device name
3. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current shall be based on the arcing current equations used.
4. Trip time, opening time, and total clearing time of the protective device.
5. Working distance in accordance with voltage class as defined by NFPA 70E.
6. Arc flash boundary for each bus/equipment in the model.
7. Arc flash hazard incident energy in cal/cm² for each bus/equipment in the model.

8-40.3(1)G Reporting and Analysis Study **(February 14, 2023 Lacey GSP)**

Provide a detailed written report that includes the following:

1. Introduction.
2. Methodology.
3. Facility Description.
4. Key Assumptions.
5. Short Circuit Study, including utility contribution information and fault current results in table format at all equipment buses.
6. Protective Device Coordination Study
7. Arc Flash Hazard Study, including the results of Arc flash Hazard Analysis.
8. Overcurrent Protective Device Recommended Settings implemented in the study to reduce arc flash hazard exposure. Overcurrent protective device settings that differ from the observed settings of existing equipment shall be specifically identified so that the existing settings shall be changed in order to validate the study.

9. Project One-Line Diagram showing the complete electrical system used in the Study.
10. Time-Current Characteristic Curves
11. Input Data Summary generated directly from the power system software utilized for the study.
12. Short Circuit Study results generated directly from the power system software utilized for the study.
13. Images of all labels.

8-40.3(1)H Deliverables

(February 14, 2023 Lacey GSP)

1. One (1) printed copy of the completed study report shall be provided in addition to an electronic version in Portable Document Format (PDF).
2. Arc Flash Hazard Labels in accordance with these specification requirements.

8-40.4 Measurement

(February 14, 2023 Lacey GSP)

“Arc Flash Study”, shall be measured per each.

8-40.5 Payment

(February 14, 2023 Lacey GSP)

“Arc Flash Study”, per each includes the labor, equipment, and materials required to perform one arc flash study based on the IEEE, NFPA, and Washington Administrative Code standards listed in these specifications and prepare an Arc Flash Study report. Contractor shall furnish two (2) arc flash labels per equipment/bus.

8-50 MISCELLANEOUS

Add the following new sections:

8-50.2 PROJECT CLOSEOUT

(April 2, 2018 Lacey GSP)

Description

This work shall consist of completing all miscellaneous items of work in accordance with the Plans and these Specifications that are required to achieve Completion and Final Acceptance, as identified by the Engineer and the Contracting Agency. This work may include but is not limited to punch list items, record drawings, O&M Manuals, training, material acceptance documents, copies of the approved “Affidavit of Prevailing Wages Paid” for the Contractor and all Subcontractors, and any other work required in these Plans and Specifications that has not been completed.

Measurement

No unit of measurement shall apply to the lump sum price for “Project Closeout”.

Payment

“Project Closeout”, lump sum.

The unit contract price per lump sum for “Project Closeout” includes all compensation for all costs of completing the miscellaneous items of work identified by the Contracting Agency prior to final acceptance of the Project. A fixed lump sum price has been included in the Proposal for this work. Any additional costs anticipated or incurred by the Contractor for the work shall be included in the various lump sum and unit price bid items as found in the Proposal. Neither partial payment, nor additional compensation shall be allowed

8-50.3 ARC FLASH TESTING

(*****)

Description

This work shall consist of completing all required testing and labeling of work in accordance with the Plans and these Specifications.

Arc Flash Study, Protection Device Coordination and Short Circuit Analysis

Provide the services of a recognized independent testing laboratory or coordination analysis consultant for the proper system coordination of the protective devices furnished on this project. Submit the name and the qualifications of the laboratory or consultant for review by the Engineer; qualifications must include professional registration of proposed personnel as electrical engineers.

The protective device on the line side closest to the fault or abnormal conditions shall isolate the problem portion of the system and minimize damage in that portion. The rest of the system shall be maintained in normal service. The coordination shall be in conformance with the recommendations of latest IEEE Standard 242.

Provide an Arc Flash Hazard Study for the electrical distribution system shown on the Plans. The intent of the Arc Flash Hazard Study is to determine hazards that exist at each major piece of electrical equipment shown on the one line diagrams. This includes switchgear, switchboards, panelboards, motor control centers, generators, transfer switches, and transformers. The study will include creation of Arc Flash Hazard Warning Labels listing all items as required in NFPA 70E-2018. These labels serve as a guide to assist technicians and others in the selection of proper Personal Protective Equipment when working around exposed and energized conductors. The electrical contractor will install the labels. The arc flash hazard study shall consider all operating scenarios during normal conditions alternate operations, emergency power conditions, and any other operations, which could result in maximum arc flash hazard. The label shall list the maximum incidental energy calculated and the Scenario number and description on the label.

Submit the analysis that shall include arc flash, impedance, and short circuit calculations, list of any assumptions made and the analysis, the recommended settings of the protective devices, and the system time/current characteristic curves. The submittal shall be completed and submitted in conjunction with the circuit breaker submittal to allow time for review and re-submittal, if necessary, before the implementation of final settings and adjustments by the testing laboratory.

Measurement

No unit of measurement shall apply to the lump sum price for “Arc Flash Study and Labeling”.

Payment

The lump sum contract price for “Arc Flash Study and Labeling” shall be full compensation for all labor, tools, equipment, and materials necessary to comply with the requirements stated above.

9-03 AGGREGATES

Add the following new Section:

9-03.16 Imported Pipe Bedding

(April 30, 2015 Lacey)

Bedding material for pressure mains and services shall be clean sand/gravel mixture free from organic matter and conforming to the following gradation:

Sieve Size	Percent Passing
3/4" square	100
3/8" square	70-100
U.S. No. 4	55-100
U.S. No. 10	35-95
U.S. No. 20	20-80
U.S. No. 40	10-55
U.S. No. 100	0-10
U.S. No. 200	0-3

Bedding material for gravity mains and stubs/or laterals shall be clean sand/gravel mixture free from organic matter and conforming to the following gradation:

Sieve Size	Percent Passing
3/8" square	85-100
U.S. No. 4	10-30
U.S. No. 8	0-10
U.S. No. 16	0-5

All percentages are by weight

9-03.21 Recycled Materials

(April 30, 2015 Lacey)

Section 9-03.21 is supplemented with the following:

Recycled materials will not be used unless approved by the Engineer.

9-14 EROSION CONTROL AND ROADSIDE PLANTING

9-14.2(1) Topsoil Type A

(March 3, 2022 Lacey GSP)

Supplement this section with the following:

Topsoil Type A shall be composed of a three way winter mix consisting of 2 parts soil, 2 parts compost, 3 parts sand.

Soil shall be classified as gravelly sand, well-graded sand, poorly graded sand, or silty sand.

Compost shall be a weed free well decomposed, humus-like material derived from the decomposition of grass clippings, leaves, branches, wood, and other organic materials. Compost shall be produced at a permitted solid waste composting facility. Composts containing shavings, cedar sawdust, or straw will not be permitted.

Sand shall consist of 100 percent passing the 3/8 inch sieve, minimum 95 percent passing the #4 sieve, and maximum of 5 percent passing the #100 sieve.

Topsoil shall meet the following requirements:

Screen Size (approximate particle size)	5/8" maximum
Maturity measure (C:N ratio)	30:1
Total Nitrogen	0.5% minimum
PH range	5.5-8.0
Foreign matter by dry weight	1% maximum

The Contractor shall provide a sample of the topsoil and a laboratory analysis with recommendations from the laboratory for desired additives for the Engineers approval. The Contractor shall incorporate any additives recommended by the laboratory.

9-14.2 Seed

[\(November 20, 2020 Lacey\)](#)

Supplement this section with the following:

There shall be several types of mixes used on this project. The list of approved seed varieties are specifically identified list below. They shall be applied at the given rates. Source identified seed shall be fourth generation or earlier. Non-Source Identified seed shall meet or exceed Washington State Department of Agriculture Certified Seed Standards. Seeds shall be certified "Weed Free", indicating there are no noxious or nuisance weeds in the seed.

Lawn Mix - shall be applied at 200 pounds per acre and the maximum weed seed shall be no more than 0.5%. Grass seed of the following composition, proportion, and quality shall be applied as follows:

Kind and Variety of Seed	Percent By Weight	Minimum Pure Seed	Minimum Germination
Equal Mix 3-Perennial Ryegrasses	60%	98%	90%
One Chewing Fine Fescue	20%	98%	90%
One Creeping Red Fescue	20%	98%	90%

Approved Seed Type:

Perennial Ryegrasses

Fiesta 4	Manhattan 5	Grand Slam GLD	Karma
SR 4650	Karma	Banfield	Sideways
Thrive	Wicked	Pavilion	Dasher 3
Tetradark			

Creeping Red Fescue

Salsa	Cindy	Jasper	Salem
Chewing Fescue			
Tiffany	Shadow II	Treazure E	Longfellow
Weekend	Tamara	Enjoy	Victory

9-14.3 Fertilizer

(October 16, 2009 Lacey)

Supplement this section with the following:

Fertilizer for seeded areas shall be 1 pound nitrogen from ammonium sulfate, 0.5 pound water insoluble organic nitrogen, 2 pounds of phosphorous, and 2 pounds of potassium per 1,000 square feet, or a 10-20-20 turf fertilizer mix at 435 pounds per acre with 60 pounds of water insoluble organic nitrogen per acre.

Fertilizer for Trees and Shrubs shall be granular, tablet, or spikes applied at a rate recommended by the manufacturer for the size of the plant or as directed by the Engineer. Fertilizer shall be a 20-10-5 plant mix with 7% water soluble organic nitrogen and 13% water insoluble organic nitrogen or as approved by the Engineer.

Mycorrhizal fungi amendment shall be applied to all trees at a rate recommended by the manufacturer for the size of the tree.

9-14.5(3) Bark or Wood Chip Mulch

(November 20, 2020 Lacey GSP)

Supplement this section with the following:

Bark mulch shall be a pathogen-free medium-grind Hemlock or Douglas Fir bark mulch. The Contractor shall submit a sample to the Engineer for approval prior to use.

9-14.6(8) Sod

(October 16, 2009 Lacey)

Supplement this section with the following:

Sod shall be high quality commercial turf produced on a commercial turf farm. The turf farm shall be registered with the American Sod Producers Association. Turf shall closely match texture and color of existing turf to be repaired.

TRAFFIC CONTROL PLANS

E TECHNICAL SPECIFICATIONS

CERTIFICATION

The technical material and data contained in Division 1 through Division 16 of the Technical Specifications in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

Divisions 1 through 15



Keith Stewart, P.E. Gray & Osborne, Inc.

Division 16



Jason Newquist, P.E. Gray & Osborne, Inc.

TECHNICAL SPECIFICATIONS

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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

<u>Section</u>	<u>Item</u>
03300	Reinforced Concrete

1.3 PAYMENT

All testing as required by this Section shall be coordinated and scheduled by the Contractor with the Owner's designated testing agency. The Owner will contract with, and pay for, a testing agency to conduct all field and laboratory tests and special inspections as designated herein.

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. Costs for retesting (beyond that which is required herein) will be reimbursed to the Owner in the form of a credit on a change order at the time of project acceptance.

All costs for scheduling, sampling, coordinating, and retesting of defective work shall be considered as incidental to the work and merged into the respective unit and lump sum prices bid.

PART 2 PRODUCTS

2.1 SOILS 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 D1556 – Density and Unit Weight of Soil in Place by the Sand Cone Method

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

2.2 AGGREGATES

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

<u>Title</u>	<u>Test Method</u>
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

2.3 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.

2.4 HOT MIX ASPHALT

Paving asphalt shall be tested in accordance with the current version of WSDOT Standard Specification Section 9-02.

PART 3 EXECUTION

3.1 SAMPLING AND TESTING FREQUENCY

A. GENERAL

The Contractor shall be responsible for the coordination and scheduling of a certified independent testing laboratory employed by the Owner to provide the following quality control tests at the number and frequency described herein. 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 recompact and retested at the Contractor's expense, until a successful density test indicating compliance with these Specifications has been achieved.

B. SOIL TESTING

The Contractor shall schedule and coordinate with the Owner-employed independent testing laboratory to conduct the following quality control tests at the given frequency:

<u>Material</u>	<u>Test</u>	<u>Minimum Sampling & Testing Frequency</u>
Backfill for foundations, walls, trenches and roads ¹	Gradation	One for every 500 cy or one per day, whichever is more frequent, 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.

<u>Material</u>	<u>Test</u>	<u>Minimum Sampling & Testing Frequency</u>
	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 ¹	Gradation	One every 750 feet of trench.
Subgrade and Fills ¹	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. HOT MIX ASPHALT TESTING FREQUENCY

The Contractor shall schedule and coordinate with the Owner-employed testing laboratory to conduct the following quality control tests at the stated frequency:

Material	Test	Minimum Sampling & Testing Frequency
Commercial HMA	Rice Density	1 – Per project.
Commercial HMA	Compaction ⁽¹⁾	1 – Per 100 TN. ⁽²⁾

- (1) All acceptance tests shall be conducted from in place samples.
- (2) Hot mix asphalt aggregate tests are not required.

D. 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 Owner-employed testing laboratory scheduled and coordinated 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:

<u>Material</u>	<u>Test</u>	<u>Minimum Sampling & Testing Frequency</u>
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).

<u>Material</u>	<u>Test</u>	<u>Minimum Sampling & Testing Frequency</u>
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.
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. Cylinders shall be 4 inch by 8 inch. 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.

E. SPECIAL INSPECTIONS

Contractor shall coordinate and schedule all required Special Inspections per WABO requirements (Chapter 17 of the IBC) with the Owner designated testing agency. Special inspections include cast-in-place concrete, concrete reinforcement, and compaction testing.

***** 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 Section D as well as Divisions 15 and 16 for additional testing requirements.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
01400	Quality Control
15050	Piping Systems
15400	Plumbing
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 Section 15400. 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 their 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 their inspection. Should the Engineer find, in their 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. Pre-operation 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 their 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 21 calendar 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 mode handling groundwater. 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

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.

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 FACILITIES 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.

3.4 FACILITY OPERATIONAL TESTING

The systems described below shall be tested to demonstrate the performance of mechanical, electrical, instrumentation and control subsystems together as an integrated system. Where the testing described in this Section conflicts with the testing requirements specified for individual equipment, or the manufacturer's recommended testing procedure, those requirements and procedures shall prevail.

Unless otherwise noted, each portion of the facility being operationally tested must perform through its complete design range for a period of 7 consecutive 24-hour days. Temporary facilities necessary for operational testing are specified in Paragraph 2.2 of this Section and in Section 01500.

Testing of the liquid stream systems shall include, but not be limited to the well and all associated suction and discharge piping. Furthermore, testing shall include all smaller diameter, ancillary support piping needed for full and complete operation of the facility.

***** 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.

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
Division 15	Equipment

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 saved for pickup by the Owner at the project location.

Reuse of salvageable equipment and material by the Contractor will not be permitted except where specifically indicated on the Plans and in the 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 shall be disposed of away from the site without additional cost to the Owner.

The Contractor shall meet with the Owner prior to initiating demolition to identify all equipment to be salvaged to the Owner. At a minimum, the following equipment shall be salvaged to the Owner.

- Existing chemical metering pump skid
- Existing well pump motor

The Contractor shall also note that select equipment will be removed and reinstalled as part of the Work. At a minimum, this includes the following.

- Existing pressure transducer and associated cable(s).

The Contractor shall coordinate with the Owner prior to project initiation to identify all equipment to be salvaged and/or reinstalled.

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, unless noted otherwise on the Plans. 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 02530

UTILITY STRUCTURES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes precast concrete vaults for a complete installation as shown on the Plans and specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
08310	Metal 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 cementitious 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.

2.3 PRECAST CONCRETE CATCH BASINS

Precast components shall conform to the requirements of ASTM C478. All Portland cement used in the manufacture of the precast sections shall conform to the requirements of ASTM C150 and shall be Type II or Type V.

Thickness of a Type 1 catch basin shall be 4 inches minimum and reinforced with welded wire fabric having a minimum area of 0.12 square inches per foot.

Welded wire fabric shall comply with ASTM A497. “Knockouts” shall be free of welded wire fabric and provided on four sides to accommodate the pipe size, invert elevations, and direction as shown on the Plans.

Standard precast riser sections shall consist of rectangular sections to accommodate a Type 1 catch basin. Reinforcement shall be in accordance with ASTM C497. Minimum height of a riser section shall be 6 inches. The height of riser and base sections shall be arranged so no pipes pass through the joining surfaces.

Precast base sections for Type 2 catch basins shall conform to the requirements for precast riser sections. The base shall be a minimum of 6-inches thick underneath the pipe invert.

Catch basins Type 2 shall contain steps. Steps shall be made of a copolymer polypropylene, superior in its resistance to corrosion, meeting the requirements of ASTM D4101 Type II, Grade 16906, and shall completely encapsulate a deformed 1/2-inch steel reinforcing rod conforming to ASTM A615, Grade 60. Steps shall be factory installed in complete accordance with the manufacturer’s instructions. This shall be accomplished by predrilling two parallel 1-inch holes, 3-3/4-inch deep, and 13-inches on center in the cured concrete base, riser, and taper sections of the manhole. The insertion ends of the step shall be fully coated with non-shrink epoxy grout then driven into the holes to the prescribed depth. In no case will the predrilled hole be allowed to penetrate through the wall of the basin. Steps shall be Lane International Corporation Manhole Step or equal.

Standard precast riser sections shall consist of circular sections in standard nominal inside diameter as shown on the Plans. Reinforcement shall be in accordance with ASTM C478. Minimum height of a riser section shall be 1 foot. The height of riser and base sections shall be arranged so no pipes pass through the joining surfaces.

Openings for pipe shall be circular, tapered toward the inside of the section, and shall be of the minimum size possible to accommodate the size of pipe to be inserted and to effectively seal the joint.

2.4 FRAMES AND GRATES

Frames and grates shall be as follows, unless otherwise noted in Section D or the Plans.

Castings for catch basin and inlet frames shall be gray-iron conforming to the requirements of ASTM A48/AASHTO M105, Grade 30B. Grates or solid covers shall be ductile iron conforming to ASTM A536, Grade 80-55-06. All frames and grates or covers shall be of uniform quality, free from blowholes, porosity,

shrinkage, distortion, cracks, or other defects. Repair of defects shall not be permitted. All mating surfaces shall be seated properly to prevent rocking of the grate/cover. The frames, grates, and covers shall have a design wheel load conforming to AASHTO/ASTM A16 design loading HS20-44.

The frames and grates/covers shall be made by East Jordan Iron Works, Olympic Foundry, Inc., D&L Foundry, or Neenah.

2.5 GASKETS AND MANHOLE ADAPTERS

Rubber gaskets shall conform to Section 9-04.4 of the WSDOT Standard Specifications. Pipe connections to existing manholes shall be made using a heavy duty sand collar with gasket, head, or equal. Pipe connections to new manholes or vaults shall utilize an adaptor coupling with gasket or watertight flexible rubber boot, Kor-n-Seal or equal. The Contractor shall provide Kor-n-Seal cavity O-rings to fill the annular spaces between the pipe and the manhole or vault wall.

2.6 ACCESS HATCHES

The access hatches shall be as specified in Section 08310.

2.7 ACCESS LADDERS

Access ladders and all associated safety devices shall be as detailed on the Plans.

PART 3 EXECUTION

3.1 PRECAST VAULTS

Precast vaults shall be installed as shown on the Plans and in accordance with the manufacturer's recommendations.

3.2 CATCH BASINS

Catch basin installation shall be as shown on the Plans. Precast sections with damaged joint surfaces or with cracks or damage that would permit infiltration shall not be installed.

Precast base sections shall be set on a prepared bedding material. Before the precast base is set, the gravel shall be carefully leveled to provide full bearing for the entire base slab.

The frame shall be set carefully to the established surface grade in a full bed of cement grout. The catch basin rim elevation shall be set flush with the pavement or improved areas.

3.3 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 02740

HOT MIX ASPHALT PAVING

PART 1 GENERAL

1.1 SCOPE

The work in this section shall be accomplished in accordance with the Standard Specifications for Road, Bridge and Municipal Construction, current edition, as issued by the Washington State Department of Transportation (WSDOT) and the American Public Works Association (APWA), Washington State Chapter (hereafter "Standard Specifications"). Delete section 5-04 of the Standard Specifications, with the exception of 5-04.2(1), and replace it with the following:

The work specified in this Section includes providing and placing one or more layers of plant-mixed hot mix asphalt (HMA) on a prepared foundation or base in accordance with these Specifications and the lines, grades, thicknesses, and typical cross-sections shown in the Plans. The manufacture of HMA may include warm mix asphalt (WMA) processes in accordance with these Specifications. WMA processes include organic additives, chemical additives, and foaming.

This work also consists of adjusting castings to grade per the details in the Contract Plans.

HMA shall be composed of asphalt binder and mineral materials as may be required, mixed in the proportions specified to provide a homogeneous, stable, and workable mixture.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
01400	Quality Control

1.3 SUBMITTALS

A. MIX DESIGN – OBTAINING PROJECT APPROVAL

1. ESALs

The number of ESALs for the design and acceptance of the HMA shall be >0.3 to <3.0 million.

Commercial HMA shall be an HMA Cl. 1/2" PG 58H-22 design mix.

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S10 Generator, Well Pump, and Site Improvements

G&O #22625

02740-1 – Hot Mix Asphalt and
Asphalt Treated Base Paving

No paving shall begin prior to the approval of the mix design by the Engineer.

Commercial evaluation will be used for Commercial HMA and for other classes of HMA in the following applications: sidewalks, road approaches, ditches, slopes, paths, trails, gores, prelevel, and pavement repair. Other nonstructural applications of HMA accepted by commercial evaluation shall be as approved by the Project Engineer. Sampling and testing of HMA mixture accepted by commercial evaluation will be at the option of the Project Engineer.

Commercial Evaluation Mix Design Approval of a mix design for “Commercial Evaluation” will be based on a review of a Mix Design from the current WSDOT QPL. At the discretion of the Engineer, agencies may accept verified mix designs older than 12 months from the original verification date with a certification from the Contractor that the materials and sources are the same as those shown on the original mix design. Testing of the HMA by the Contracting Agency for mix design approval is not required.

Using Warm Mix Asphalt Processes. The Contractor may elect to use additives that reduce the optimum mixing temperature or serve as a compaction aid for producing HMA. Additives include organic additives, chemical additives and foaming processes. The use of Additives is subject to the following:

- Do not use additives that reduce the mixing temperature more than allowed in subsection 3.3 F. in the production of mixtures.
- Before using additives, obtain the Engineer’s approval using WSDOT Form 350-076 to describe the proposed additive and process.

PART 2 PRODUCTS

2.1 NOT USED

2.2 HMA PAVEMENT

HMA pavement, Commercial HMA, HMA Cl. 1/2" PG 58H-22.

A. MATERIALS

Materials shall meet the requirements of the following sections of the Standard Specifications:

Asphalt Binder	9-02.1(4)
Cationic Emulsified Asphalt	9-02.1(6)
Anti-Stripping Additive	9-02.4
HMA Additive	9-02.5
Aggregates	9-03.8
Recycled Asphalt Pavement	9-03.8(3)B
Mineral Filler	9-03.8(5)
Recycled Material	9-03.21
Portland Cement	9-01
Sand	9-03.1(2).
(As noted in subsection 3.3D.1. for crack sealing)	
Joint Sealant	9-04.2
Foam Backer Rod	9-04.2(3)A

The Contract documents may establish that the various mineral materials required for the manufacture of HMA will be furnished in whole or in part by the Contracting Agency. If the documents do not establish the furnishing of any of these mineral materials by the Contracting Agency, the Contractor shall be required to furnish such materials in the amounts required for the designated mix. Mineral materials include coarse and fine aggregates, and mineral filler.

The Contractor may choose to utilize recycled asphalt pavement (RAP) in the production of HMA. The RAP may be from pavements removed under the Contract, if any, or pavement material from an existing stockpile.

The Contractor may use up to 20 percent RAP by total weight of HMA. The asphalt content and gradation test data shall be reported to the Contracting Agency when submitting the mix design for approval on the QPL. The Contractor shall include the RAP as part of the mix design as defined in these Specifications.

The grade of asphalt binder shall be as required by the Contract. Blending of asphalt binder from different sources is not permitted.

The Contractor may only use warm mix asphalt (WMA) processes in the production of HMA with 20 percent or less RAP by total weight of HMA. The Contractor shall submit to the Engineer for approval the process that is proposed and how it will be used in the manufacture of HMA.

Production of aggregates shall comply with the requirements of Section 3-01 of the Standard Specifications.

Preparation of stockpile site, the stockpiling of aggregates, and the removal of aggregates from stockpiles shall comply with the requirements of Section 3-02 of the Standard Specifications.

B. HMA TOLERANCES AND ADJUSTMENTS

1. Job Mix Formula (JFM) Tolerances

After the JMF is determined as required in subsection 3.6A. The constituents of the mixture at the time of acceptance shall conform to the following tolerances:

Aggregate, percent passing	Commercial Evaluation
1", 3/4", 1/2", and 3/8" sieves	±8%
U.S. No. 4 sieve	±8%
U.S. No. 8 sieve	±8%
U.S. No. 200 sieve	±3.0%
Asphalt Binder	±0.7%

These tolerance limits constitute the allowable limits as described in Standard Specification Section 1-06.2. The tolerance limit for aggregate shall not exceed the limits of the control points section, except the tolerance limits for sieves designated as 100 percent passing will be 99-100. The tolerance limits on sieves shall only apply to sieves with control points.

PART 3 EXECUTION

3.1 GENERAL

Where paving occurs on a facility, the Contractor shall maintain access to the facility at all times. The Contractor shall provide 1-week notification to the Contracting Agency prior to paving and shall coordinate all work with the

Contracting Agency to ensure their paving plan does not interfere with the Contracting Agency's on-going operations.

When paving occurs on a roadway open to traffic, the requirements of subsection 3.3B. apply.

The Contractor shall provide, place and maintain all temporary markings and signage as required to warn and direct facility traffic as necessary during their paving operations.

3.2 NOT USED

3.3 HMA PLACEMENT

A. WEATHER LIMITATIONS

Do not place HMA for wearing course on any Traveled Way beginning October 1st through March 31st of the following year without written concurrence from the Engineer.

Do not place HMA on any wet surface, or when the average surface temperatures are less than those specified below, or when weather conditions otherwise prevent the proper handling or finishing of the HMA.

Minimum Surface Temperature for Paving

Compacted Thickness (Feet)	Wearing Course	Other Courses
Less than 0.10	55 degrees F	45 degrees F
0.10 to .20	45 degrees F	35 degrees F
More than 0.20	35 degrees F	35 degrees F

B. PAVING UNDER TRAFFIC

When the Roadway being paved is open to traffic, the requirements of this Section shall apply.

The Contractor shall keep intersections open to traffic at all times except when paving the intersection or paving across the intersection. During such time, and provided that there has been an advance warning to the public, the intersection may be closed for the minimum time required to place and compact the mixture. In hot weather, the Engineer may require the application of water to the pavement to accelerate the finish rolling of the pavement and to shorten the time required before reopening to traffic.

Before closing an intersection, advance warning signs shall be placed and signs placed marking the detour or alternate route.

During paving operations, temporary pavement markings shall be maintained throughout the project. Temporary pavement markings shall be installed on the Roadway prior to opening to traffic. Temporary pavement markings shall be in accordance with Standard Specifications Section 8-23.

All costs in connection with performing the Work in accordance with these requirements shall be included in the unit Contract prices for the various Bid items involved in the Contract.

C. EQUIPMENT

1. Mixing Plant

Plants used for the preparation of HMA shall conform to the following requirements:

a. Equipment for Preparation of Asphalt Binder

Tanks for the storage of asphalt binder shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the storage tank. The circulating system for the asphalt binder shall be designed to ensure proper and continuous circulation during the operating period. A valve for the purpose of sampling the asphalt binder shall be placed in either the storage tank or in the supply line to the mixer.

b. Thermometric Equipment

An armored thermometer, capable of detecting temperature ranges expected in the HMA mix, shall be fixed in the asphalt binder feed line at a location near the charging valve at the mixer unit. The thermometer location shall be convenient and safe for access by Inspectors. The plant shall also be equipped with an approved dial-scale thermometer, a mercury actuated thermometer, an electric pyrometer, or another approved thermometric instrument

placed at the discharge chute of the drier to automatically register or indicate the temperature of the heated aggregates. This device shall be in full view of the plant operator.

c. Heating of Asphalt Binder

The temperature of the asphalt binder shall not exceed the maximum recommended by the asphalt binder manufacturer nor shall it be below the minimum temperature required to maintain the asphalt binder in a homogeneous state. The asphalt binder shall be heated in a manner that will avoid local variations in heating. The heating method shall provide a continuous supply of asphalt binder to the mixer at a uniform average temperature with no individual variations exceeding 25 degrees F. Also, when a WMA additive is included in the asphalt binder, the temperature of the asphalt binder shall not exceed the maximum recommended by the manufacturer of the WMA additive.

2. Hauling Equipment

Trucks used for hauling HMA shall have tight, clean, smooth metal beds and shall have a cover of canvas or other suitable material of sufficient size to protect the mixture from adverse weather. Whenever the weather conditions during the work shift include, or are forecast to include, precipitation or an air temperature less than 45 degrees F or when time from loading to unloading exceeds 30 minutes, the cover shall be securely attached to protect the HMA.

The Contractor shall provide an environmentally benign means to prevent the HMA mixture from adhering to the hauling equipment. Excess release agent shall be drained prior to filling hauling equipment with HMA. Petroleum derivatives or other coating material that contaminate or alter the characteristics of the HMA shall not be used. For live bed trucks, the conveyer shall be in operation during the process of applying the release agent.

3. Pavers

HMA pavers shall be self-contained, power-propelled units, provided with an internally heated vibratory screed and shall be

capable of spreading and finishing courses of HMA plant mix material in lane widths required by the paving section shown in the Plans.

The HMA paver shall be in good condition and shall have the most current equipment available from the manufacturer for the prevention of segregation of the HMA mixture installed, in good condition, and in working order. The equipment certification shall list the make, model, and year of the paver and any equipment that has been retrofitted.

The screed shall be operated in accordance with the manufacturer's recommendations and shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, segregating, or gouging the mixture. A copy of the manufacturer's recommendations shall be provided upon request by the Contracting Agency. Extensions will be allowed provided they produce the same results, including ride, density, and surface texture as obtained by the primary screed. Extensions without augers and an internally heated vibratory screed shall not be used in the Traveled Way.

When specified in the Contract, reference lines for vertical control will be required. Lines shall be placed on both outer edges of the Traveled Way of each Roadway. Horizontal control utilizing the reference line will be permitted. The grade and slope for intermediate lanes shall be controlled automatically from reference lines or by means of a mat referencing device and a slope control device. When the finish of the grade prepared for paving is superior to the established tolerances and when, in the opinion of the Engineer, further improvement to the line, grade, cross-section, and smoothness can best be achieved without the use of the reference line, a mat referencing device may be substituted for the reference line. Substitution of the device will be subject to the continued approval of the Engineer. A joint matcher may be used subject to the approval of the Engineer. The reference line may be removed after the completion of the first course of HMA when approved by the Engineer. Whenever the Engineer determines that any of these methods are failing to provide the necessary vertical control, the reference lines will be reinstalled by the Contractor.

The Contractor shall furnish and install all pins, brackets, tensioning devices, wire, and accessories necessary for satisfactory operation of the automatic control equipment.

If the paving machine in use is not providing the required finish, the Engineer may suspend Work as allowed by Standard Specification Section 1-08.6. Any cleaning or solvent type liquids spilled on the pavement shall be thoroughly removed before paving proceeds.

4. Rollers

Rollers shall be of the steel wheel, vibratory, oscillatory, or pneumatic tire type, in good condition and capable of reversing without backlash. Operation of the roller shall be in accordance with the manufacturer's recommendations. When ordered by the Engineer for any roller planned for use on the project, the Contractor shall provide a copy of the manufacturer's recommendation for the use of that roller for compaction of HMA. The number and weight of rollers shall be sufficient to compact the mixture in compliance with the requirements of subsection 3.3J. The use of equipment that results in crushing of the aggregate will not be permitted. Rollers producing pickup, washboard, uneven compaction of the surface, displacement of the mixture or other undesirable results shall not be used.

D. PREPARATION OF TREATED SURFACES FOR HMA

A treated surface includes cement concrete, asphalt concrete, brick, seal coat, bituminous surface treatment and cement treated base. When the treated surface or old base is irregular, the Contractor shall bring it to a uniform grade and cross-section as shown on the Plans or approved by the Engineer.

Preleveling of uneven or broken treated surfaces over which HMA is to be placed may be accomplished by using an asphalt paver, a motor patrol grader, or by hand raking, as approved by the Engineer.

Compaction of preleveling HMA shall be to the satisfaction of the Engineer and may require the use of small steel wheel rollers, plate compactors, or pneumatic rollers to avoid bridging across preleveled areas by the compaction equipment. Equipment used for the compaction of preleveling HMA shall be approved by the Engineer.

Before construction of HMA on an existing paved surface, the entire surface of the pavement shall be clean. All fatty asphalt patches, grease

drippings, and other objectionable matter shall be entirely removed from the existing pavement.

All treated surfaces over which HMA is to be placed shall be thoroughly cleaned of dust, soil, pavement grindings, and other foreign matter. All holes and small depressions shall be filled with an appropriate class of HMA. The surface of the patched area shall be leveled and compacted thoroughly. Prior to the application of tack coat, or paving, the condition of the surface shall be approved by the Engineer.

A tack coat of asphalt shall be applied to all treated surfaces on which any course of HMA is to be placed or abutted. Tack coat shall be uniformly applied to cover the treated surface with a thin film of residual asphalt free of streaks and bare spots at a rate between 0.02 and 0.10 gallons per square yard of retained asphalt. The rate of application shall be approved by the Engineer. A heavy application of tack coat shall be applied to all joints. For Roadways open to traffic, the application of tack coat shall be limited to surfaces that will be paved during the same working shift. The spreading equipment shall be equipped with a thermometer to indicate the temperature of the tack coat material.

Equipment shall not operate on tacked surfaces until the tack has broken and cured. If the Contractor's operation damages the tack coat it shall be repaired prior to placement of the HMA.

The tack coat shall be CSS-1, or CSS-1h emulsified asphalt. The CSS-1 and CSS-1h emulsified asphalt may be diluted once with water at a rate not to exceed one part water to one part emulsified asphalt. The tack coat shall have sufficient temperature such that it may be applied uniformly at the specified rate of application and shall not exceed the maximum temperature recommended by the emulsified asphalt manufacturer.

1. Pavement Repair

The Contractor shall excavate pavement repair areas and shall backfill these with HMA in accordance with the details shown in the Plans and as marked in the field. The Contractor shall conduct the excavation operations in a manner that will protect the pavement that is to remain. Pavement not designated to be removed that is damaged as a result of the Contractor's operations shall be repaired by the Contractor to the satisfaction of the Engineer at no cost to the Contracting Agency. The Contractor shall excavate only within one lane at a time unless approved otherwise by the Engineer. The Contractor shall not excavate more

area than can be completely finished during the same shift, unless approved by the Engineer.

Unless otherwise shown in the Plans or determined by the Engineer, excavate to a depth of 1.0 feet. The Engineer will make the final determination of the excavation depth required. The minimum width of any pavement repair area shall be 40 inches unless shown otherwise in the Plans. Before any excavation, the existing pavement shall be sawcut or shall be removed by a pavement grinder. Excavated materials will become the property of the Contractor and shall be disposed of in a Contractor-provided site off the Right of Way or used in accordance with Standard Specifications Sections 2-02.3(3) or 9-03.21.

Asphalt for tack coat shall be required as specified in subsection D. A heavy application of tack coat shall be applied to all surfaces of existing pavement in the pavement repair area.

Placement of the HMA backfill shall be accomplished in lifts not to exceed 0.35-foot compacted depth. Lifts that exceed 0.35 foot of compacted depth may be accomplished with the approval of the Engineer. Each lift shall be thoroughly compacted by a mechanical tamper or a roller.

E. PRODUCING/STOCKPILING AGGREGATES AND RAP

Aggregates and RAP shall be stockpiled according to the requirements of Standard Specifications Section 3-02. Sufficient storage space shall be provided for each size of aggregate and RAP. Materials shall be removed from stockpile(s) in a manner to ensure minimal segregation when being moved to the HMA plant for processing into the final mixture. Different aggregate sizes shall be kept separated until they have been delivered to the HMA plant.

F. MIXING

After the required amount of mineral materials, asphalt binder, recycling agent and anti-stripping additives have been introduced into the mixer the HMA shall be mixed until complete and uniform coating of the particles and thorough distribution of the asphalt binder throughout the mineral materials is ensured.

When discharged, the temperature of the HMA shall not exceed the optimum mixing temperature by more than 25 degrees F as shown on the

reference mix design report or as approved by the Engineer. Also, when a WMA additive is included in the manufacture of HMA, the discharge temperature of the HMA shall not exceed the maximum recommended by the manufacturer of the WMA additive. A maximum water content of 2 percent in the mix, at discharge, will be allowed providing the water causes no problems with handling, stripping, or flushing. If the water in the HMA causes any of these problems, the moisture content shall be reduced as directed by the Engineer.

Storing or holding of the HMA in approved storage facilities will be permitted with approval of the Engineer, but in no event shall the HMA be held for more than 24 hours. HMA held for more than 24 hours after mixing shall be rejected. Rejected HMA shall be disposed of by the Contractor at no expense to the Contracting Agency. The storage facility shall have an accessible device located at the top of the cone or about the third point. The device shall indicate the amount of material in storage. No HMA shall be accepted from the storage facility when the HMA in storage is below the top of the cone of the storage facility, except as the storage facility is being emptied at the end of the working shift.

Recycled asphalt pavement (RAP) utilized in the production of HMA shall be sized prior to entering the mixer so that a uniform and thoroughly mixed HMA is produced. If there is evidence of the RAP not breaking down during the heating and mixing of the HMA, the Contractor shall immediately suspend the use of the RAP until changes have been approved by the Engineer. After the required amount of mineral materials, RAP, new asphalt binder and asphalt rejuvenator have been introduced into the mixer the HMA shall be mixed until complete and uniform coating of the particles and thorough distribution of the asphalt binder throughout the mineral materials, and RAP is ensured.

G. SPREADING AND FINISHING

The mixture shall be laid upon an approved surface, spread, and struck off to the grade and elevation established. HMA pavers complying with subsection 3.3C. shall be used to distribute the mixture. Unless otherwise directed by the Engineer, the nominal compacted depth of any layer of any course shall not exceed the following:

HMA Class 1"	0.35 feet
HMA Class 3/4" and HMA Class 1/2" wearing course	0.30 feet
HMA Class 3/4" and HMA Class 1/2" other courses	0.35 feet
HMA Class 3/8" wearing course	0.25 feet
HMA Class 3/8" other courses	0.30 feet

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the paving may be done with other equipment or by hand.

When more than one job mix formula (JMF) is being utilized to produce HMA, the material produced for each JMF shall be placed by separate spreading and compacting equipment. The intermingling of HMA produced from more than one JMF is prohibited. Each strip of HMA placed during a work shift shall conform to a single JMF established for the class of HMA specified unless there is a need to make an adjustment in the JMF.

H. AGGREGATE ACCEPTANCE PRIOR TO INCORPORATION IN HMA

Sampling and testing of aggregates for HMA accepted by commercial evaluation will be at the option of the Engineer.

I. SURFACE SMOOTHNESS

The completed surface of all courses shall be of uniform texture, smooth, uniform as to crown and grade, and free from defects of all kinds. The completed surface of the wearing course of the following sections of Roadway shall not vary more than 1/4 inch from the lower edge of a 10-foot straightedge placed on the surface parallel to centerline on all Sections of roadway within the project limits that are posted less than 45 mph.

The completed surface of the wearing course of all other sections of Roadway shall not vary more than 1/8 inch from the lower edge of a 10-foot straightedge placed on the surface parallel to centerline.

The transverse slope of the completed surface of the wearing course shall vary not more than 1/4 inch in 10 feet from the rate of transverse slope shown in the Plans.

When deviations in excess of the above tolerances are found that result from a high place in the HMA, the pavement surface shall be corrected by one of the following methods:

1. Removal of material from high places by grinding with an approved grinding machine; or

2. Removal and replacement of the wearing course of HMA; or
3. By other method approved by the Engineer.

Correction of defects shall be carried out until there are no deviations anywhere greater than the allowable tolerances.

Deviations in excess of the above tolerances that result from a low place in the HMA and deviations resulting from a high place where corrective action, in the opinion of the Engineer, will not produce satisfactory results will be accepted with a price adjustment. The Engineer shall deduct from monies due or that may become due to the Contractor the sum of \$500.00 for each and every section of single traffic lane 100 feet in length in which any excessive deviations described above are found.

J. SEALING PAVEMENT SURFACES

Apply a fog seal where shown in the plans. Construct the fog seal in accordance with Standard Specifications Section 5-02.3. Unless otherwise approved by the Engineer, apply the fog seal prior to opening to traffic.

K. HMA ROAD APPROACHES

HMA approaches shall be constructed at the locations shown in the Plans or where staked by the Engineer. The Work shall be performed in accordance with Section 3.3.

3.4 NOT USED

3.5 HMA JOINTS

A. TRANSVERSE JOINTS

The Contractor shall conduct operations such that the placing of the top or wearing course is a continuous operation or as close to continuous as possible. Unscheduled transverse joints will be allowed and the roller may pass over the unprotected end of the freshly laid mixture only when the placement of the course must be discontinued for such a length of time that the mixture will cool below compaction temperature. When the Work is resumed, the previously compacted mixture shall be cut back to produce a slightly beveled edge for the full thickness of the course.

A temporary wedge of HMA constructed on a 20H:1V shall be constructed where a transverse joint as a result of paving or planing is

open to traffic. The HMA in the temporary wedge shall be separated from the permanent HMA by strips of heavy wrapping paper or other methods approved by the Engineer. The wrapping paper shall be removed and the joint trimmed to a slightly beveled edge for the full thickness of the course prior to resumption of paving.

The material that is cut away shall be wasted and new mix shall be laid against the cut. Rollers or tamping irons shall be used to seal the joint.

B. LONGITUDINAL JOINTS

The longitudinal joint in any one course shall be offset from the course immediately below by not more than 6 inches nor less than 2 inches. All longitudinal joints constructed in the wearing course shall be located at a lane line or an edge line of the Traveled Way. A notched wedge joint shall be constructed along all longitudinal joints in the wearing surface of new HMA unless otherwise approved by the Engineer. The notched wedge joint shall have a vertical edge of not less than the maximum aggregate size or more than 1/2 of the compacted lift thickness and then taper down on a slope not steeper than 4H:1V. The sloped portion of the HMA notched wedge joint shall be uniformly compacted.

3.6 QUALITY CONTROL

A. HMA MIXTURE ACCEPTANCE

Acceptance of HMA shall be as provided under nonstatistical, or commercial evaluation.

Commercial evaluation will be used for Commercial HMA and for other classes of HMA in the following applications: sidewalks, road approaches, ditches, slopes, paths, trails, gores, prelevel, temporary pavement, and pavement repair. Other nonstructural applications of HMA accepted by commercial evaluation shall be as approved by the Engineer. Sampling and testing of HMA mix accepted by commercial evaluation will be at the option of the Engineer.

The mix design will be the initial JMF for the class of HMA. The Contractor may request a change in the JMF. Any adjustments to the JMF will require the approval of the Engineer and may be made in accordance with this section.

1. HMA Tolerances and Adjustments

See Section 2.2 for Job Mix Formula Tolerances.

- a. Job Mix Formula Adjustments – An adjustment to the aggregate gradation or asphalt binder content of the JMF requires approval of the Engineer. Adjustments to the JMF will only be considered if the change produces material of equal or better quality and may require the development of a new mix design if the adjustment exceeds the amounts listed below.
 - i. Aggregates – 2 percent for the aggregate passing the 1-1/2", 1", 3/4", 1/2", 3/8", and the No. 4 sieves, 1 percent for aggregate passing the No. 8 sieve, and 0.5 percent for the aggregate passing the No. 200 sieve. The adjusted JMF shall be within the range of the control points in Standard Specifications Section 9-03.8(6).
 - ii. Asphalt Binder Content – The Engineer may order or approve changes to asphalt binder content. The maximum adjustment from the approved mix design for the asphalt binder content shall be 0.3 percent.

2. Mixture Acceptance – Commercial Evaluation

If sampled and tested, HMA mix produced under Commercial Evaluation and having all constituents falling within the tolerance limits of the job mix formula shall be accepted at the unit Contract price with no further evaluation. When one or more constituents fall outside the commercial tolerance limits in the Job Mix Formula shown in Section 2.2, the lot may be subject to rejection. When less than three sublots exist, backup samples of the existing sublots or samples from the street shall be tested to provide a minimum of three sets of results for evaluation.

B. HMA COMPACTION ACCEPTANCE

HMA mixture accepted by commercial evaluation and HMA constructed under conditions other than those listed above shall be compacted on the basis of a test point evaluation of the compaction train or by testing of roadway cores. Compaction of the HMA mixture to a minimum of 92 percent of the reference maximum density is required for acceptance.

1. HMA Compaction – General Compaction Requirements

Compaction shall take place when the mixture is in the proper condition so that no undue displacement, cracking, or shoving occurs. Areas inaccessible to large compaction equipment shall be compacted by other mechanical means. Any HMA that becomes loose, broken, contaminated, shows an excess or deficiency of asphalt, or is in any way defective, shall be removed and replaced with new hot mix that shall be immediately compacted to conform to the surrounding area.

The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided the specified densities are attained. Unless the Engineer has approved otherwise, rollers shall only be operated in the static mode when the internal temperature of the mix is less than 175 degrees F. Regardless of mix temperature, a roller shall not be operated in a mode that results in checking or cracking of the mat. Rollers shall only be operated in static mode on bridge decks.

2. HMA Commercial Evaluation Compaction

The location of the HMA compaction tests will be randomly selected by the Engineer.

Tests for the determination of the pavement density will be taken by the Contractor, in accordance with the required procedures for measurement by a nuclear density gauge or roadway cores, after completion of the finish rolling.

HMA mixture accepted by commercial evaluation shall be compacted on the basis of a test point evaluation of the compaction train. The Contractor shall provide the RICE density test results for the HMA mixture, identifying the reference maximum density of the mix, prior to the first day of paving. The test point evaluation shall be performed by the Contractor, in accordance with instructions from the Engineer. The number of passes with an approved compaction train, required to attain a minimum of 92 percent of the reference maximum density, shall be used on all subsequent paving.

If the Contracting Agency uses a nuclear density gauge to determine density the test procedures FOP for WAQTC TM 8 and

WSDOT SOP T 729 will be used on the day the mix is placed and prior to opening to traffic.

Alternatively, the HMA mixture accepted by commercial evaluation may be evaluated by testing of roadway cores taken after completion of the finish rolling, resulting in a minimum of 92 percent of the reference maximum density. Roadway cores for density shall be obtained by the Contractor in accordance with WSDOT SOP 734. The core diameter shall be 4-inches minimum, unless otherwise approved by the Engineer. Roadway cores will be tested by the Contractor in accordance with WSDOT FOP for AASHTO T 166. Core locations shall be outside of wheel paths and as determined by the Engineer

If the Contract includes the Bid item “Roadway Core” the cores shall be obtained by the Contractor in the presence of the Engineer on the same day the mix is placed and at locations designated by the Engineer.

C. REJECT WORK

1. Reject Work General

Work that is defective or does not conform to Contract requirements shall be rejected. The Contractor may propose, in writing, alternatives to removal and replacement of rejected material. Acceptability of such alternative proposals will be determined at the sole discretion of the Engineer.

2. Rejection by Contractor

The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material. Any such new material will be sampled, tested, and evaluated for acceptance.

3. Rejection Without Testing (Mixture or Compaction)

The Engineer may, without sampling, reject any batch, load, or section of Roadway that appears defective. Material rejected before placement shall not be incorporated into the pavement. Any rejected section of Roadway shall be removed.

No payment will be made for the rejected materials or the removal of the materials unless the Contractor requests that the rejected material be tested.

Commercial Evaluation: If the Contractor elects to have the rejected material tested, a minimum of three representative samples shall be obtained and tested by the Contractor. Acceptance of rejected material will be based on conformance with the commercial evaluation tolerances in Section 2.2. If one or more of the mixture components are out of tolerance then, no payment will be made for the rejected material; in addition, the cost of sampling and testing shall be borne by the Contractor. If the material is rejected before placement and all of the mixture components are within the commercial evaluation tolerances, then compensation for the rejected material will be at the unit Contract price, with an addition of 25 percent of the unit Contract price added for the cost of testing, removal and disposal.

3.7 SAWCUTTING

Where shown on the Plans or where directed in the field by the Contracting Agency, the Contractor shall make a neat vertical sawcut at the boundaries of the area to be removed. Care shall be taken during sawcutting so as to prevent damage to the existing HMA or cement concrete pavement, to remain in place. Any pavement or cement concrete surface that is damaged by the Contractor outside the area scheduled for removal due to the Contractor's operations or negligence shall be repaired or replaced to the Contracting Agency's satisfaction by the Contractor at no additional cost to the Contracting Agency.

All cuts shall be continuous, full depth, and shall be made with saws specifically equipped for this purpose. No skip cutting, wheel cutting or jack hammering will be allowed unless specifically approved otherwise in writing by the Contracting Agency. However, even if preapproved as a method of cutting, no payment will be made for this type of work, and it shall be considered incidental and included in the various unit contract and lump sum prices listed in the Proposal.

The location of all pavement cuts shall be preapproved by the Contracting Agency in the field before cutting commences.

All water and slurry material resulting from sawcutting operations shall not be allowed to enter the storm drainage or sanitary sewer system and shall be removed from the site and disposed of in accordance with the Washington State Department of Ecology regulations.

All existing pavement edges shall be saw cut back to sound material, in uniform lines immediately prior to paving operations. Any edges broken between the time of cutting and placement of new paving shall be recut to the satisfaction of the Contracting Agency at no additional cost to the Contracting Agency. All excess excavated materials shall be hauled to waste.

3.8 NOT USED

3.9 NOT USED

3.10 PAVEMENT MARKINGS

In those areas where the proposed work causes existing pavement with striping and/or pavement markings to be removed, the Contractor shall not only replace the pavement, as noted herein, and as shown on the Plans, but shall also remark and restripe the new pavement so as to restore the new pavement to its former condition.

Pavement markings shall conform to Standard Specification Section 8-22.2 and 8-22.3, and the latest edition and amendments thereto of the Manual on Uniform Traffic Control Devices (MUTCD) as adopted by the State of Washington, and shall be constructed as shown in the Plans except as modified herein.

Raised pavement markers shall conform to Standard Specifications Section 8-09.2 and 8-09.3.

3.11 ADJUSTING STRUCTURES TO GRADE

All utility castings and monuments within the existing and/or new pavement area shall be referenced by the Contractor prior to any pavement removal or planing. The Contractor shall keep a record of such references and submit a copy to the Contracting Agency.

Existing structures and new structures shall be adjusted to the finished grade as shown on the Plans and as further specified herein. Existing boxes, rings, grates, covers, and lids shall be reset in a careful and workmanlike manner to conform to the required grades.

The new and existing utility castings and monuments shall be adjusted to grade in the following manner:

As soon as the street has been paved past each structure or casting, the HMA mat shall be scored around the location of the structure or casting. After rolling has been completed and the mat has cooled, it shall be cut along the scored lines. The

structure or casting shall then be raised to finished pavement grade and the annular spaces filled as indicated on the Plans. The Contractor shall install the pavement to give a smooth finished appearance. All covers, lids, frames, and grates shall be thoroughly cleaned.

After pavement is in place, all new pavement joints shall be sealed with a 6-inch-wide strip of hot asphalt sealer. A sand blanket shall be applied to the surface of the hot asphalt sealer immediately after the placement of the sealer to help alleviate the tracking of the asphalt. The sealer shall meet the requirements of the Standard Specifications Section 9-04.2(1).

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

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

<u>Section</u>	<u>Item</u>
03300	Cast-In-Place Concrete

1.3 REFERENCES

This Section references the latest revisions of the following documents:

<u>Reference</u>	<u>Title</u>
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 the Contract Documents.

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. 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. SET-XP, Simpson Strong Tie, Inc.
 - c. PE1000+, 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. Bar lap splicing shall have full contact. Where full contact cannot be achieved, the maximum space between the spliced bars shall not exceed 2 inches. 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

<u>Section</u>	<u>Item</u>
01400	Quality Control
03200	Concrete Reinforcement
07900	Caulking and Sealants

1.3 REFERENCES

This Section references the latest revisions of the following documents:

<u>Reference</u>	<u>Title</u>
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

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. Plastic Joint Formers

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. 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.

D. 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.

Coarse aggregate will be the largest nominal size permitted by ACI 301/318.

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 Pozzoloth NC534
Sika Plastocrete 161 FL
W.R. Grace Polarset or DCI

D. WATER REDUCING, RETARDING ADMIXTURE

ASTM C494, Type D.

Master Builders Pozzoloth 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 Pozzoloth 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 Armatex 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

Do not use curing compounds unless they are NSF61/372 approved.

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. 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.

Minimum compressive strength @ 28 days: 4,000 psi
Minimum cement content: 6 sacks per cubic yard
Maximum water cement ratio by weight: 0.45
Nominal coarse aggregate size: 1-1/2" to No. 4
(size designation 467)

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 complying with ASTM C260 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 \pm 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 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

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. 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.

C. 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.

D. 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.

E. 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 |

3.10 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.

3.11 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.

3.12 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.

3.13 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.

3.14 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.

3.15 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. 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 their 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.

6. 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.

7. 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.

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

SECTION 07900

CAULKING AND SEALANTS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes the furnishing of all labor, materials, tools, and equipment required to install caulking and sealants, as indicated 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

<u>Section</u>	<u>Item</u>
03300	Cast-In-Place Concrete

1.3 REFERENCE STANDARDS

This Section references the latest revisions of the following documents:

<u>Reference</u>	<u>Title</u>
AAMA 800	Sealant Manual, Specifications and Test Methods for Sealants
ASTM C834	Standard Specification for Latex Sealants
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C1193	Standard Guide for Joint Sealants
ASTM C1311	Standard Specification for Solvent Release Sealants
ASTM D5249	Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

ASTM D7174 Standard Specification for Preformed Closed-Cell
Polyolefin Expansion Joint Fillers for Concrete Paving and
Structural Construction

NSF/ANSI 61 Drinking Water System Components – Health Effects

PART 2 PRODUCTS

2.1 POLYURETHANE SEALANTS

Provide a one-component, gunnable grade, non-sag, solvent-free polyurethane sealant. The sealant shall cure under the influence of atmospheric moisture. Sealant shall meet ASTM C920, Type S, Grade NS, Class 35, under uses NT, T, M, G, I, A, and O. Performance characteristics shall include a 175 psi 21-day tensile strength, a minimum 500-percent ultimate elongation, and a maximum Shore “A” Hardness of 45.

Polyurethane sealants shall be Sikaflex-1a, as manufactured by the Sika Corporation, or equal by Tremco, Inc. or BASF Corporation.

2.2 SILICONE SEALANTS

Provide a one-component, gunnable grade, neutral cure, silicone sealant. Sealant shall meet ASTM C920, Type S, Grade NS, Class 50, under uses NT, M, G, A and O. Performance characteristics shall include a 200 psi 21-day tensile strength, a minimum 700-percent ultimate elongation, and a maximum Shore “A” Hardness of 25.

Silicone sealants shall be Sikasil WS-295, as manufactured by the Sika Corporation, or equal by Tremco, Inc. or BASF Corporation.

2.3 ACRYLIC LATEX CAULK

Provide a one-component, gunnable grade, pure acrylic latex sealant. Sealant shall meet ASTM C834, Type OP, Grade -18 °C. Performance characteristics shall include a maximum 25-percent shrinkage, and a movement capability of plus/minus 12.5-percent.

Acrylic latex sealants shall be Tremflex 834, as manufactured by the Tremco, Inc. or equal by BASF Corporation.

2.4 TAPE SEALANT

Provide a 100-percent solid, isobutylene preformed sealant tape. Tape sealant shall meet the American Architectural Manufacturer's Association AAMA 807.3 standard. Performance characteristics shall include a density of 1.5 and a minimum peel adhesion of 8 pounds per inch.

Tape sealant shall be Sikalastomer-95, as manufactured by the Sika Corporation, or equal by Tremco, Inc. or BASF Corporation.

2.5 PREFORMED FLEXIBLE JOINT MATERIAL

Provide a closed-cell, polyolefin preformed foam joint material. Foam joint material shall meet ASTM D7174. Performance characteristics shall include an expansion recovery greater than 99-percent, a maximum 50-percent compression strength of 15 psi, and a maximum water absorption of 0.25-percent by volume.

Foam joint material shall be Ceramar, as manufactured by W.R. Meadows, or equal.

2.6 PREFORMED FLEXIBLE JOINT BACKER MATERIAL

Provide a closed-cell, polyolefin preformed foam backer rod material. Backer rod material shall meet ASTM D5249 and shall be compatible with the proposed cold-applied sealant.

Backer rod material shall be Kool-Rod, as manufactured by W.R. Meadows, or equal.

2.7 PRIMERS

Provide primer materials made by or recommended by the sealant manufacturer 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.

PART 3 EXECUTION

3.1 GENERAL

All sealant and primer work shall comply with ASTM C1193 and with the manufacturer's written instructions.

The Contractor shall confirm that the proposed sealant and primer materials are compatible with any concrete curing compound used, or the Contractor shall

lightly sandblast and thoroughly clean concrete joint surfaces prior to application of sealant materials.

All priming and sealant work shall be done under temperature and moisture conditions that are within the requirements of the manufacturer's written instructions.

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 profiles and surfaces of all joints prior to application. Verify joint dimensions are adequate for development of the sealant movement capability. All joints shall be solvent cleaned, dry, and free of dust, oils and grease before receiving backing materials and sealant. Floor joints shall be wire brushed, free of laitance or other residues. 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. Joint sealants shall be installed before other surface finishes are applied. Proceed with joint sealant work only once conditions meet the manufacturer's requirements.

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 or as required by the manufacturer, 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. Filler or backer material shall be of a depth as required to bring the top surface to within 1/2 inch of the slab surface, or as indicated on the Plans. All joints shall include a suitable bond breaker between backing materials and sealant.

C. MASKING

Both sides of joints shall be masked with tape to prevent soiling floor, slab, or wall beyond limits of the joint.

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. 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. Do not apply sealants to wet or damp surfaces nor in temperatures below 50 degrees F, and as required by the manufacturer. 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. When applying sealant, do not permit thickness of sealant to exceed 1/2 of the width of the joint. Any joints over 1/2-inch wide shall be reported to the Owner and instructions for correcting the applications will be given.

3.3 CLEANUP

Upon completion, the Contractor shall remove and dispose of masking materials. Remove any excess materials and clean adjacent surfaces free from any soiling or staining resulting from the sealing and caulking operations.

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

SECTION 08310

METAL ACCESS HATCHES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of furnishing and installing 1 access hatch and accessories as shown on the Plans and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
03300	Cast-in-Place Concrete

1.3 QUALITY ASSURANCE

Access hatches shall be guaranteed against defects in material and/or workmanship for a period of 10 years by the manufacturer.

1.4 EQUIPMENT LIST

The metal access hatches to be installed are as follows:

<u>Location</u>	<u>Clear Opening</u>	<u>Type</u>
Sample Connection Vault	48" x 132"	Type 1

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

Metal access hatches shall be as manufactured by Halliday, Bilco, or L. W. Hatch. No other manufacturers are acceptable.

2.2 ACCESS HATCH TYPE 1

Type 1 access frames and covers shall be Halliday Series W3S, or equal. The hatch shall be a three leaf design where all hatch lids share a common hinge side. Hatches shall have a 1/4-inch thick, one-piece, mill finish, extruded aluminum frame, incorporating a continuous concrete anchor. A bituminous coating shall be applied to the frame exterior in areas in contact with concrete. The door panels shall be 1/4-inch aluminum diamond plate reinforced to withstand a live load of 300 psf. Doors shall open to 90 degrees and automatically lock with a type 316 stainless steel hold open arms that include release handles. Doors shall

incorporate enclosed stainless steel compression spring assists. Doors shall close flush with the frame and rest on a built-in neoprene cushion/gasket. Hinges and all fastening hardware shall be type 316 stainless steel. Unit shall lock with a type 316 stainless steel slam lock with removable keys and have a non-corrosive handle.

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 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 some way, the entire wall or ceiling surface is to be painted.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
03300	Concrete
07900	Caulking and Sealant
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 Cleaning

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

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. Manufacturer's approval of protective coating systems applicator.
6. List of Applicator's experience and qualifications. A minimum of 5-years of experience in the painting of treatment facilities is 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. No other manufacturers are allowed.

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 treatment plant atmospheres. Any paint that cannot be so guaranteed shall not be used. Paint shall be lead-free and mercury-free.

2.2 PAINT SYSTEMS

A. NON-SUBMERGED METAL - SEVERE CONDITIONS

1. Scope

This Section shall apply to all metal which is not submerged but is located indoors, outdoors, or is subject to splashing from water, sludge, oil and grease or other corrosive materials unless specified otherwise.

2. Surface Preparation

Near-white blast cleaning, SSPC-SP-10.

3. Coatings

Tnemec Shop Primer System:

Coat One

Product: Omnithane Series 1

MDFT: 2.5 to 3.5 mils

Tnemec Field Finish System:

Coat One

Product: Hi-Build Epoxoline Series N69

MDFT: 4.0 to 6.0 mils

Coat Two

Product: Endura-Shield Series 1095

MDFT: 3.0 to 5.0 mils

Total MDFT: 9.5 to 14.5 mils

Sherwin Williams Shop Primer System:

Coat One

Product: Corothane I Galvapak

MDFT: 2.5 to 4.0 mils

Sherwin Williams Field Finish System:

Coat One

Product: DuraPlate 235 Multi-purpose Epoxy

MDFT: 4.0 to 6.0 mils

Coat Two

Product: Acrolon 218 HS

MDFT: 3.0 to 5.0 mils

Total MDFT: 9.5 to 15.0 mils

B. 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

Tnemec Shop Primer System:

Coat One

Product: Typoxy Series N27

MDFT: 2.0 to 3.0 mils

Tnemec Field Finish System:

Coat One

Product: Endura-Shield Series 1095

MDFT: 3.0 to 5.0 mils

Total MDFT: 5.0 to 8.0 mils

Sherwin Williams Shop Primer System:

Coat One

Product: Macropoxy 646FC

MDFT: 2.0 to 3.0 mils

Sherwin Williams Field Finish System:

Coat One

Product: Acrolon 218 HS

MDFT: 3.0 to 5.0 mils

Total MDFT: 5.0 to 8.0 mils

C. 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.

2. Surface Preparation

Provide surface profile in accordance with NAPF 500-03-04.

3. Coatings

Tnemec Shop Primer System:

Coat One

Product: Omnithane Series 1

MDFT: 2.5 to 3.5 mils

Tnemec Field Finish System:

Coat One

Product: Hi-Build Epoxoline Series N69

MDFT: 4.0 to 6.0 mils

Coat Two

Product: Endura-Shield Series 1095

MDFT: 3.0 to 5.0 mils

Total MDFT: 9.5 to 14.5 mils

Sherwin Williams Shop Primer System:

Coat One

Product: Corothane I Galvapak

MDFT: 2.5 to 4.0 mils

Sherwin Williams Field Finish System:

Coat One

Product: DuraPlate 235 Multi-purpose Epoxy

MDFT: 4.0 to 6.0 mils

Coat Two

Product: Acrolon 218 HS

MDFT: 3.0 to 5.0 mils

Total MDFT: 9.5 to 15.0 mils

D. 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

Tnemec Paint System:

Product:	PerimePrime Tnemec Series 394
MDFT:	3.0 to 5.0 mils

Total MDFT: 3.0 to 5.0 mils

Sherwin Williams System:

Coat One

Product:	Corothane I Galvapak
MDFT:	3.0 to 4.0 mils

Total MDFT: 3.0 to 4.0 mils

E. 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

Tnemec Paint System:

Product:	Hi-Build Epoxoline Series N69
MDFT:	4.0 to 6.0 mils

Total MDFT: 4.0 to 6.0 mils

Sherwin Williams Paint System:

Product: Macropoxy 646FC
MDFT: 2.0 to 3.0 mils

Total MDFT: 2.0 to 3.0 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)	Piping	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:

<u>Outside Diameter of Pipe or Covering</u>	<u>Minimum Height of Letters</u>
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.

<u>Process</u>	<u>Abbreviation</u>	<u>Color of Pipe</u>	<u>Color of Letters</u>
Drain	D	Dark Gray	White
Water	W	Dark Blue	White

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 their 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 minimum 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).

<u>Description</u>	<u>SSPC</u>
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. 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.

C. 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.

D. 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. Conduit and appurtenances.

4. Ferrous metals.
5. Copper and brass surfaces.
6. 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. New machinery and equipment.
4. Machinery and equipment in sumps, pits, boxes, channels, wetwells and structures.

The Contractor shall paint all exposed interior and exterior surfaces including:

1. Insulated or wrapped piping, valves, fittings, yard or fire hydrants and appurtenances except when covered by lagging.
2. Conduit and appurtenances.
3. Exterior and interior surfaces of ferrous metal tankage.
4. Ferrous metals.

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. Interior of pipe, ductwork, and conduits.
5. Moving parts of mechanical and electrical units.
6. Code labels and equipment identification and rating plates.
7. Piping, ductwork, or pipe conduit when enclosed between suspended ceiling and overhead slabs or located in pipe chases or surfaces to be lagged.
8. Contact surfaces of friction-type connections.
9. 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 *****

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 2018 *International Building Code* (IBC) Section 1613 and ASCE 7-16 *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:

Parameter	Value
Risk Category	IV
Site Class	D
Component Importance Factor (I_p)	1.5
Response Acceleration Coefficients S_{DS} S_{D1}	1.094g 0.603g
Seismic Design Category	D

D. STANDARDS

Provide equipment and materials suitable for service conditions and meeting standard requirements of ANSI, ASME, AWWA, ASTM, NEMA, IBC, 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, 15, and 16.

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.

Motor FLA shall not exceed those defined by the National Electrical Code.

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.

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.

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 consecutive 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.

3.5 EQUIPMENT STARTUP AND ADJUSTMENT

The Contractor, at their 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.
- 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.

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, presentations, etc.). Cost of instruction and audio-visual training materials shall be included in the bid price for the equipment.

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

SECTION 11211

SUBMERSIBLE WELL PUMPS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes furnishing and installing one new submersible well pump and supporting appurtenances as shown on the Plans and as specified herein. 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

<u>Section</u>	<u>Item</u>
Division 11	Equipment
Division 16	Electrical

1.3 EQUIPMENT LIST

Equipment numbers are as follows:

<u>Item</u>	<u>Equipment Number</u>
Submersible Well Pump 1 (S10)	WP 01

1.4 PERFORMANCE REQUIREMENTS

The submersible pump covered by these Specifications shall have the motor mounted below the pump as shown on the Plans and as specified herein.

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 submarine type cable. The cable shall be supported on the riser column.

The submersible pump shall be capable of meeting the performance requirements listed below.

Parameter	Value
Flow capacity (gpm)	1,200
Total dynamic head (ft)	337
Minimum Shutoff head (ft)	420
Minimum efficiency (Design point, percent)	81
Discharge pipe diameter (in)	8
Column diameter (in)	8
Motor size (hp)	See Part 2.12
Motor speed (rpm)	See Part 2.12

1.5 SUBMITTALS

A. PRODUCT DATA

1. Specifications and data describing all pump parts, pieces, and components. Include information on materials of construction and proposed coating systems.
2. Performance curves showing total dynamic head (TDH) in feet, efficiency, horsepower (hp) required, and net-positive-suction head required (NPSHR) versus output in gallons per minute (GPM). All losses from the drive shaft, seal, coupling and other mechanical losses shall be included in the pump efficiency data presented. Catalog or software generated curves may be submitted for preliminary approval and ordering.
3. Minimum required submergence between the flow ranges of 500 and 1,200 gpm.
4. Complete list of all pump system components and accessories to be provided.
5. Column pipe headloss calculation (if applicable).
6. Bearing life (L10) for ball and roller bearings. Calculations supporting L10 of no less than 40,000 hours.
7. Provide any special tools required for pump or motor maintenance.
8. Estimated delivery time.

9. Specific and accurate diameters and all dimensions in order to facilitate the "dummy" test.

B. SHOP DRAWINGS

Provide detailed dimensional drawings showing outline dimensions, lengths, overall sizes, materials and weights for each pump unit and associated accessories.

C. PUMP CURVES

Provide certified pump curves and data from shop factory testing prior to pump shipment.

D. FINAL DOCUMENTS

Prior to project closeout, provide the following items.

1. Operations and Maintenance Manual
2. Manufacturer Signed Warranties with pump serial numbers
3. Field Pump Test Results and Installation Data

1.6 DELIVERY, STORAGE, AND HANDLING

All equipment shall be completely factory assembled, skid mounted, crated and delivered to protect against damage during shipment. All exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion. All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions.

1.7 WARRANTY

In addition to the warranty required in the General Conditions, the pump 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 submersible pump shall be Goulds VIS-12CHC Series, or as manufactured by Integrity, Franklin Electric, or equal.

The structural, mechanical and electrical designs shown on the Plans are based on the equipment manufactured by Goulds. Any modifications to the mechanical, structural, electrical, instrumentation and control and other portions of work that may be required to adapt the general layout and details shown on the Plans to the equipment actually furnished shall be at no additional cost to the Owner. All necessary revisions shall be made at Contractor's sole expense. All redesign information prepared by the contractor shall be submitted for review prior to incorporating the redesign into the work.

2.2 COLUMN ASSEMBLY

The column shall be of 8-inch standard weight steel column pipe with a wall thickness of not less than 0.237 inches and interchangeable sections of not less than 20 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.

2.3 BOWL ASSEMBLY

Bowls shall be constructed from close grained type 316 stainless steel (ASTM A744, Grade CF8M) and shall be flanged. Bowls shall have glass-lined enamel waterways. All threaded components shall be fit to NPT standards. Bowl shall be interchangeable.

Bearings shall be Glide 400 NSF polymer, bronze (ASTM B584), or equal.

All bolting and fasteners shall be stainless steel.

Bowl shaft shall be stainless steel (ASTM A582) and shall be precision machined.

2.4 IMPELLERS

Impellers shall be machined for optimum fit, efficiency, and performance. Taper locks, if required, shall be stainless steel construction (ASTM A582). Impellers shall be stainless steel (ASTM A744, Grade CF8M), meet the requirements of ASTM A296, and shall be enclosed. Impellers shall be adjustable. Impellers shall be balanced in accordance with G6.3 of ISO 1940, or better.

2.5 MOTOR BRACKET SUCTION STRAINER

Unit shall include a strainer having a net inlet opening of not less than four times the area of the suction pipe. Bracket suction strainer shall be Type 304 stainless steel.

2.6 CHECK VALVE

Check valve shall be Flomatic 80DI-VFD, or equal.

2.7 WATER LEVEL ACCESS CONDUITS

The pump column shall be installed with pipe conduits to allow measurement of water levels by installation of electronic devices, either permanent or portable. The conduits shall be schedule 80 PVC quick set drop pipe, flush joint threaded, and in 10 foot long segments. The PVC flush joint pipe shall meet ASTM Standard F 480-88A for thermoplastic well casing pipe and couplings.

The PVC conduits shall be installed and strapped to the column with gradual curves to allow passage of a device such as a level transducer or a sensor from a portable depth gauge. The conduits shall be installed to the depth as shown on the Plans.

2.8 STRAPS

Column straps shall be stainless steel and shall be suitable for groundwater applications. Straps shall accommodate possible difficulties that may be encountered upon pump and column installation within the close tolerances to be encountered.

2.9 CENTRALIZERS

Centralizers shall be furnished and installed as shown on the Plans. Centralizers shall be non-metallic, bow-spring, rubber, or PVC "spider" units, or equal. Centralizer materials shall comply with NSF 61, ANSI 372, and NSF Annex G.

2.10 NAMEPLATE

All pumps are to include an engraved non-corrosive metal nameplate on the exterior of the pump head or body (duplicate attached to pump support flange or shipped loose if submersible), readily accessible without requiring any disassembly. Nameplates shall not be painted, scratched, covered, or otherwise altered. Contractor shall take photographs of the final nameplate and shall transmit these photographs to the Owner prior to pump installation. The nameplate shall include, at a minimum, the following information:

- A. Pump Manufacturer
- B. Pump Model Number
- C. Pump Serial Number
- D. Impeller Number
- E. Impeller Trim
- F. Number of Stages
- G. Design TDH (feet)
- H. Design Flow (gpm)
- I. Supplier Name and Phone Number
- J. Date of Manufacture

2.11 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 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.

The motor cable length shall be coordinated by the Contractor based on the final setting depth and electrical connections required at grade, but shall be at least 200 feet or as recommended by the pump manufacturer.

2.12 MOTOR

A. APPROVED MANUFACTURERS

Motors shall be by Franklin Miller, Tesla, Hitachi, or equal.

B. MOTOR PERFORMANCE CHARACTERISTICS

Parameter	Value
Motor Size	150 hp
Operating Voltage	480 VAC
Phase	3
Frequency	60 Hz
Synchronous Speed	1,800 rpm (4-pole)
Inverter Duty?	No
Motor Over-temperature Protection?	No
Classified Environment?	No

C. GENERAL MOTOR REQUIREMENTS

Motor shall be stainless steel construction and suitable for the proposed submersible application. Motor shall include Sand Fighter construction/sealing system for protection against abrasion, and shall have a Kingsbury-type water lubricated thrust bearing with a capacity of 3,000 pounds.

The motors shall be standard vertical, premium efficiency, electric induction motors meeting all applicable NEMA, ANSI, and IEEE standards. Motors shall be constructed with Class F insulated windings, Class B 30,000 anti-friction bearings. The motor nameplates shall be rated for continuous duty at 40 degrees C ambient temperature with a 1.15 service factor.

Motors shall meet the efficiency requirements of the Washington State Energy Code (Washington Administrative Code, Title 51, Chapter 51-11) Table 14-4, regardless of whether or not a particular motor is exempted from meeting this efficiency by the Washington State Energy Code.

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.

Motor manufacturer shall verify that the submitted motor is suitable for use with the motor starting method shown in the Plans. 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.

2.13 MOTOR ADAPTER

The inlet motor adapter shall be of ASTM A744 Gr. CF8M stainless steel and shall contain a sleeve type bearing with grooves of thermoplastic material. The inlet area shall have a net open area of at least four times the eye of the impeller and shall be protected with a type 316 stainless steel screen. The openings on the screen shall not be more than 75 percent of the minimum opening of the water passage through the bowl or the impeller.

2.14 MOTOR PROTECTIVE DEVICE COORDINATION AND DOCUMENTATION

Motor overcurrent protection shall be sized by the motor manufacturer. 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., for inclusion in the O&M manuals.

This list shall also include any additional information needed to setup, program or adjust the variable frequency drive, or solid state drive (soft start) which serves motor driven equipment.

The Contractor shall record the size and/or settings of each motor protective device and drive configuration.

In addition, the Contractor shall take a digital photo of each motor nameplate when the motor arrives at the jobsite.

Spreadsheet of motor nameplate information, motor settings, drives configuration (if applicable), and photo of each nameplate shall be included in the O&M manuals.

2.15 SOLE PLATES AND FLANGES

Sole plates shall be fabricated from A36 carbon steel meeting all applicable ASTM requirements.

Discharge elbow flange shall be fabricated from A36 carbon steel meeting all applicable ASTM requirements as well as requirements noted in AWWA C207 and C208.

2.16 SPARE PARTS

The Contractor shall provide the manufacturer's recommended spare parts and special tools. At a minimum, this shall include one set of any O-rings, seals, or wear rings. All parts and tools shall be suitably identified and effectively protected from moisture and corrosion with appropriate wrappings or coatings or a combination thereof. All parts and tools shall be furnished in sturdy labeled boxes. At a minimum these shall include all special tools and appliances necessary to service, repair, and adjust the equipment.

2.17 FACTORY TESTING

Contractor shall perform certified factory performance tests in accordance with Hydraulic Institute Standards. A performance test as described in the latest edition of Hydraulic Institute's (HI) Pump Tests (ANSI/HI 11.6) shall be performed, submitted to the Engineer, and approved for each pump prior to shipment to the construction site. Pumps shall be tested at the factory to Hydraulics Institute standards, except as modified below.

- A. Test speed must be within 20 percent of the rated speed unless prior written approval is given by the Engineer.
- B. For HI 14.6.5.7.1, no less than three additional test points beyond the five points listed in the HI standard are required. Two of these points between shutoff head and design point, and one point to the right of the design point.
- C. For HI 14.6 Appendix K, 11.6.10, model tests are not allowed.
- D. A certified data sheet and performance curve shall be provided for each pump in similar fashion to HI 14.6 Appendix H pump test summary of information. At a minimum provide:
 - 1. Information per HI standards.
 - 2. TDH (ft) vs. Flow (gpm).
 - 3. Power (hp) vs. Flow (gpm).
 - 4. NPSHR (ft) vs. Flow (gpm) (catalog data is acceptable).
 - 5. Motor Input Power.
 - 6. Hydraulic Efficiency (%) vs. Flow (gpm) (where applicable).
 - 7. Overall Efficiency of motor and pump (%).

Variations between factory tests and previously submitted catalog curves may be cause for rejection.

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.

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.

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. Connect suction and discharge piping to the pump in a manner which prevents strain on pump flanges.

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, effective March 13, 1990, as prepared by Washington State Department of Ecology.

Domestic water pumps shall be disinfected per AWWA A-100 prior to installation. After disinfecting, immediately flush and rinse the pumps with clean water to remove the high chlorine concentration solution. This includes the impellers and interior of bowls and casings.

All modifications to the well casing shall be performed by a well driller currently licensed in Washington State. The well driller shall have maintained a valid Washington State license for at least the previous 5 years.

3.2 FIELD TESTING

The Contractor shall perform the field testing described in Sections 01800 and 11000.

Each pump shall be field tested when the installation is complete. The field test shall be made by the Contractor in the presence of and as directed by the Engineer. Voltage, amperage draw on each phase of power, flow capacity, discharge pressure and other significant parameters shall be recorded. 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.

A performance test similar to those described in the latest edition of Hydraulic Institute's Pump Tests (ANSI/HI 11.6) shall be performed, submitted to the Engineer, and approved for each pump.

Upon completion of pump installation and testing, manufacturer's representative shall provide written certification that equipment is fully warranted installed. Certification shall be provided that pumps meet all requirements set forth in these specifications and submittal literature. The Contractor shall also provide a written report of all test conditions and results.

The field test shall be performed to the accuracy obtainable with the monitoring equipment installed with the piping and instrumentation. If sufficient field devices are not available to test all parameters, the Contractor shall provide testing gauges and meters as needed. At a minimum, the following are needed:

- Suction pressure gauge or water level probe.
- Discharge pressure gauge.
- Flow meter.
- Electric current (Amp) meter(s), per phase.
- TDH vs. Flow at a minimum of four points, including shutoff head (unless pressure is deemed excessive by the Engineer), design flow, fully open to system or 120 percent of design flow (whichever is lower or at the discretion of the Engineer), and approximately 50 percent design flow with throttled discharge valve. Additional points may be required at the discretion of the Engineer.

Where existing gauges and meters are installed and have not been replaced under this contract, the Contractor may temporarily replace such equipment during testing with their own at their expense, if approved by the Owner. The Owner makes no guarantee of the accuracy of existing gauges and meters. The Contractor shall provide calibration certificates for all flow meters, ammeters and pressure gages to be used for all pump testing.

Results shall be within plus or minus 1 percent of the tolerances listed above under Performance Requirements.

Testing shall be completed under the observation of the Owner and Engineer.

3.3 PUMP “DUMMY” TEST

As noted on the Plans and elsewhere in this Specification, the existing well casing deviates from the vertical plane and is known to have sudden changes in alignment (i.e., “kinks”).

After acceptance of the proposed pumping equipment, but prior to installation of the new submersible pump, the Contractor shall perform a “dummy” test on the pumping equipment. The intent of the dummy test is to ensure that the proposed pumping equipment can navigate the well casing and is able to be fully and completely lowered into its final position without damage.

As part of the Work, the Contractor shall fabricate a metal shaft/cylinder with dimensions (diameter and length) that match the proposed pumping equipment, disinfect this unit, then lower the unit down the well casing to ensure the pump can reach its desired elevation. The materials for this test dummy are at the discretion of the Contractor, but shall be steel, aluminum, or other similar type metal material. Plastic dummies are not acceptable. The dummy test must be conducted in the presence of the City's preferred hydrogeologist.

All existing pumping equipment (column, couplings, tubes, pump, motor, etc.) shall be maintained onsite until successful completion of the dummy test. This is so that the existing equipment may be reinstalled if project delays are incurred as a result of failure of the dummy test.

Any work performed by the Contractor to reinstall existing equipment as a result of failure of the dummy test will be paid for under Minor Changes, or will be paid for by Change Order.

3.4 MANUFACTURER'S SERVICES

The services of a factory-trained representative of the equipment manufacturer shall be provided by the Contractor. Services shall include 2 days (two visits) onsite for the supervision of equipment startup, testing, and instruction of the Owner's personnel in the operation and maintenance of the equipment. One trip (1 day) shall be for installation inspection, certification and testing; and one trip (2 days) shall be for startup and training. Instruction and training of the Owner's personnel shall not take place until startup is completed and the equipment is 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.

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

SECTION 11345

HYPOCHLORITE METERING PUMP SYSTEM

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes furnishing and installing a new sodium hypochlorite (NaOCl) feed system as shown on the Plans and as specified herein. The sodium hypochlorite system shall consist of a metering pump skid and all associated piping, tubing, valving and accessories required for a complete and workable installation.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
01800	Testing, Commissioning and Training
09900	Painting
11000	Equipment General Provisions
13433	Chlorine Analyzer System
Division 15	Mechanical
Division 16	Electrical

1.3 EQUIPMENT LIST

Equipment numbers are as follows:

<u>Item</u>	<u>Equipment Number</u>
Sodium Hypochlorite Metering Pump 1	MP 01

1.4 PERFORMANCE REQUIREMENTS

Equipment associated with the sodium hypochlorite system shall meet the following minimum performance requirements:

Parameter	Performance Requirement
Sodium Hypochlorite Metering Pump No. 1	
Design flow (gph)	12.9
Operating Pressure (psi)	145
Solution	Sodium Hypochlorite
Solution Concentration (percent)	0.8

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 exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion. 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 metering pumps shall be Prominent Sigma 1. To maintain uniformity with existing equipment, no other manufacturers or models shall be accepted.

2.2 METERING PUMPS

A. GENERAL

The chemical metering pump(s) shall be microprocessor-controlled, motor driven pump. The pump shall have a corrosion resistant housing with a minimum IP65 protection rating.

All pumping functions shall be set from the front of the pump and status shall be displayed on an illuminated LCD.

B. ELECTRICAL

The pump shall have a universal power supply that allows it to operate using a 120VAC, 1-phase, 60 Hz electrical supply. The pumps will be provided with a grounded electrical plug-in connection, and any associated adapters or cords required for a complete and workable installation.

C. DIAPHRAGM

PTFE faced EPDM with Nylon reinforcement and a solid steel core.

D. LIQUID END

The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the drive if the primary diaphragm fails. The liquid end shall be virgin PVDF and NSF 61 Certified for use with standard water treatment chemicals.

Liquid end shall be auto degassing style without bypass.

E. STROKE

Stroke length control shall be electronically adjustable in increments of 1 percent, from 1 percent to 100 percent of stroke length. Stroke length shall be controlled by the pump solenoid without the use of mechanical stops and provide accurate feedback to the electronics of the pump for calibration for LCD display of stroke length.

Stroke frequency shall be adjustable from 1 to 12,000 strokes per hour (0.0167 to 200 strokes per minute).

It shall be possible to selectively slow the discharge and/or the suction stroke speed of the pump to accommodate application requirements and process fluid viscosity and off-gassing conditions.

F. OUTPUTS

The system shall be equipped with an output relay which shall be programmable for any of the following indications:

1. Fault Indication.
2. Fault Indication and pacing relay.
3. mA Output - The current output signal indicates the pump's actual calculated metering volume.

For simplified operator monitoring the pump shall be equipped with an LED display to locally indicate normal operation, fault conditions and warning conditions.

The pump shall be provided with sufficient inputs/outputs to accommodate the desired method of operation as shown on the Plans and

as specified herein. Contractor shall coordinate the equipment specified herein with Sections 13451 and 13452.

G. OPERATING MODES

The pump shall have the following operating modes available:

1. Manual operating mode permitting the operation of the pump stroke and speed controls manually.
2. Contact operating mode providing the option of controlling the pump externally by means of potential-free contacts. The number of pump strokes per input contact can be scaled by a factor ranging from 0.01 to 99.99 to tailor the pump feed rate to the application.
3. Batch operating mode providing the option of working with large factors. Metering can be triggered either by pressing the keypad or by a pulse received via the "External control" terminal or through a contact or a semiconductor switching element.
4. Analog operating mode allows the capacity and/or stroke rate to be controlled via an analog (4-20mA) current signal via the "External control" socket. The processing of the current signal can be preselected via the control unit.

H. MATERIALS OF CONSTRUCTION AND PUMP OPTIONS

1. Liquid end wetted materialPVDF
2. Suction/Discharge Connectors.....PVDF
3. SealsPTFE/Viton
4. Check BallsCeramic SS
5. Pressure Relief ValvesPVDF/Viton O-Rings
6. O-RingsPTFE/PTFE
7. Speed Control.....Manual, Pulse, & 4-20mA
8. Remote Pause.....Dry Contact
9. Diaphragm Failure Indicator.....Local Only

10. Output RelayFault & 4-20mA
11. Bluetooth.....None

2.3 CHEMICAL

The City will provide all chemicals, including chemicals required for startup and testing.

2.4 SODIUM HYPOCHLORITE EQUIPMENT PIPING AND VALVING

Piping, valving, fittings, and accessories shall be in accordance with Section 15050 of these Specifications.

2.5 BACK PRESSURE/PRESSURE RELIEF VALVE

Back pressure/pressure relief valves for metering pump skid shall meet the following requirements:

Diaphragm:	PTFE faced EPDM
Liquid handling materials:	PVC
Pressure adjustment:	150 psig
Process Connection:	Threaded

Valves shall be compatible with the proposed sodium hypochlorite solution and shall be coordinated with pumping equipment for a complete and workable installation.

2.6 PIPELINE STRAINER

A pipeline strainer shall be installed on the pump suction line as shown on the Plans. Strainer shall be Y-style and of PVC construction. All seals shall be viton o-rings and screen shall be of PVC construction 1/32-inch perforations.

2.7 PULSATION DAMPENER

Pulsation dampener for metering pump skid shall meet the following requirements:

Volume:	As required by pump skid manufacturer
Housing:	CPVC
Bladder:	EPDM
Process Connection:	Threaded
Operation:	Unit shall be chargeable

Column shall be compatible with the proposed sodium hypochlorite solution and shall be coordinated with pumping equipment for a complete and workable installation.

2.8 CALIBRATION COLUMN

Calibration column for metering pump skid shall meet the following requirements:

Volume:	250 mL
Material:	PVC, clear
Process Connection:	Threaded, both ends

Column shall be compatible with the proposed sodium hypochlorite solution and shall be coordinated with pumping equipment for a complete and workable installation.

2.9 VALVES

Isolation valves shall be PVC, SCH80, Tru-Union ball type, Spears, Asahi, American Valve, or equal.

2.10 PRESSURE GAUGE

Metering pump skid pressure gauge(s) shall meet the following minimum requirements:

Dial Size:	2-1/2-inch
Dial Fill:	Glycerin (80/20)
Body:	Type 316 stainless steel
Top Assembly:	Noryl
Process Connection:	Bottom, 1/4-inch or 1/2-inch NPT
O-Ring:	Viton
Diaphragm:	Viton
Selector:	Stainless steel
Accuracy:	ANSI Grade A; +/- 1.5 percent
Pressure Range:	As listed in Part 1.4

Gauges shall be supplied with bronze pressure snubber and diaphragm seal. Diaphragm seals shall have silicone DC200 fluid fill and shall have a Type 316 stainless steel body, with 1/4-inch flushing connection and 1/2-inch process connection.

2.11 BACKPLATE/SKID

The components listed above shall be mounted on a rigid plastic high density polyethylene skid. The skid shall have a minimum clearance from the floor and shall be capable of both free-standing and wall-mounted installations. HDPE shall be virgin materials and have a minimum thickness of 3/8-inch or as recommended by the skid manufacturer. Dimensions for the skid shall be minimized as much as possible, but may not exceed 36" x 16" x 42" (W x D x H).

2.12 SPARE PARTS

The Contractor shall provide the manufacturer's recommended spare parts and special tools. All parts and tools shall be suitably identified and effectively protected from moisture and corrosion with appropriate wrappings or coatings or a combination thereof. All parts and tools shall be furnished in sturdy labeled boxes. At a minimum these shall include all special tools and appliances necessary to service, repair, and adjust the equipment, and the following spare parts items:

Pumphead assemblyone set for each pump supplied

2.13 PAINTING

Units, motors, and accessories shall be painted in accordance with Section 09900. Nameplates, drain holes, vent openings, or lubrication fittings shall not be painted.

2.14 FACTORY TESTING

The pumps shall be fully tested on water at the manufacturer's plant before shipment. Tests shall consist of checking the unit at its rated speed, head, and capacity. Certified copies of test curves and report shall be submitted to the Engineer prior to shipment.

PART 3 EXECUTION

3.1 INSTALLATION

The equipment shall be installed as shown on the Plans and in accordance with the manufacturer's instructions and recommendations.

3.2 FIELD TESTING

The Contractor shall perform the field testing described in Sections 01800 and 11000.

The field test shall be made by the Contractor in the presence of and as directed by the Engineer. The entire sodium hypochlorite system shall be tested to ensure a complete and workable installation. 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. Completed forms shall be provided by the Contractor within 14 calendar days of completion of 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 equipment manufacturer shall be provided by the Contractor. Services shall include 2 days (two visits) onsite for the supervision of equipment startup, testing and instruction of the Owner's personnel in the operation and maintenance of the equipment. One trip (1 day) shall be for installation inspection, certification and testing; and one trip (2 days) shall be for startup and training. Instruction and training of the Owner's personnel shall not take place until startup is completed and the equipment is 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.

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

SECTION 13429

FLOW SWITCHES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes furnishing and installing flow switches as shown on the Plans and as specified herein. The flow switches shall include all necessary grounding rings, accessories, cables, and hardware for a complete and workable installation.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
01800	Testing, Commissioning, and Training
11000	Equipment General Provisions
13433	Chlorine Analyzer System
Division 16	Electrical

1.3 EQUIPMENT LIST

Equipment numbers are as follows:

<u>Item</u>	<u>Equipment Number</u>
Chlorine Analyzer Flow Switch	FS 01

1.4 PERFORMANCE REQUIREMENTS

The flow switch shall be designed to monitor the presence of flow in the chlorine analyzer supply piping and shall be suitable for a flow range between 5-100 gph.

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 protected and stored as specified in accordance with the manufacturer's recommendations.

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 structural, mechanical and electrical designs shown on the Plans are based on the equipment manufactured by Prominent. Any modifications to the mechanical, structural, electrical, instrumentation and control and other portions of work that may be required to adapt the general layout and details shown on the Plans to the equipment actually furnished shall be at no additional cost to the Owner. All necessary revisions shall be made at Contractor's sole expense. All redesign information prepared by the contractor shall be submitted for review prior to incorporating the redesign into the work.

2.2 FLOW SWITCHES

A. GENERAL

Flow switches shall be compatible with liquids. Unit should allow for field installation in pipelines from 1/2-inch to 1-inch diameter. The intent of the switch is to monitor/sense flow to the chlorine analyzer, and to alarm the Owner (via the PLC) if flow to the chlorine analyzer is paused, stopped, or interrupted.

B. MATERIALS OF CONSTRUCTION

1. Vane: Type 301 stainless steel.
2. Body: Type 303 stainless steel.
3. Magnet: Ceramic 8.
4. Other: Type 301 or 316 stainless steel.

C. OTHER PERFORMANCE PROPERTIES

1. Temperature: The unit shall be rated for ambient temperatures up to 150 degrees F and media temperatures up to 100 degrees F.
2. Pressure: The unit shall be compatible for system pressures up to 200 psi.
3. Enclosure: The enclosure shall be NEMA 4X compliant.

4. Type: SPST hermetically sealed reed switch. The switch shall be field adjustable for normally open or normally closed.
5. Process Connection: 1/2-inch or as shown on the Plans.
6. Operation: The vane and all associated setpoints for the switch shall be field adjustable (trimmable).

D. ELECTRICAL

Switch shall be compatible with the proposed 24VDC electrical service. 120VAC units are acceptable, but the Contractor shall coordinate any and all changes to the electrical components necessary for this change. The costs for these changes, as well as any additional design needed, shall be fully borne by the Contractor.

Unit shall be UL listed or certified by an acceptable agency and shall be suitable for the proposed installation in accordance with all applicable codes, requirements, and regulations.

2.3 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 switch shall be installed as shown on the Plans. Installation shall be in strict 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 flow switch 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.

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

SECTION 13433

CHLORINE ANALYZER SYSTEM

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes furnishing and installing one new chlorine analyzer system as shown on the Plans and as specified herein. The analyzer system shall include sensor, sensor holder, cables, cords, controller(s), and all necessary accessories and hardware for a complete and workable system.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
01800	Testing, Commissioning, and Training
11000	Equipment General Provisions
11345	Hypochlorite Metering Pump System
13429	Flow Switch
Division 15	Mechanical
Division 16	Electrical

1.3 EQUIPMENT LIST

Equipment numbers are as follows:

<u>Item</u>	<u>Equipment Number</u>
Chlorine Analyzer System	CA 01

1.4 PERFORMANCE REQUIREMENTS

The system shall be capable of measuring free chlorine in potable water with the following characteristics:

Parameter	Value
pH	5.0 – 9.0
Temperature (deg-C)	8 – 20
Free chlorine (mg/L)	0.5 – 1.5
Alkalinity (mg/L as CaCO ₃)	70 – 130
Hardness (mg/L as CaCO ₃)	80 – 140
Total Iron (mg/L)	≤0.05

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 chlorine analyzer system shall be as manufactured by Prominent. In order to maintain uniformity with the Owner's existing equipment, no other manufacturers or equipment is acceptable.

2.2 GENERAL

The intent of this Specification is to provide the Owner with a fully operational chlorine, pH, and temperature analysis system. The system shall be capable of measuring the chlorine residual from the finished potable water, displaying the results from that measurement, and relaying the measured value to the City's PLC for display on a separate monitoring system. Additionally, the pH and temperature values as measured by the chlorine analyzer shall also be displayed and relayed to the City's PLC.

Systems that utilize reagents for this analysis are not acceptable.

2.3 SENSOR

Sensors shall be Prominent CLE (free chlorine), Prominent PHEI 112SE (pH), and Prominent PT1000 (temperature). No other manufacturers shall be accepted. The sensors shall be mounted on a common panel with all other analytical appurtenances and shall be as follows:

A. FREE CHLORINE

- | | | |
|----|-------|-----|
| 1. | Type: | CLE |
| 2. | Body: | - |

3. Range: 0.01 - 5 mg/L (ppm)
4. Pressure: 0 - 14 psi
5. Temperature: 40 - 110 deg-F
6. Input Power: 24 VDC
7. Output: 1x, Digital

B. pH

1. Type: Potentiometric
2. Body: FRP reinforced polypropylene
3. Range: 0 - 14
4. Pressure: 0 - 14 psi
5. Temperature: 35 - 110 deg-F
6. Input Power: 24 VDC
7. Output: 1x, Digital

C. TEMPERATURE

1. Type: -
2. Body: Glass sleeve with polypropylene head
3. Range: 32 - 212 deg-F
4. Pressure: 0 - 14 psi
5. Temperature: 35 - 110 deg-F
6. Input Power: 24 VDC
7. Output: 1x, Digital

2.4 WYE STRAINER

A pipeline strainer shall be installed on the pump suction line as shown on the Plans. Strainer shall be Y-style and of PVC construction. All seals shall be viton o-rings and the screen shall be of PVC construction 1/32-inch perforations.

2.5 CARTRIDGE FILTER

The Contractor shall salvage and reinstall the Owner's existing cartridge filter housing. Filter housing shall be installed as shown on the Plans. The Owner will provide a new filter cartridge for installation by the Contractor.

2.6 PRESSURE REGULATOR VALVE

A miniature plastic water pressure regulator shall be installed where indicated on the Plans. Regulator shall be corrosion resistant, compact and lightweight. Regulator shall be manufactured from NSF approved plastics and contain FDA grade internal rubber and metal parts.

Pressure adjustment shall be compatible with the inlet pressure as required by the analyzer system manufacturer.

Valve shall be Watts Series P60-M1, or equal.

2.7 ISOLATION VALVE

Isolation valves shall be PVC, SCH80, Tru-Union ball type, Spears, Asahi, American Valve, or equal.

2.8 NEEDLE VALVE

Needle valves shall provide high level of flow control. Valves shall be PVC, Sch. 80, and with EPDM or PTFE o-rings/seals. Connection types shall be coordinated with adjacent piping, but shall be 3/8-inch or 1/2-inch unless noted otherwise on the Plans.

Valves shall be suitable for operational pressures up to 250 psi.

Valves shall be Marquest NG, or equal.

2.9 FLOW MEASUREMENT MODULE

Shall allow for the precise flow through the analyzer system. Provide engraved or molded marking lines in gph and/or gpm as required. Material of construction shall be clear PVC with FPM seals.

2.10 BACKBOARD

The components listed above shall be mounted on a rigid plastic high density polyethylene skid. The skid shall have a minimum clearance from the floor and shall be capable of both free-standing and wall-mounted installations. HDPE shall be virgin materials and have a minimum thickness of 3/8-inch or as recommended by the skid manufacturer.

2.11 SENSOR HOLDER

Each sensor shall be provided with a sensor holder. The holder shall be clear PVC material with integral flow control valve and rotameter for flow adjustment. Flow shall be directed at the sensor membrane to provide continuous cleaning action.

2.12 FLOW SWITCH

A flow switch shall be provided as specified in Section 13429 of these Specifications.

2.13 CONTROLLER

Controller shall be Prominent DACb. No other manufacturers shall be accepted. The controller shall be mounted on a common panel with all other analytical appurtenances and shall be as follows:

A. MATERIALS OF CONSTRUCTION AND PERFORMANCE PROPERTIES

- | | | |
|----|--------------------|--|
| 1. | Type: | Multi-parameter controller |
| 2. | Input power: | 120 VAC, 60 Hz |
| 3. | Inputs: | 4-20mA (sensors) |
| 4. | Outputs: | 3x 4-20mA (one each for chlorine, pH, and temperature), max load of 450 Ohms
Additional outputs for controls and alarms shall be provided |
| 5. | Temperature range: | 0 - 120 deg-F |
| 6. | Enclosure: | Polycarbonate, NEMA 4x |
| 7. | Display: | LCD with backlight |

The controller shall include at least one controllable pulse output for control of the sodium hypochlorite metering pump. The pulse output shall provide PID algorithm and shall be spannable from 1 – 500 pulses per minute. Pulse shall be by reed relay with a rated life greater than 50 x 0106 switching operations. Sepoint control shall be provided with a single control output by factoring a water flow input times the calculated PIC control output. Flow signal shall be input by means of a 4-20 mA signal.

The controller shall include relay outputs rated for 250 VAC (3A). Relays shall include one general fault alarm relay to change state upon exceeding limits, loss of input signal, or sensor failure. Two additional limit relays shall be provided, each with adjustable hysteresis periods, one of which shall include a fault alarm relay to change state upon exceeding limits, loss of input signals, or sensor failure.

The process control instrumentation and equipment shall be of solid state type and of the manufacturer's latest design. The equipment shall use 4 to 20 milliamperes standard DC (direct current) signals. Transmitted electronic signals between equipment items shall be separate isolated floating outputs for each item of equipment and shall conform to ISA 50.1. Signals and equipment capacities,

impedance's, resistances, etc. shall be compatible throughout a loop and from loop to loop for similar equipment. The system components shall be designed to operate as a complete system.

2.14 SPARE PARTS

The Contractor shall provide the manufacturer's recommended spare parts and special tools. All parts and tools shall be suitably identified and effectively protected from moisture and corrosion with appropriate wrappings or coatings or a combination thereof. All parts and tools shall be furnished in sturdy labeled boxes. At a minimum these shall include all special tools and appliances necessary to service, repair, and adjust the equipment.

2.15 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. Signed copies of test report(s) shall be submitted to the Engineer prior to shipment.

PART 3 EXECUTION

3.1 INSTALLATION

The chlorine analyzer system shall be installed as shown on the Plans and in strict accordance with the manufacturer's instructions and recommendations.

3.3 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.

3.4 MANUFACTURER'S SERVICES

The services of a factory-trained representative of the chlorine analyzer system manufacturer shall be provided. Services shall include a minimum of 2 days (two trips) 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

analyzers 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.

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

SECTION 13451

PLC PROGRAMMING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes Programmable Logic Controller (PLC) and Operator Interface Unit (OIU) programming requirements, internal testing, witness testing, commissioning, and training responsibilities.

1.2 RELATED WORKS SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
13452	Human Machine Interface (HMI) Programming

1.3 SYSTEM REQUIREMENTS

A. DESIGN REQUIREMENTS

Reference Specification 13452 for HMI programming 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.
2. The system includes programmed screens which run on the OIU hardware to provide status, alarming, and setpoint modification for the process.

B. PERFORMANCE REQUIREMENTS

1. The installed system performs the functional and operational algorithms required for control of the process.
2. The installed system allows the operator to view process information and configure operator adjustable parameters in the PLC.

1.4 DEFINITIONS

A. GENERAL

Reference Section 16050 for additional information.

B. FACILITIES INTEGRATOR

If required for this project, the Facility Integrator shall be either of the following vendors:

1. Technical Systems Inc.
23030 196th Street SW
Lynnwood, WA 98036
(425) 775-5696
Attn: Colin Dightman-Kovak
colind@tsicontrols.com
2. Systems Interface, Inc.
10802 47th Avenue West
Mukilteo, WA 98275
(425) 622-9550
Attn: Lars Knapp
ljk@systems-interface.com

No other Facility Integrators will be accepted.

C. PROGRAMMER

For this project, the Programmer shall be as follows:

1. SCADA & Controls Engineering, Inc.
(425) 818-0160
Attn: Caden Sowers
caden@scadace.com

No Programmer substitutions will be allowed. The Programmer is a City-provided Programmer and is not a subcontractor and/or subconsultant of the Contractor.

1.5 SYSTEM DESCRIPTION

This section describes the minimum requirements for the main control system as indicated on the Plans and as specified herein. The control components and programming shall be supplied, installed and programmed as an integrated system which includes all hardware, accessories, and programming necessary for operation.

A. WORK TO BE PROVIDED BY THE FACILITY INTEGRATOR

The Facility Integrator shall be responsible for the coordination and integrated testing, startup, and commissioning of the pump control system, and the site's PLC control panel Control panel.

1. Motor Starter Panels

The Facility Integrator shall furnish, assemble, test, and commission motor starters as indicated by the Plans and Specifications and provide startup and training services related to this equipment.

- a. See Specification Section 16420 for any additional information.
- b. Work associated with motor starter control panels shall include procurement, fabrication, testing, shipping, and commissioning of the motor starters per the Plans and Section 16420.
- c. Control panels shall be fabricated following the controls as shown on the Plans. The exact dimensions and component layout shall be submitted for approval prior to procurement and fabrication.
- d. The Contractor shall coordinate all interface signals shown on the Plans with the Facility Integrator.
- e. Demolition of the existing motor starters and installation of the new starters shall be by the Contractor.

The Facility Integrator shall also coordinate and schedule Factory Testing as described later in this Section.

2. Control Panel

The Facility Integrator shall furnish, assemble, test, and commission the required panel as indicated by the Plans and specifications and provide startup and training services related to this equipment.

- a. With the exception of PLC and OIU programming, all work associated with to the panel, hardware procurement and installation, and internal wiring shall be provided by the Facility Integrator.
- b. The Facility Integrator shall furnish, assemble, and test new equipment within the panel.

B. WORK TO BE PROVIDED BY THE PROGRAMMER

1. All PLC, OIU, and HMI programming including new process control programming, OIU screens, HMI screens, and database updates shall be provided by the Programmer. Responsibilities include, but are not limited to:
 - a. Providing, installing, and testing the process control program, integrating new functions within the PLC, and providing OIU screens and operator controls as described herein.
 - b. Programming and assisting with testing the PLC at the Facility Integrator's shop.
 - c. Field testing and adjustments as required, for a complete and workable system.

C. TOTAL SYSTEM

1. The assignment of specific responsibilities herein to the Facility Integrator and Programmer shall not, in any way and under any conditions, diminish or usurp the Contractor's full and complete responsibility for all work performed and all materials installed under the contract. The contract between the Contractor and the Facility Integrator shall specifically require that the Facility Integrator conform to and meet all requirements of the Owner and as specified herein.

2. Responsibilities of the Contractor include but are not limited to:
 - a. Reviewing the Facility Integrator's submittals and wiring diagrams for coordination with programming, space requirements, raceway requirements of field wiring, etc.
 - b. Supplying the Facility Integrator with submittals of equipment related to the control system which the Facility Integrator must include in their submittals and incorporate into the work, such as motors, packaged control panels, metering enclosures, power distribution panels and enclosures, etc. which the Facility Integrator does not build or provide.
 - c. Installation of the control panels.
 - d. Installation of the interconnecting wiring per the Facility Integrator's wiring diagrams.
 - e. Installation of instruments per detailed contract drawings or drawings or instruction supplied by the Facility Integrator.
 - f. Coordination between the Facility Integrator and Programmer as required to complete the work.
 - g. Coordinate with the Owner's inspector for scheduling instrumentation commissioning/pre-start inspection. The Contractor and their electrical subcontractor shall be present for the instrumentation commissioning/pre-start inspection.
 - h. The Contractor shall be required to complete any punch list items from the City that are a result from the pre-start inspection.

1.6 SUBMITTALS

A. PRODUCT DATA

1. Submit, at least 1 month before the start of commissioning, all proposed OIU screens including the following:
 - a. Description and pictorial of proposed screen layout(s).

- b. Description and pictorial of graphic symbols used to represent process equipment.
- c. Displayed operator configurable parameters and setpoints

B. OPERATION AND MAINTENANCE MANUALS

1. After acceptance of the final programmed product, provide the following:
 - a. Two electronic copies of the final annotated source code of system programming, final cross reference, and final I/O and register lists. Provide this information on two USB memory sticks and CDs.
 - i. Annotations include the following:
 - (1) Description of each rung's intended function.
 - (2) Description of each coil, contact, timer, counter, or similar function block component.
 - ii. Aliasing section where each I/O point is aliased to a logical function name. Use dot fields if available.
 - 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.
2. Description of proposed screens detailing operator controls.

1.7 QUALITY ASSURANCE

Utilize one lead PLC programmer for the entire project.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 APPLICATION

Provide programming to accomplish all control and monitoring requirements indicated or specified.

The programming work shall be provided to match the existing system control and display scheme to the maximum extent possible. Provide all organization, buffering, and logic to match the existing system.

3.2 PROGRAM CONTROL METHODS

A motor is considered running “UNDER-LOADED” when it’s motor current $I_m < 5\%$ of its Full Load Amp (FLA) rating for more than 5 consecutive seconds. This is indicative of a motor disconnected from its load (broken coupling, broken shaft, etc.)

A motor is considered running in its “NORMAL” range when $5\% \leq I_m \leq 110\%$ FLA (true for motors with service factor of 1.15).

A motor is considered running “OVER-LOADED” when it’s motor current $I_m > 110\%$ FLA for more than 5 consecutive seconds (true for motors with service factor of 1.15).

3.3 PROCESS CONTROL ALGORITHM

The Programmer shall attend up to four telephone meetings with the Owner and the Engineer to determine and document programming changes required to display the status of the new equipment as specified herein and in Section 13452. The Programmer shall coordinate their programming and SCADA communication with the Owner's existing system.

The Programmer shall provide services to in order to achieve the level of control and monitoring as described below. Additionally, the Programmer shall provide up to 8 hours to coordinate and program additional signals or programming services as desired by the Owner.

If no alarm setpoint is provided below, the Programmer shall coordinate with the Engineer or the Owner for this information.

A. GENERAL OPERATIONAL SEQUENCE

The specific operating algorithm for the project components is described below, but the following text provides a generic description of the overall desired system function.

The system is designed to move water from one well (S10) at the project location to the City's distribution system and storage reservoirs. The operation of the well pump is controlled by the water level within the storage reservoirs, and when the water level within the reservoir drops to a setpoint, the well pump is called to energize. The well pump then moves water first through the pump to waste piping, then through the discharge piping and on to the distribution system and/or storage reservoirs. When the water level in the storage reservoirs reaches the appropriate (pump off) setpoint, the well pump will de-energize.

B. WELL PUMP

1. Well S10 Pump

a. Equipment ID numbers (Tags)

Well Pump 1 [WP 01]

b. Process Control Description

The final control narrative, operational sequence, and alarm/response conditions shall be determined by the City in collaboration with the Programmer during construction.

c. Method of Process Control

The method of process control will remain the same as the existing system to the maximum extent possible.

2. Hydraulic Control Valves

a. Equipment ID numbers (Tags)

Well S10 Flow to Waste Valve [HCV 01]

Well S10 Discharge Valve [HCV 02]

b. Process Control Description

The hydraulic control valves control the flow of water through either a flow to waste system or to the discharge piping.

c. Method of Process Control

The method of control for the hydraulic control valves will not change.

d. Monitoring and Alarms

The new system will maintain the same monitoring and alarm conditions as the existing system.

C. INSTRUMENTATION

1. Chemical Metering Pump

a. Equipment ID numbers (Tags)

S10 Chemical Metering Pump [MP 01]

b. Process Control Description

The metering pump (Chlorine Building) moves sodium hypochlorite solution from the existing storage tank (Chlorine Building) to the S10 well discharge piping (Pump Building).

The final control narrative, operational sequence, and alarm/response conditions shall be determined by the City in collaboration with the Programmer during construction.

c. Method of Process Control

The new equipment will be controlled by the City's PLC and SCADA system. Controls will be as similar to the existing conditions as possible.

d. Monitoring and Alarms

The final control narrative, operational sequence, and alarm/response conditions shall be determined by the City in collaboration with the Programmer during construction.

2. Chlorine Analyzer

a. Equipment ID numbers (Tags)

S10 Chlorine Analyzer [CLA 01]

b. Process Control Description

The final control narrative, operational sequence, and alarm/response conditions shall be determined by the City in collaboration with the Programmer during construction.

c. Method of Process Control

The new equipment will be controlled by the City's PLC and SCADA system. Controls will be as similar to the existing conditions as possible.

d. Monitoring and Alarms

The final control narrative, operational sequence, and alarm/response conditions shall be determined by the City in collaboration with the Programmer during construction.

D. OIU PROGRAMMING

1. General Schematic Screen Requirements

OIU screens shall match the Owner's existing system to the maximum extent possible.

2. 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.

3. 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.

The screens shall have an appearance and level of complexity similar to the Owner's existing SCADA/HMI screens.

3.4 SOURCE QUALITY CONTROL

A. FACTORY TESTING

The Facility Integrator shall schedule a factory test of all items for the City to inspect prior to field installation. The factory test will test the control panels, etc., as described in the Contract Documents. All items noted in the factory test shall be completed prior to field installation. At a minimum, the factory testing shall include the following tasks:

1. Operate the program through all possible input paths and check for correct operation including program operation, loop controls, indications, alarm responses, and on/off sequencing control.
2. Simulate or emulate I/O conditions to verify proper operation of programming.
3. Coordinate parameter addressing, aliasing, and integrated operation with the OIU and HMI programmer.

B. FIELD TESTING, PRIOR TO COMMISSIONING

The Facility Integrator shall assist with PLC commissioning and shall provide a PC and software as required during testing to allow viewing of system parameters. Verify remote communication and transfer of data. Verify proper transfer of data through all networked devices. Test and calibrate PLC scaling against actual instruments.

1. Assist in verifying all field I/O connectivity.
2. Test all analog I/O scaling and internal setpoints against actual instruments.
3. Test proper control operation of program.

4. Test PLC communication and process data and control with all networked devices (OIU, HMI, motor starters, etc.).
5. Coordinate testing with OIU and HMI programmers.

C. FIELD TESTING, DURING COMMISSIONING

Provide for programming personnel to be present on site at startup of the system(s):

1. Demonstrate PLC communication and process data and control with all networked devices (OIU, HMI, motor starters, etc.).
2. Demonstrate proper operation of the process control program, alarming functions, and setpoint input functions with the Process Engineer and the Owner.
3. Make adjustments to parameters, setpoints, and program as required to satisfy control requirements.
4. 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.

D. DEMONSTRATION

Demonstrate the system in accordance with Section 01800.

E. ON-SITE TRAINING

1. Provide the following training/modification sessions at the Owner's facility for Owner's operating and maintenance personnel by an instructor familiar with both the manufacturer's commercially available applications provided, and the specific programmed applications provided for this project, after the system has successfully completed commissioning and acceptance procedures.
 - a. Integrator
 - i. Up to 4 hours of training on equipment and operation thereof.

- ii. Provide for up to an additional 4 hours of system adjustments for optimization.
- b. Programmer
 - i. Up to 4 hours of training on equipment and operation thereof.
 - ii. Provide for up to an additional 8 hours of system adjustments for optimization or coordination.

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

SECTION 13452

HMI PROGRAMMING

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of Human Machine Interface (HMI) and peripheral support device programming, internal testing, witness testing, commissioning, and training responsibilities.

1.2 RELATED WORKS SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
13451	PLC Programming

1.3 SYSTEM REQUIREMENTS

Program new algorithms, screens, pop-up windows, data storage, and alarm features for the HMI computer as described herein.

In all cases listed here, colors, locations, naming, or other designations are for guidance only. The aesthetic of the desired additions show match the Owner's existing system to the maximum extent possible. The style of additional screens shall match the overall appearance of existing HMI screens.

1.4 DEFINITIONS

Reference specification 16050.

1.5 SUBMITTALS

A. PRODUCT DATA

1. Submit, at least 30 calendar days prior to startup, all proposed HMI screens including the following:
 - a. Description and pictorial of proposed screen layout(s).
 - b. Description and pictorial of graphic symbols used to represent process equipment.
 - c. Displayed operator configurable parameters and setpoints

B. OPERATION AND MAINTENANCE MANUALS

1. Final copies of annotated computer system configuration.
Annotations include:
 - a. Logins and passwords
 - b. Protocols installed and associated configurations.
 - c. Services installed and associated configuration.
 - d. Description of the functions and controls on each screen.

PART 2 PRODUCTS

2.1 APPLICATION

A. CREATE TAG NAME DATABASE AND SCRIPTS

1. Provide programming to accomplish all operator control and monitoring requirements indicated or specified in Specification Section 13451.
2. Provide programming to accomplish all operator control and monitoring requirements associated with other local networked devices that contain not resident within the PLC.
3. Provide system programming required for communication between facilities via selected telemetric technology.

B. PROGRAM ORGANIZATION

1. Organize and format additions to the tag name database logically and consistently with the existing system/equipment.

Assign tag names in a consistent manner which identifies the general purpose of the actual variables.

Programming and annotation for any given program or script shall be formatted and organized similarly to other comparable scripts in the system.

2. Organize and format the screens logically and consistently.

Assign screen names in a consistent manner which identifies the general purpose of the screen.

Objects, symbols, cells, and screens denoting similar equipment, systems, or plant processes shall be formatted and displayed similarly in the system. In addition, new objects shall be displayed and formatted similarly to the existing ones.

3. Create the program to utilize system memory and resources in an efficient and logical manner.

Assign or use tag names, scripts, and memory space to minimize complexity, and memory space, but not at the expense of logical order or function.

C. PROCESS DESCRIPTION

Review the process algorithm descriptions in Section 13451 and coordinate the program and screens with the requirements described therein. Provide displays or screens for information described there even if not described in this Section.

2.2 HMI PROGRAMMING AND SCREENS

A. GENERAL

1. Error Traps

- a. Include error traps to prevent mis-keyed or erroneous values from being entered into the system. This includes items such as, but not limited to:
 - i. Non-numerical keystrokes or entries for numerical values.
 - ii. Values outside expected ranges.
 - iii. Provide warning when low setpoints being higher than high setpoints.
 - iv. Provide warning when high setpoints being lower than low setpoints.

- b. Include confirmation steps for operator entered values such that entry of a new value is a two-step process requiring entry of the number plus a confirmatory keystroke not likely to occur by accident.
- 2. Alarm Groups
 - a. Alarm groups shall be assigned according to the process areas of the facility.
 - b. Tag names shall be assigned to alarm groups in accordance with the location of the equipment with which they are most closely associated.

PART 3 EXECUTION

3.1 HMI PROGRAMMING

The HMI software shall be programmed to provide the screen displays and functionality as described in the following sections. In addition to the functions described below, the HMI system shall be provided with all of the functions of the current HMI system.

It is the intent of this project to modify the existing SCADA screens to the maximum extent possible in lieu of developing new screens. This will help ensure familiarity of the system for the City staff, and in general, continued operations in accordance with historical procedures.

The final control narrative, operational sequence, alarm/response conditions, and how they are displayed on City devices shall be determined by the City in collaboration with the Programmer during construction.

The following sections are provided as a general guideline, but it is the intent of this specification to have the new, proposed screens and programming match those of the Owner's existing system to the maximum extent possible.

A. GENERAL SCHEMATIC SCREEN REQUIREMENTS

HMI screens shall match the Owner's existing system to the maximum extent possible.

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.

E. AUTODIALER

The software autodialer shall be programmed with the names and phone numbers of contacts specified by the Owner. Call schedules shall be set up to meet the Owner's needs for weekday working hours, weekday nights, weekends, and holidays. Alarm tags shall be set up to dial-out on alarm conditions.

F. DATA ACQUISITION AND DATABASE MANAGEMENT

The HMI system shall be set-up to manage collected data in an efficient manner so that it can be displayed, recorded, trended and reported as needed by the operator.

G. REPORTS

All existing reporting capabilities provided by the Owner's existing system shall be maintained.

3.2 DEMONSTRATION AND TRAINING

Demonstrate the system in accordance with Section 01800.

Provide the following training/modification 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.

1. Integrator
 - a. Up to 8 hours of training on equipment and operation thereof.
 - b. Provide for up to an additional 8 hours of system adjustments for optimization.
2. Programmer
 - a. Up to 8 hours of training on equipment and operation thereof.
 - b. Provide for up to an additional 8 hours of system adjustments for optimization or coordination.

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

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

<u>Section</u>	<u>Item</u>
01800	Testing, Commissioning and Training
09900	Painting
Division 11	Equipment
Division 13	Special Construction
Division 15	Mechanical
Division 16	Electrical
Section D	City of Lacey Specifications

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. Piping materials and other technical information may also be provided in Section D.

<u>Process</u>	<u>Abby.</u>	<u>Above Grade</u>	<u>Below Grade</u>
Drain <4"	D	Cast Iron, No Hub	Cast Iron, No Hub
Drain ≥4"	D	Ductile Iron, FL	Per Section D
Water (<2")	W	Per Section D	Per Section D
Water (>2")	W	Ductile Iron, FL	Ductile Iron, MJ
Water, Plumbing	W	Copper, THD/S	Welded HDPE
Sample	SAM	Solvent Welded PVC (Sch. 80)	Solvent Welded PVC (Sch. 80)
Vent, Plumbing and Drainage	V	Schedule 40 PVC	Cast Iron, No Hub

1.5 SUBMITTALS

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 piping in contact with potable water shall be certified under NSF 61 and NSF 372 for potable water use.

For information on piping not shown below, please see Section D of the project Specifications for more information.

2.2 PVC PIPE AND FITTINGS

All PVC pipe shall be Schedule 80. Joints shall be solvent weld with press fit.

Provisions for pipe expansion shall be as recommended by the pipe manufacturer.

Bolts for PVC pipe, where required, shall be 316 stainless steel, ASTM A193, Grade B8M, hex head with ASTM A194, Grade 8M hex nuts. Washers of the same material shall be supplied.

2.3 VINYL TUBING

Vinyl tubing for sample line shall be Norton PRS Industrial Grade PVC, formulation C-486-A, sized as required by the component manufacturer.

2.4 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. FLANGED COUPLING ADAPTERS

Flanged coupling adapters shall be Rockwell (Smith-Blair) Type 912, Dresser Style 127, or equal.

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. 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.

E. 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.

F. 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.

G. 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 OmniSleeve® 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.

H. BRONZE AND BRASS MATERIALS

All bronze and brass fittings shall be made in America and must be certified as such. Bronze and brass fittings and connectors not made in America are not acceptable.

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

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 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.

3.5 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.

3.6 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.

3.7 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.

3.8 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.

3.9 PIPE BEDDING

All pipe shall be bedded as specified and/or as shown on the Plans.

3.10 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 calendar 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 shall be pressurized with water to 100 psig and remain leaktight for a period of 4 hours.

Plant potable water piping shall be pressurized with water to 125 psig and remain leaktight for a period of 1 hour.

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

Shall be as required in Specification Section D.

***** 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

<u>Section</u>	<u>Item</u>
01800	Testing, Commissioning, and Training
09900	Painting
Division 15	Mechanical
Division 16	Electrical

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
IPC	International Plumbing Code

1.4 SUBMITTALS

Manufacturer's technical data for all hangers, brackets, supports and documentation of conformance with appropriate standards and these specifications.

Location of pipe and conduit support, including type of structural and pipe attachments, shown on detail drawings and/or specified in Section 15050.

PART 2 PRODUCTS

2.1 GENERAL

The Contractor shall furnish 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 Part 1.3 of this Section.

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 Part 2.7 of this Section 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 Type 316 stainless steel for outdoor use.

Pipe and conduit clamps and hangers shall be as manufactured by Anvil or equal and shall be as follows:

Type	Pipe Size (In.)	Pipe Material	Anvil Figure
Swivel Ring, Split Type	3/4 to 8	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	3 to 24	All type	590
Pipe Clamp	3 to 42	All type	216
Socket Clamp	4 to 24	Cast Iron	595
Pipe Stanchion	4 to 24	All Type	63
Stanchion Saddle	4 to 36	All type	259
Adjustable Saddle Support	3 to 36	All type	264
Riser Clamp	2 to 24	All type	40
Adjustable Pipe Roll	6 to 12	Stainless Steel	177, 181, or 274

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 Plans. 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 166 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	6
	Copper	4-1/2
	Plastic	continuous
	Tubing	continuous
1-1/4 to 2"	Iron or Steel	8
	Copper or Plastic	5
2-1/2 to 4"	Iron or Steel	10
	Copper or Plastic	6
6 to 8"	Iron or Steel	12
	Plastic	8

PART 3 EXECUTION

3.1 INSTALLATION

Pipe support system shall be installed strictly in accordance with standards and codes referenced in paragraph 1.3 of this Section 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

<u>Section</u>	<u>Item</u>
01800	Testing, Commissioning and Training
Division 11	Equipment
Division 15	Mechanical

1.3 SUBMITTALS

Submit Catalog cuts and shop drawings 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. All materials in contact with potable water shall be NSF 61 and NSF 372 certified for potable water use. See Section 15400 for Plumbing specifications and requirements.

PART 2 PRODUCTS

2.1 GENERAL

Valves listed below are for above grade equipment only. Information on buried equipment is provided elsewhere in the project documents.

For information on valves not shown below, please see Section D of the project Specifications for more information.

2.2 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.

2.3 CHECK VALVES

Check valves for well pump discharge shall be as specified in Section 11211.

2.4 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.

2.5 VALVE BOXES

For all valves installed underground, the Contractor shall furnish and install valve boxes as shown on the Plans.

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.

***** 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.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
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.

All materials in contact with potable water shall be NSF 61 and NSF 372 certified for potable water use.

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. 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.

3. Brass Materials

All brass pipe and fittings shall be manufactured in the United States of America and comply with public law 111-380 (reduction of lead in Drinking Water Act). Imported brass pipe and fittings shall not be permitted.

2.2 PIPING SPECIALTIES

A. UNIONS

2 inches and smaller; ground joint, malleable iron type. Grinnell, Crane, Walworth, Syspac.

B. INSULATING UNION

Epcos, Capitol.

C. PIPE MARKING

See Section 15050.

2.3 MECHANICAL SUPPORTING DEVICES

A. PIPE HANGERS

Adjustable threaded rod type in accord with MSS SP-58, MSS SP-69, and ANSI B31.1

B. ALIGNMENT GUIDES

Keflex series P or equal by Flexonics.

PART 3 EXECUTION

3.1 PIPE AND PIPE FITTINGS

A. PIPES

Remove burrs by reaming. Use Teflon tape on male threads only.

B. OPENINGS IN PIPES

Keep closed during progress of work.

C. COORDINATION

Install so as not to interfere with light fixtures or other trade components.

D. CLOSE NIPPLES

Not permitted on any part of work. Use standard short nipples for short pipe connections. Use of bushings not permitted.

E. 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.

F. 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.

G. CUTTING OF COPPER PIPE

Use a cutter. Smooth sharp edges with emery cloth.

H. SADDLES ON PIPE IN LIEU OF TEES AND BENDING PIPE

Not permitted.

I. EQUIPMENT ISOLATION

Provide isolation valves (gate or ball valve) and unions at piping connections to all equipment.

J. CONCEALED PIPING

Conceal all piping in finished areas unless otherwise noted.

3.2 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. UNIONS

Install at final connections to all equipment items and on control side of all valves in mains, branches and risers.

C. 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.

3.3 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.

3.4 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 their operations on the project.

3.5 CONTAMINATION

Prevent contamination of the pipeline during construction from any operation or source.

3.6 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.

3.7 TESTING AND STERILIZATION

Shall be as required in Specification Section D.

3.8 INSPECTION

It shall be the Contractor's responsibility to contact the Owner and arrange for final inspection.

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

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 WORKS SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
01800	Testing, Commissioning, and Training
Division 3	Concrete
09900	Painting
11000	Equipment General Provisions
Division 15	Mechanical
Division 16	Electrical

1.3 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. 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).

C. 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.

D. 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).

E. 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.

F. 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.

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. DIGITAL I/O

A digital I/O point consists of a single input or output binary bit at one of two possible 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 these specifications, both terms are synonymous.

J. 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.

K. EXPOSED AREAS

Locations that are visible, outdoors, or exposed to a process or room environment. Exposed areas are not concealed (see CONCEALED AREAS).

L. 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.

M. HAZARDOUS AREAS

Class I, Divisions 1, and 2; Class II, Divisions 1 and 2; Class III, Divisions 1 and 2 locations where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings (reference National Electrical Code, Article 500).

N. 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.

O. 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. Peripheral support devices, such as a mouse, keyboard, touch screen, and remote controls are also included. The HMI system is typically PC based, located in an office or lab environment.

P. HOT SPARE

A “Hot Spare” is a PLC analog or digital channel in a PLC card that is powered but the channel is unassigned. Hot spares are connected to fused field I/O terminal block groups per Specification 16940.

Q. 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.

R. I/O

Inputs/Outputs – Input and output signals into and out of a PLC or RTU.

S. OIU

Operator Interface Unit – A graphical display of industrial plant system variables and status. It may also allow for process control adjustments. 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.

An Operator Interface Unit is considered a possible extension of a PLC, like an I/O or network card. PLC installations may or may not include an OIU.

T. 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.

U. 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.

V. 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.

W. 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 differ from PLCs in that they do not control a process.

X. 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.

Y. SHOP FABRICATED

Manufactured or assembled equipment for which a UL test procedure has not been established.

Z. SOFT START MOTOR CONTROLLERS

See SOLID STATE MOTOR CONTROLLERS in this Section.

AA. SOLID STATE MOTOR CONTROLLERS

Solid State motor controllers provide an electronically controlled acceleration and deceleration of AC squirrel-cage induction motors. Once the motor has reached full speed, the electronics are switched off and replaced with a motor drive contactor that connects the motor directly to line power, thus assuring continuous full voltage to the motor. Solid State motor controllers are also referred to Soft Start motor controllers.

Unlike VFD drives, Solid State motor controllers do not alter the sine wave *frequency* to the motor; instead they alter the portion of the sine wave that reaches the motor. This controls the amount of power sent to the motor and affects the motor's ability to create torque. The electronic

Solid State control is only used during acceleration and deceleration. During acceleration the controller switches the waveform from 0 up to 100 percent (full voltage) and during deceleration switches the waveform from 100 down to 0 percent (no voltage).

BB. TELEMETRY

Telemetry is the transfer of data between remote sites. Typical methods of data transfer are utility phone lines, radio transmission, and fiber optics.

CC. VIBRATING EQUIPMENT

Equipment that is subject to vibration under normal operating conditions, such as motors, transformers, electrically operated valves, etc.

DD. 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:

<u>References</u>	<u>Title</u>
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
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 the Contract Documents.
- 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 also include:

1. Manuals for Motor Control Centers. MCC wiring diagrams shall include updated title block showing the date redline field changes were incorporated into the documentation.
2. Manuals for fabricated control panels. Wiring diagrams shall include updated title block showing the date redline field changes were incorporated into the documentation.
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.
5. The Contractor shall supply three CD-Rom or USB copies of the final equipment manuals in a tabbed, searchable, .pdf format, with

a table of contents bookmarked to provide a navigation link to each section of the manual(s).

1.6 SYSTEM DESCRIPTION

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.

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.

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.

Pay and make arrangements for necessary permits, licenses, and inspections.

1.7 QUALITY ASSURANCE

A. TESTING AGENCY QUALIFICATIONS

A "Nationally Recognized Testing Laboratory" (NRTL) recognized and approved by the State of Washington.

1. Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies, or equal, to supervise onsite 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. A NRTL recognized and approved by the State of Washington.

1.8 DELIVERY, STORAGE AND HANDLING

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.
 - 1. 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 the Contract Documents.
- 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

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.

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.

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.

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.

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, 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

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 (2020). 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

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.

Record voltage, current, and megohmmeter 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.

Equipment and raceways installed under this contract for future work shall be dimensioned on the Record Drawings.

3.3 COORDINATION

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.

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.

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.

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.

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.

Coordinate installing electrical identification after completion of finishing work where identification is applied to field-finished surfaces.

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 where the enclosure may 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 4x 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 508A, Standard for Industrial Control Panels.
- c. UL 698, Industrial Control Equipment for use in Hazardous Locations.

B. WORKMANSHIP

Install the equipment and materials 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.

1. 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 3 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 1 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/manufacture'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."

3.10 REQUEST FOR INFORMATION

Contractor shall locate all relevant information pertaining to the question prior to submission to the Engineer for review.

The Electrical Contractor shall review and approve all RFIs concerning electrical topics before submission.

3.11 TESTING, THIRD PARTY

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.

A. THIRD-PARTY CIRCUIT BREAKER TEST

Prior to energization engage an independent electrical testing organization to perform the test below.

1. For the four new molded case circuit breakers 100 Amps and larger, provide an 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.
2. Provide third party breaker test documents signed by the independent testing agency and the contractor and issued and approved by the Engineer prior to energizing the breaker(s).

These documents shall clearly show and describe the methods and equipment used in the test and all relevant readings and findings and shall include, as a minimum, the following:

- a. All breakers tested shall use the breaker tag numbers as assigned on the Plans.
 - b. Each parameter measured shall include the dimension in the measured column (Amps, mΩ, seconds, etc.).
 - c. Each parameter measured shall include an associated minimum and maximum acceptable value (acceptable range).
 - d. Each breaker shall include a “passed” or “failed” status.
 - e. Failed breakers shall include a short statement describing the failed parameter.
 - f. Each breaker shall include the manufacturer’s associated circuit breaker curve.
3. A copy of these signed test results shall be included in the O&M Manual.
 4. Breakers that fail third party testing shall be replaced with new and retested by the same third-party testing agency. This process shall be repeated until all breakers subjected to this requirement have successfully passed testing and have been documented.

Upon failure of a third-party breaker test, the cost of a new breaker and additional third party testing shall be borne by the device/equipment manufacturer.

5. These specifications apply to the following Sections if they are included in this contract: 16230, 16410.

B. THIRD-PARTY ENGINEERING COORDINATION STUDY

Provide updated coordination study per Contract Appendix D, Section 8-40 “Arc Flash Study.”

C. THIRD-PARTY ENGINEERING ARC FAULT AND SHOCK HAZARD STUDY

Provide updated coordination study per Contract Appendix D, Section 8-40 “Arc Flash Study.”

3.12 TESTING NOT REQUIRING THIRD PARTY

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.

A. CONDUCTOR MEGGER TEST

1. Power Conductor Testing

After pulling and prior to connection perform a Megger test between all power conductors (including the equipment ground) and between each power conductor and earth ground in the following manner:

- a. Perform megger tests at 600 V.
- b. Record ambient temperature and humidity during testing.
- c. Cables or conductors with a steady-state value less than 100 megohms shall be considered “failed”.

- d. Failed cables and conductors shall be removed and replaced with new and retested per these specifications.
 - e. Provide a Power Conductor Megger Testing Report. A blank copy of this report, specifically associated with this contract, is available from Engineering on request. 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.
- 2. Control Conductor Testing
 - a. Control conductor insulation testing is not required.
- 3. Instrumentation Conductor Testing
 - b. Instrumentation conductor insulation testing is not required.

B. CONDUCTOR INSPECTION

On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

- 1. Procedures
 - a. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.2. Certify compliance with test parameters.
 - b. 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.

C. MOTOR COMMISSIONING TEST

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.

D. GROUND TEST

Engage an independent electrical testing organization to perform the test below.

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.

Maximum grounding resistance values shall be as listed below:

- a. Equipment Grounding System: 25 ohms.
 - b. Main Service, Grounding Electrode System: 5 ohms.
2. Provide ground test documents signed by the tester and the contractor and issued and approved by the Engineer prior to energizing the power distribution system.

These documents shall clearly show and describe the methods and equipment used in the test and all relevant readings and findings including ground resistance at each test location and observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

These documents shall clearly state whether the system has passed or not passed and show the point(s) where failure occurred. A copy of these signed test results shall be included in the O&M Manual.

3. 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 repeat testing until resistance is within specifications.
4. These specifications apply to the following Section if it is included in this contract: 16060.

3.13 GENERAL TESTING AND INSPECTION

A. PRIOR TO ENERGIZATION

1. After installing disconnect switches and circuit breakers, perform visual and mechanical inspection of enclosures and devices.
2. Test the equipment and electrical circuits for proper connection, tightness, and absence of undesirable shorts and grounds.
3. Check for continuity, visual damage, marking, and proper phase sequence.
4. Remove any burrs, filings, or other foreign materials from all enclosures; completely wipe down and vacuum.
5. Run a magnet around the bottom of each enclosure and around surfaces that may have collected metal shavings during manufacturing or construction.

B. AFTER ENERGIZATION

1. After electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
2. Correct malfunctioning units on site where possible and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.
3. Test operation, calibration, and settings of the meters, relays, and indicating devices.
4. Test all operating controls for proper operation.
5. 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.
6. Take load readings on each panelboard after all loads are connected. Record these measurements to give the maximum reading for each phase and neutral obtained with lighting, appliances, motors, and other loads connect to, and operating from, the panels in service.

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, and surge protective devices. Check control connections and tightness at terminal blocks, relays, meters, switches, etc. Tug on each connection to verify a tight connection.
8. Check field connections to field devices, PLCs, and motor starters.
9. Verify proper communication reliability and data transfer speed on local networks.
10. Rework or repair equipment, which performs unsatisfactorily during, or as a result of, testing at no additional expense to the Owner.
11. Additional testing requirements specific to other sections are specified in those sections.

C. INSPECTIONS BY THE AHJ

For any situations concerning the AHJ and/or inspections, the Electrical Contractor shall provide a written description of the issue encountered during inspection, documentation of any field conversation with the AHJ/inspector, and recommendations to rectify the situation.

3.14 TEST DOCUMENTS

Test documents, as described above, shall be signed and submitted to Engineering for review prior to energizing associated electrical circuits.

3.15 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.

3.16 CLEANING

Clean dirt and debris from all internal and external surfaces. Vacuum out the interior of electrical panels.

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 WORKS SPECIFIED ELSEWHERE

<u>Sections</u>	<u>Items</u>
16050	Basic Electrical Materials and Methods
16120	Conductors and Cables
16130	Raceway and Boxes
WAC 296-46B-250	Grounding and Bonding

1.3 DEFINITIONS

- A. BONDING JUMPER (from NEC 2017, 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 2017, 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 SERVICE CONDUCTOR

Also called “utility neutral.” A conductor used to connect the neutral point of the utility transformer to the neutral point of the service entrance.

See SUSE, SYSTEM GROUNDING.

D. **GROUNDING ELECTRODE** (from NEC 2017, Article 100 - Definitions)

A conducting object through which a direct connection to earth is established.

E. **GROUNDING ELECTRODE CONDUCTOR** (from NEC 2017, 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 USE AS SERVICE EQUIPMENT**.” It is the point in the electrical grounding system where the **SYSTEM GROUNDING CONDUCTORS** connect to the **EQUIPMENT GROUNDING CONDUCTORS**, or the **GROUNDED SERVICE CONDUCTOR**, or both. 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 **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 listed elsewhere in the Contract Documents and as required in 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

Ground rods shall be 3/4-inch diameter by 10-feet long unless otherwise stated on the Plans.

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 Electro Systems and (2) Equipment Grounding Circuits.

- 1. Grounding Electro Systems shall comply, as a minimum, to the requirements of NEC Sections 250.50 through 250.104, including Table 250.66, "Grounding Electro 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 Electro Conductors to each ground rod shall be accessible through a ground rod box as described herein.

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.*

Each ground rod box shall be mounted flush to grade.

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.

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. OTHER GROUNDING ELECTRODE DEVICES AND METHODS

1. Generators

- a. In addition to the equipment ground provided with the generator feeder, provide a grounding electrode conductor to the generator's neutral terminal sized per the Plans or per NEC Table 250.66, whichever is larger. Treat this conductor as a neutral wire.

- b. Grounding Methods

- i. The Grounding Electrode Conductor shall be connected to the neutral terminal of the generator as a neutral. This conductor shall be connected to the grounding system at the SUSE bonding connection.

If required to run through a transfer switch, then this neutral wire shall terminate at the transfer switch's

isolated neutral bus before continuing to the SUSE bonding point.

- ii. The Equipment Grounding Conductor shall be connected to the metal frame of the generator in compliance with NEC.250.110.

2. 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. 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.

D. METALLIC RACEWAYS

Install grounding bushings at the end of each conduit and connect to the equipment ground or GROUNDING ELECTRODE SYSTEM.

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.

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

Provide ground testing per Specification 16050.

***** 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

<u>Section</u>	<u>Item</u>
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

1.3 SUBMITTALS

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

All power, control, and instrumentation conductors larger than #20 AWG shall be stranded.

All equipment ground conductors larger than #16 AWG shall be stranded.

All grounding electrode conductors larger than #10 AWG shall be stranded.

A. 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

B. 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 6 (6e).
 - i. 600 V, polypropylene insulation, with inner PVC jacket and Industrial Grade, Sunlight and Oil Resistant, Black, PVC outer jacket.
 - ii. 8-Conductor, 4 twisted bonded pairs, #23 AWG, solid bare copper, 100 percent overall foil shield.
 - iii. 19.8 dB attenuation per 100 meters at 100 MHz.
 - iv. Belden #7953A or equivalent.

3. Enhanced Category 5 (5e) and 6 (6e) RJ45 cable plugs

RJ45 cable plug connectors shall be 8-wire, 10 – 10000 Mbit/sec with metal housing and FC connection technology.



Siemens P/N 6GK1901-1BB12-2AA0 or equal.

4. DeviceNet Cables

DeviceNet cables shall be 2x #16 AWG Power Pair plus 2x #18 AWG data pair, stranded copper, 600 V, 75 C, 100 percent individual shield plus 65 percent overall braided shield.

- a. 600 V, 75 C, Gray Sunlight/Oil-Resistant PVC jacket.
- b. 2-Conductor, 1 twisted pair, #16 AWG, PVC-Nylon insulated, stranded copper power conductors with 100 percent foil shield with common foil drain wire.
- c. 2-Conductor, 1 twisted pair, #18 AWG, F-R Polypropylene insulated, stranded copper data conductors with 100 percent foil shield with common foil drain wire.
- d. 65 percent tinned copper overall braided shield.
- e. Belden #7896A or equivalent.

5. Profibus Cables

Profibus cables shall be #22 AWG, solid bare copper, 600 V, FHDPE insulation, 100 percent foil shield plus a 65 percent tinned copper braid shield, in a sunlight resistant PVC jacket.

Profibus cables shall comply with:

EU Directive 2000/53/EC (ELV),
EU Directive 2002/95/EC (RoHS),
EU Directive 2002/96/EC (WEEE),
EU Directive 2003/11/EC (BFR),
CA Prop 65

- a. 600 V, 75 C, Cellular Polyolefin Insulation, Violet jacket.
- b. 100 percent overall foil shield with drain wire plus 65 percent tinned copper braided shield.
- c. 2-Conductor, 1 twisted pair, #22 AWG, solid bare copper.
- d. Beldon #3079A or equivalent.

2.2 SPLICES, TAPS AND TERMINAL BLOCKS

Splices are only allowed under the conditions of Section 4.2.E.

A. SPLICES TO POWER CONDUCTORS

1. Splices in Outdoor Areas, Handholes, Vaults, or Direct Buried
 - a. 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.
 - b. 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
2. Indoor Splices and Taps for Receptacles and Lighting
 - a. Use quick spin, wing torque Electrical Spring and Grounding Connectors; 3M 312, 412, 512, and 512G or equal.

3. Motor Lead Connectors

- a. Motor terminal connectors shall be insulated multiple tap connectors rated for 600 Vac; N.S.I. Polaris or equal.

4. Power Terminal Blocks

- a. All power terminals shall be 600 Vac, suitable for 75 degrees C rated copper conductor.
- b. 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.

B. SPLICES TO CONTROL CONDUCTORS

Splices to control conductors in junction boxes and handholes shall be made with 600 V, UL486D certified, water-proof direct bury connectors with strain relief, pre-filled with waterproof and corrosion-proof, non-hardening, silicone dielectric sealant; DRYCONN DBSR Series or equal.

C. SPLICES TO INSTRUMENTATION CABLES AND CONDUCTORS

For splices to instrumentation cables and conductors in junction boxes, strip back the cable outer sheath exposing cable conductors and shield lengths to 1-inch or less. Twist the wires together and solder. Insert and engage into 600 V, UL486D certified, water-proof connectors, pre-filled with waterproof and corrosion-proof, non-hardening, silicone dielectric sealant; DRYCONN Aqua Series 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 600V, 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.

A. 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.

Exceptions:

- *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.

Exceptions:

- *Unless called out otherwise in the Cable and Conduit Schedule.*
- *Unless approved in writing by the Electrical Engineer.*

b. Minimum control wire size in conduits and raceways

The minimum control wire size in conduits and raceways shall be #14 AWG.

B. WIRES IN CONTROL PANELS

Wires in control panels are those that are terminated within a control panel, and do not extend beyond the control panel enclosure. Wires that extend beyond the control panel enclosure shall be installed and terminated per the provisions of “WIRES IN RACEWAYS,” above.

1. Control Panel Power and Control Wire

a. Insulation

Power and control conductors in control panels shall be MTW or THHN/THHN-2.

- b. Wires shall have the following minimum sizes and colors:

Circuit Type	Wire Size ⁽¹⁾	Wire Color
120 VAC Power Circuits		
120 VAC, Line	#14 AWG	Black
120 VAC, Neutral	#14 AWG	White
120 VAC, Equipment Ground	#14 AWG	Green
120 VAC Control Circuits		
120 VAC, Line	#18 AWG	Black
120 VAC, Neutral	#18 AWG	White
Low-Voltage AC Control Circuits		
Low-Voltage, Line	#18 AWG	Red
Low-Voltage, Neutral	#18 AWG	White
24 VDC Power Circuits		
+24 VDC Power	#14 AWG	Blue
24 VDC Common	#14 AWG	White with Blue stripe
24 VDC Equipment Ground	#14 AWG	Green
Isolated (Shield) Ground	#12 AWG	Yellow with Green stripe ⁽²⁾
24 VDC Control Circuits		
+24 VDC Control	#18 AWG	Blue
24 VDC Common	#18 AWG	White with Blue stripe
PLC I/O Circuits		
DC I/O	#18 AWG ⁽³⁾	Purple
DC I/O Common	#18 AWG	White with Purple stripe
Analog Inputs	#18 AWG	Analog Instrument Cable ⁽⁴⁾
Analog Outputs	#18 AWG	Analog Instrument Cable

Notes:

- (1) Wire sizes are minimums; size wires to comply with NEC and UL 508.
- (2) Isolated (Shield) ground wires shall be of a color scheme that is approved for ground wires but distinct from equipment grounds.
- (3) For PLC digital outputs, conductors may be #18 AWG between the PLC output terminal and the buffer relay coil when fused at not more than 5A. Wiring from the buffer relay output contacts to field terminals shall be #14 AWG minimum. For retrofit panels without buffer relays, digital output wiring shall be #14 AWG.
- (4) Contractor shall provide one of the Analog Instrument Cables described in the "PRODUCTS" section of this specification.

2. Where panels are required to be manufactured and certified to a particular standard (such as UL 508A), the contractor shall substitute wire colors where required to meet the standard.

C. 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.

D. 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.*

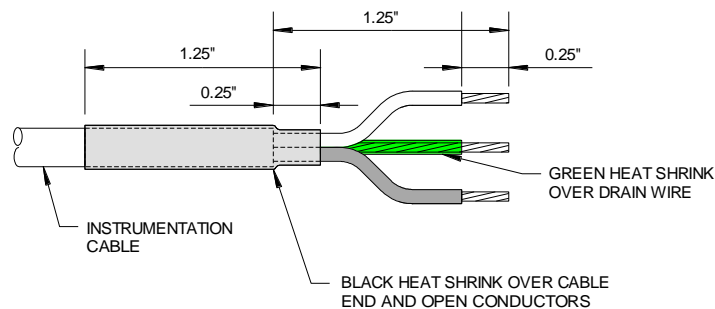
C. CONDUCTORS IN CONTROL PANELS

1. Control Panel Instrumentation (Signal) Wiring
 - a. 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.
 - b. 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.

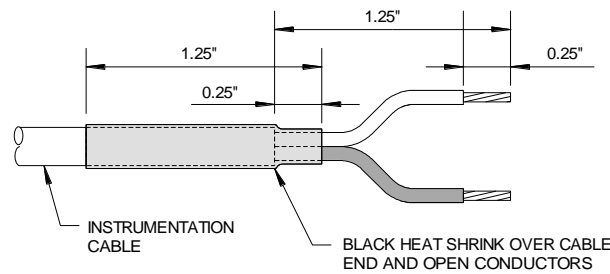
D. INSTRUMENTATION (SIGNAL) CABLES

1. Preparing the Shielded End



- a. Neatly trim the end of the cable.
- b. Strip back 1.25 inch 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-inch 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



- Neatly trim the end of the cable.
- Strip back 1.25 inch of the outer jacket taking care not to cut into the signal conductor insulation.
- Neatly trim the foil back to the edge of the outer jacket.
- Cut the drain wire at the edge of the outer jacket taking care not to damage the signal conductor insulation.
- For signal cables with a braided shield over a foil shield, carefully cut the braid back to the edge of the outer jacket.
- Provide a 1.25-inch 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.
- Strip the signal conductors exposing 0.25 inch of conductor.

E. SPLICING CONDUCTORS

- 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.*
- With written permission from the Engineer.*

4. 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.*

5. 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 resplicing.

- 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 2-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.S.I. Polaris or equal.

Cover the splice with a minimum of three layers of black electrical tape. Provide a 2-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.

E. 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.*

F. 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.*

F. CONDUCTOR COLORS

7. For conductor colors inside control panels, reference Section 3.1.C.1.
8. 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.*

9. Equipment grounding conductors: Green or green with yellow stripes.

10. 480/277 volt, 3-phase systems:

Phase A	Phase B	Phase C	Neutral
Brown	Orange	Yellow	Gray

11. 208/120 or 240/120 volt, 3-phase systems:

Phase A	Phase B	Phase C	Neutral
Black	Red	Blue	White

12. 240/120 volt, single phase systems:

Phase A	Phase B	Neutral
Black	Red	White

13. Use wire with insulation of required color for conductors of #6 AWG and smaller. For wire larger than #6 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.

14. 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.

G. 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.

H. CABLE SUPPORTS

Support cables according to Section 16050.

Provide vertical conductor support per NEC Table 300.19(A).

I. 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

Provide conductor megger testing per Section 16050.

***** 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 SECTIONS SPECIFIED ELSEWHERE

<u>Sections</u>	<u>Items</u>
16050	Basic Electrical Materials and Methods
16060	Grounding and Bonding
16120	Conductors and Cables

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 Specification 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. FINISHED AREAS

Reference Section 16050, Definitions.

K. FMC

Flexible Metal Conduit (a type of RMC).

L. HANDHOLES

A handhole is a pullbox that is not sufficiently sized for entrance of personnel (reference PULLBOXES).

M. 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.

N. 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.

1. Junction Boxes, Type J1

Junction boxes identified as TYPE J1 can contain only non-linear power circuits.

2. Junction Boxes, Type J2- not used

3. Junction Boxes, Type J3

Junction boxes identified as TYPE J3 can contain only instrumentation circuits.

Junction boxes not containing circuits of the types identified for TYPE J1, TYPE J2, or TYPE J3 are simply called “junction boxes” (without a TYPE identifier).

O. LFMC

Liquidtight Flexible Metal Conduit (a type of RMC).

P. 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.

Q. NON-LINEAR POWER LOADS

Non-linear power loads shall include all VFD circuits (both line or load) and all UV ballast circuits. Although actually non-linear, fluorescent lighting circuits shall be considered linear.

R. 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.

S. PROCESS AREAS

Reference Section 16050, Definitions.

T. PVC

Polyvinyl Chloride Conduit (a type of RNC).

U. 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.

V. PVC-RMC

Reference PVC-RGS.

W. RGS

Rigid Galvanized Steel (a type of RMC).

X. RMC

Rigid Metal Conduit (General NEC Category).

Y. RNC

Rigid Nonmetallic Conduit (General NEC Category).

Z. 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.

AA. WET LOCATIONS

Reference Section 16050, Definitions.

1.4 SUBMITTALS

Submit under provisions listed elsewhere in the Contract Documents.

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. 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.

B. 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.

C. 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. All 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 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.

PART 3 APPLICATION

3.1 CONDUIT BODIES

This section describes the types of raceways, junction boxes, and device boxes that can be 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."

c. Relationships Between Circuit Categories and Conduit Types

Many electrical circuit types do not require special conduit routing considerations. However, Table 3.1.B.1 shows the circuit types where the conduit route must be 100 PERCENT CONTINUOUS (reference Definitions).

Table 3.1.B.1

Type	100% Continuous?
Power	No
Control	No
Instrumentation	Yes

2. Conduit Shape

Wiring shall be routed in pipe or tubular conduits, NOT in fabricated wireways or gutters.

C. 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.

D. 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. 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.*

3. 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 containing grounding electrode conductors shall be PVC Schedule 80 over their entire length.*

4. All portions of conduits penetrating concrete floors, walls, or ceilings shall be RGS.

Exception:

- *In below ground vaults as described above.*

5. All conduit penetrations from grade shall be RGS.

Exception:

- *All conduits containing grounding electrode conductors shall be PVC Schedule 80 over their entire length.*

6. All portions of exposed conduits inside closed buildings shall be RGS.

Exceptions:

- *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.*

E. 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 any device that may require minor movement during maintenance or repair or that may require physical adjustment.

F. EMT RACEWAY – SHALL NOT BE USED

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 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.*

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.

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

- a. Receptacles

Cast iron device box body with cast aluminum gasketed cover and top-opening “in-service” cover.

2. Indoor, Wet Areas (see Definitions).

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. Surface-mounted – cast aluminum device box body with gasketed die cast aluminum, snap-action, weatherproof cover.

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. When installing utility conduits, comply with the spacing and depth requirements of the utilities.
2. 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. 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.

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.

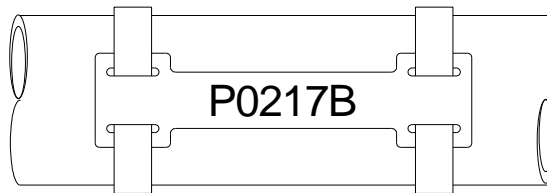


Figure 4.2.D.11

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.

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, conduit entries that are made into the side or top of an enclosure shall be made using 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. In rare cases where bottom entry is not possible, side and top entries shall be made using Myer-type hubs.*

F. 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.

G. 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.)

H. BENDS AND OFFSETS

1. Fabricated bends and offsets shall be made with manufacturer-approved bending tools, by manufacturer-certified personnel.
2. Where possible, use standard elbows, conduit fittings, or junction boxes to avoid fabricated bends.
3. Make bends and offsets uniform and symmetrical. Make bends and offsets so that the inner diameter is not reduced. Use expanding plugs for bends in PVC conduit of 2-inch trade size or larger. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

I. 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 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.*

- *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. 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."
 4. 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.
2. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends are not visible above the finished slab.
3. 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.
4. 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.
5. All stub-ups shall be provided with pull string.
6. Provide conduit labels on all stub-ups which are not flush mounted.

4.4 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.

4.5 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.

4.6 QUALITY CONTROL

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 16230

GENERATOR ASSEMBLIES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of a packaged diesel engine generator set with accessories as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
16050	Basic Electrical Materials and Methods
16060	Grounding and Bonding
16410	Enclosed Switches, Fuses, and Circuit Breakers

1.3 DEFINITIONS

A. FULL LOAD

The generator delivering 100 percent of its rated output power.

B. MAXIMUM FREQUENCY DIP AND PEAK

The maximum allowable frequency deviation, in percent, below and above the generator's specified output frequency during application-specific starting and stopping steps as specified in 1.5.

Example: A 10 percent MAXIMUM FREQUENCY DIP AND PEAK on a 480 Vac, 3 PH, 60 Hz generator equates to ± 10 percent (± 6 Hz) maximum deviation from 60 Hz, or 54 Hz absolute minimum to 66 Hz absolute maximum frequency limits during the worse-case specified step changes while either loading or unloading.

C. MAXIMUM FREQUENCY RECOVERY TIME PERIOD

The maximum period of time, in seconds, for the frequency to recover back to its specified steady-state operating band following load transitions from no load to full load or from full load no load.

Example: A 5 second MAXIMUM VOLTAGE RECOVERY TIME PERIOD requires that the generator repeatedly recover from

full load added or removed load steps within 5 seconds maximum. This means that during a full load transition, in either direction, the generator frequency may deviate from its specified steady-state operating band for a maximum of 5 seconds before it has fully recovered back to its specified steady-state operating band.

D. MAXIMUM STEADY-STATE FREQUENCY OPERATING BAND

The maximum allowable frequency deviation, in percent, below and above the generator's specified operating frequency during steady-state operating conditions at any load between no load and full load.

Example: 0.5 percent MAXIMUM STEADY-STATE FREQUENCY OPERATING BAND on a 480 Vac, 3 PH, 60 Hz generator equates to ± 0.5 percent (± 0.3 Hz) maximum deviation from 60 Hz, or 59.7 Hz absolute minimum to 60.3 Hz absolute maximum frequency limits at any stable operating load from no load to full load.

E. MAXIMUM VOLTAGE DIP AND PEAK

The maximum allowable voltage deviation, in percent, below and above the generator's specified output voltage during application-specific starting and stopping steps as specified in 1.5.

Example: 25 percent MAXIMUM VOLTAGE DIP AND PEAK on a 480 Vac, 3 PH, 60 Hz generator equates to ± 25 percent (± 120 Vac) maximum deviation from 480 Vac, or 360 Vac absolute minimum to 600 Vac absolute maximum voltage limits during the worse-case specified step changes while either loading or unloading.

F. MAXIMUM VOLTAGE RECOVERY TIME PERIOD

The maximum period of time, in seconds, for the voltage to recover back to its specified steady-state operating band following load transitions from no load to full load or from full load no load.

Example: A 5 second MAXIMUM VOLTAGE RECOVERY TIME PERIOD requires that the generator repeatedly recover from full load added or removed load steps within 5 seconds maximum. This means that during a full load transition, in either direction, the generator voltage may deviate from its specified steady-state operating band for a maximum of

5 seconds before it has fully recovered back to its specified steady-state operating band.

G. MAXIMUM STEADY-STATE VOLTAGE OPERATING BAND

The maximum allowable voltage deviation, in percent, below and above the generator's specified operating voltage during steady-state operating conditions at any load between no load and full load.

Example: 2 percent MAXIMUM STEADY-STATE VOLTAGE OPERATING BAND on a 480 Vac, 3 PH, 60 Hz generator equates to ± 2 percent (± 9.6 Vac) maximum deviation from 480 Vac, or 470.4 Vac absolute minimum to 489.6 Vac absolute maximum voltage limits at any stable operating load from no load and full load.

H. NO LOAD

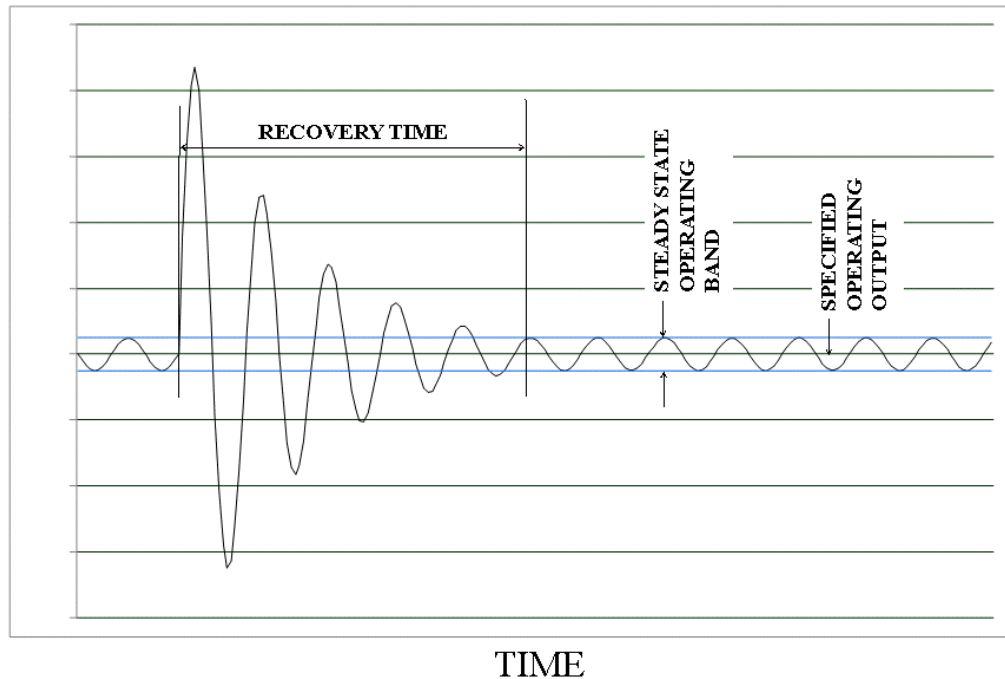
The generator delivering 0 percent of its rated output power.

I. STANDBY POWER OUTPUT RATING

The power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of an electrical utility power outage. The power output rating is the gross electrical power output of the generator set minus the total power requirements of the electric motor driven cooling fan, water pump, and other auxiliary loads related to the generator set operations.

J. DEFINITIONS REFERENCE GRAPH

The following graph is a reference chart to better define the following terms "MAXIMUM VOLTAGE RECOVERY TIME PERIOD," "MAXIMUM STEADY-STATE VOLTAGE OPERATING BAND", "MAXIMUM FREQUENCY RECOVERY TIME PERIOD," and "MAXIMUM STEADY-STATE FREQUENCY OPERATING BAND." The Y axis can either be voltage or frequency and the X axis is time.



1.4 REFERENCES

- A. The latest Washington State adopted, published edition of a reference shall be applicable.
- B. All Washington State amendments adopted prior to the effective date of this Contract shall be applicable.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 1. National Fire Protection Association (NFPA)
 - a. NFPA 30 Flammable and Combustible Liquids Code
 - b. NFPA 37 Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
 - c. NFPA 70 National Electrical Code
 2. International Fire Code (IFC)
 3. International Building Code (IBC)

4. National Electrical Manufacturers Association (NEMA)
 - a. NEMA MG 1: Motors and Generators
5. International Mechanical Code (IMC)
6. Underwriters Laboratory (UL)
 - a. UL 2200 Generator Engine Generator Assemblies
 - b. UL 142 Steel Aboveground tanks for Flammable and combustible Liquids.

1.5 PERFORMANCE REQUIREMENTS

- A. Engineering calculations indicate a standby power output rating requirement of 200 kW at 80 percent power factor at 480/277 volts, 3 phase, 60 hertz while operating under the site conditions listed in Part 1.8 of this Section in an ambient temperature range of 0 to 104 degrees F at less than 90 percent rated capacity. The manufacturer shall calculate generator unit size according to the following bus rated loads and starting steps:

Step No./ Device No.	Device Description	Motor Code	Load Hp	Load kVA	Starter Type
Step 1					
	Chlorination Room Transformer, 480/240-120, 1 ph	-	-	7.5kVA	-
[01 XFMRP 01]	Transformer and Panelboard, 480/240-120, 1 ph	-	-	15kVA	-
Step 2					
[01 MTR 01]	Well Pump	-	150 hp	-	RVSS w/400% inrush

- B. The Generator shall be suitable for operation with pulse width modulated variable frequency drives (connected as loads as shown on the Plans and operating motors throughout a speed range of 6 to 60 hertz) without detrimental effects on voltage or frequency regulation and stability.
- C. MAXIMUM VOLTAGE DIP AND PEAK

Shall not exceed 25 percent.

D. MAXIMUM FREQUENCY DIP AND PEAK

Shall not exceed 10 percent.

E. MAXIMUM STEADY-STATE VOLTAGE OPERATING BAND

Shall not exceed 2 percent.

F. MAXIMUM STEADY-STATE FREQUENCY OPERATING BAND

Shall not exceed 0.5 percent.

G. MAXIMUM VOLTAGE RECOVERY TIME PERIOD

Shall not exceed 5 seconds.

H. MAXIMUM FREQUENCY RECOVERY TIME PERIOD

Shall not exceed 5 seconds.

I. ALTERNATOR OUTPUT WAVEFORM

At no load, harmonic content measured line-to-line or line-to-neutral does not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, does not exceed 50.

J. SUSTAINED SHORT-CIRCUIT CURRENT

For a 3-phase, bolted short circuit at the system output terminals, the system will supply 300 percent of rated full load current for not less than 10 seconds to coordinate circuit breaker tripping. This system shall include over-voltage relay protection to preclude damage to any generator system component.

K. TEMPERATURE RISE OF GENERATOR

Within limits permitted by NEMA MG 1, when operating continuously at full nameplate rating, the temperature rise of the generator shall not exceed 250 degrees F over 100 degrees F ambient.

L. STARTING TIME

The maximum allowable time period to cold start the generator, while operating at the low end of the specified temperature range, and have its voltage and frequency sufficiently stable for a transfer switch to accept or automatically initiate a power transfer, shall be 10 seconds.

1.6 SUBMITTALS

For each generator set submit under provisions listed elsewhere in the Contract Documents and as specified herein.

A. PRODUCT DATA

Provide the manufacturer and a full description of the generator set and associated components. Include features, ratings, and performance including, but not limited to:

1. Engine including the following:
 - a. Horsepower at rated speed and load
 - b. Emission Ratings
 - c. Lubrication oil capacity
2. Overall dimensions of generator set system including the sub-base fuel tank, and the enclosure.
3. Fuel consumption for 1/4, 1/2, 3/4, and full load of generator set
4. Electrical governor
5. Coolant heater
6. Alternator
 - a. Electrical rating (kVA, reactance, time constants, temperature rise, etc.).
7. Voltage regulator type, make, model, and wiring diagram
8. Noise levels at twenty-three feet (7 meters) in a free field

9. Exhaust pipe and muffler sizing backpressure calculations
10. Warranty and Service Agreement documentation
11. Vibration isolation calculations, Plans and seismic certification from manufacturer per the seismic information listed in Part 1.8B of this Section.
12. Bill of Materials
13. Wiring Diagram

B. QUALITY ASSURANCE

Provide documentation showing all CD&Es (compliances, deviations, and exceptions) for this Specification.

C. GENERATOR SIZING CALCULATIONS

Submit calculations showing that the submitted generator's standby power output rating is capable of meeting the specified loads in the specified steps listed. The calculations shall show that the generator meets the specified performance requirements.

D. OPERATION AND MAINTENANCE MANUAL

1. Field Test Reports

Indicate and interpret test results for compliance with manufacturer's published standards for unit provided. Provide written approval of installation in accordance with all manufacturers' recommendations.

2. Operation and Maintenance Data

Provide information to be included in the operation and maintenance equipment manuals specified in the Contract Documents, Section 11000, and as specified herein.

3. Test Reports

The O&M manual shall include a copy of the factory test data and the field test report.

4. Service Agreement and Warranty

Include copies of the Service Agreement and Warranty in the Operation and Maintenance Manual.

1.7 QUALITY ASSURANCE

See Section 16050.

A. SOURCE LIMITATIONS

1. Obtain engine generator set from a single supplier with responsibility for the complete system. Furnish a new product built from components with proven reliability and compatibility. The generator set shall be coordinated to operate as a unit as evidenced by records of prototype testing by the Original Equipment Manufacturer (OEM).
2. The warranty shall be supported by the original distributor, not offset to an engine manufacturer, an alternator manufacturer, or a new manufacturer's distributor.
3. The local representative for the generator manufacturer shall have the minimum qualifications and meet the minimum requirements:
 - a. Shall have represented the product for a minimum of 5 years.
 - b. Shall provide, on request, a reference list of five similar projects, no older than 2 years, with site contact information.
 - c. Shall provide formal classroom training for service and maintenance of generators and transfer switches on a regular basis. The schedule and pricing for this training shall be available on request. The training shall be conducted in a location that is within a 1 day drive of the job site.
 - d. Shall have a field service group, with no fewer than 10 qualified field service technicians, dedicated to generator repair and maintenance with dedicated service vehicles, parts, and tooling needed for general maintenance and common repairs.

- e. Shall have qualified field service technicians with a minimum of 2 years of generator field experience on the product being supplied and shall be factory trained and certified.
 - f. Shall have qualified field service technicians with a current EL-07 Maintenance Electrician License as required by the Washington State Department of Labor and Industries.
 - g. Shall have a warehouse of with sufficient parts located within 150 miles of the job site.
- 4. Only a factory direct or a first tier distributor shall be acceptable. Second tier dealers are not approved.
 - 5. Only approved local distributors shall supply equipment provided under this contract. Equipment by non-local distributors shall not be accepted.
 - 6. The distributor shall be the authorized engine distributor for the prime mover.

B. PRODUCT SELECTION FOR RESTRICTED SPACE

The site and building are designed around the approved generator sets. This includes sizing of fuel tanks, proper airflow, NEC clearance requirements, and access space. The Contractor, in concurrence with the Engineer, shall make all changes necessary required to meet the design requirements when submitting on an alternate generator at no additional cost to the Owner.

C. Generator set to be UL 2200 listed.

D. EMISSIONS

EPA certified for all current EPA emissions requirements.

E. FACTORY TEST

Test assembled generator set at the factory prior to shipment to the job site. The power factor for the factory test shall be at 0.8 p.f.

- 1. Show the following conditions at load and no load on the Generator Set: Charging System Volts, Voltage Output, Frequency, Coolant Temperature, and Oil Pressure, and other

pertinent information on the test report. Provide a plot of the transient voltage and a plot of the frequency response versus time as a result of a full load single step.

2. Perform manufacturer's standard factory tests.
3. Test for a minimum of 30 minutes at full load per NFPA 110.

F. REGULATORY REQUIREMENTS

1. The NEC defines the following items:
 - a. Article 700 – EMERGENCY SYSTEMS
 - b. Article 701 – LEGALLY REQUIRED STANDBY SYSTEMS
 - c. Article 702 – OPTIONAL STANDBY SYSTEMS
2. For this project the installation shall meet all requirements of an NEC 702 system. Generator shall be provided with all options and features required for installation as part of this system.

1.8 PROJECT/SITE CONDITIONS

A. ENVIRONMENTAL REQUIREMENTS

Engine generator system is designed, engineered, and rated to withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 5 degrees F to 122 degrees F.
2. Relative Humidity: 0 to 95 percent.
3. Elevation: Sea level to 500 feet.

B. SEISMIC REQUIREMENTS

The entire generator package including all mounted accessories shall comply with the requirements of the latest editions of 2018 IBC and of ASCE 7-16 Minimum Design Loads for Building and Other Structures, Chapter 13 "Seismic Design for Nonstructural Components," as referenced and amended by the IBC. Seismic design parameters are as follows:

Parameter	Value
Risk Category	IV
Site Class	D
Component Importance Factor (I _p)	1.5
Response Acceleration Coefficients	
S _{DS}	1.094g
S _{D1}	0.603g
Seismic Design Category	D

1.9 WARRANTY AND MAINTENANCE

The manufacturer shall warrant the materials and workmanship of the generator set for a minimum of 5 years, or 2,500 hours from the registered commissioning and startup.

The warranty shall be comprehensive and shall include all components included in the generator package. No deductibles shall be allowed for travel time, service hours, repair part costs, etc., during the warranty period.

A. 2-YEAR MAINTENANCE SERVICE

Beginning at time of Substantial Completion, provide 24 months full maintenance service performed by qualified service technicians of the manufacturer's designated service organization. Include quarterly inspections to check for defects and operational abnormalities. Include routine preventive maintenance (oil changes, filter changes, belt adjustments, etc.) as recommended by the manufacturer and perform adjustments as required to bring the generator performance back into compliance with the original specifications. 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. No deductibles shall be allowed for travel time, service hours, repair part costs, etc., during the warranty period.

Provide a 2-hour load bank test on the generator at 11 months and 23 months from the time of Substantial Completion.

1.10 EXTRA MATERIALS

Reference Specification Section 16050 for spare parts.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. APPROVED MANUFACTURERS

1. Kohler as provided by Power Systems West.
2. Cummins Power Generation as provided by Cummins Northwest.
3. MTU as provided by Pacific Power Group.
4. Caterpillar as provided by NC Power Systems.

No other manufacturers are acceptable.

2.2 ENGINE

A. FEATURES

1. Four-stroke cycle diesel engine of either vertical in-line or V-type suitable for operation on No. 2 diesel fuel.
2. Engine speed shall be governed by an electronic governor. Refer to frequency requirements specified earlier in this Specification.

B. COMPONENTS

1. Oil Pump

Gear type lubricating oil pump for supplying oil under pressure to main bearings, crankpin bearings, pistons, piston pins, timing gears, camshaft bearings, and valve rocker mechanism.

2. Oil Filters

Full flow oil filters conveniently located for servicing, with a spring-loaded bypass valve to ensure oil circulation.

3. Air Filter

Dry type air filter.

4. Cooling System

Sufficient to cool the engine when the generator set is delivering full rated load in an ambient temperature of 104 degrees F.

- a. Engine-driven, centrifugal-type water circulating pump.
- b. Thermostatic valve.

5. Coolant/Jacket/Block Heater

As described in Part 2.6-B of this Section.

6. Electrical starters sufficient to start the engine within 10 seconds of call to start.

7. Batteries

Lead acid batteries shall be of sufficient capacity to permit starting the generator engine a minimum of four times without recharging. Batteries are to be mounted in an earthquake- and drip-proof rack on the skid, frame, or other approved separate location with required connections provided.

8. Battery Heater

As described in Part 2.6-B of this Section.

9. Battery Charger

- a. Silicone rectifier static type, self regulated with high current and full float operation with a filtered output.
- b. The charger shall be capable of providing a 10 A DC high current charging rate when the battery voltage is below the “float voltage set point.” Full floating charging when voltage is above the set point.
- c. Battery charger operates from 120 volts, single phase AC connected to Generator Auxiliary Device Panel (GADP) as per Section 2.6.A.
- d. The charger shall be complete with voltmeter, ammeter, charging rheostat, automatic equalizing timer, and high/low battery voltage alarm.

- e. The battery charger shall be factory mounted with vibration isolators to prolong service life.
 - f. Battery charger shall include standard NFPA outputs where generator is legally required for life safety.
10. Provide watertight flex connections for all conduits and piping attached to generator.

2.3 ALTERNATOR

- A. Four pole, 1,800 rpm revolving field generator.
- B. Enclosure shall be of drip-proof construction.
- C. Insulation Class H.
- D. Wiring shall be 12-lead, reconnectable, and configured for the specified voltage, phasing, neutral point, and frequency.
- E. Alternator heater shall be as described in Part 2.6-B of this Section.

2.4 VOLTAGE REGULATOR

An electronic voltage regulator shall be provided.

2.5 CONTROL PANEL

The Control panel shall be of the rotatable dead-front type, vibration free mounted on the generator set. The generator control panel and the generator main circuit breaker shall be installed per NEC clearances and provide accessibility to equipment. The tops of control panels and the circuit breakers shall be mounted a maximum of 72 inches above the finished floor.

- A. The control panel shall operate at 12 or 24 VDC from the generator/battery electrical system as required by manufacturer based on the size of the system.
- B. Control panel shall include the following functions/devices:
 - 1. Automatic Starting System
 - a. Provides three 15 second cranking cycles and two rest periods followed by a lockout and alarm.

- b. Operation is initiated by the closing of a remote Form A contact in the automatic transfer switch control circuit.
- 2. Indicating light for alarm condition.
- 3. Indication for the following:
 - a. Running
 - b. Low coolant level
 - c. High coolant temperature
 - d. Low oil pressure
 - e. Over speed
 - f. Over crank
 - g. AC volts for each phase
 - h. AC current for each phase
 - i. Frequency
 - j. Lube oil pressure
 - k. Coolant temperature
 - l. Run Time
 - m. Number of Starts
- 4. Engine “AUTO-OFF-MANUAL” control selector switch.
- 5. Red colored emergency shutdown pushbutton/switch.
- 6. Time delay relay to permit operation at “NO-LOAD” after retransfer of load to normal source (cool down timer).
- 7. Automatic safety controls which shut down the engine on:
 - a. Low lubricating oil pressure

- b. Low coolant level
 - c. High jacket water temperature
 - d. Engine over speed
8. Include a Form A (N.O. Dry) contact for remote connection for each of the following Generator functions.
- a. Running
 - b. General Alarm
 - c. Fail (shall include, as a minimum, any combination of conditions in 8 above)
 - d. AUTO-OFF-MANUAL control switch in Auto Mode
 - e. Low Battery Voltage
 - f. Low Oil Pressure
 - g. High Coolant Temperature
 - h. Low Fuel Level
 - i. High Fuel Level
 - j. Fuel Tank Leak
9. Control Cabinet Heater

As described in Part 2.6-B of this Section.

2.6 ACCESSORIES

A. GENERATOR AUXILIARY DEVICE PANEL

The generator manufacturer shall provide, install, and prewire a Generator Auxiliary Device Panel (GADP) as part of the generator system with the following minimum features:

1. The GADP shall consist of one or more 20 A, 4-plex receptacle sets in cast aluminum boxes under the following conditions:
 - a. The battery charger and all heater loads are 120 VAC, single phase,
 - b. The sum of the battery charger and all heater loads does not exceed 1920 VA (16 A),
 - c. All loads are prewired by the manufacturer with grounded plug cables,
 - d. The receptacles are placed within reach of all load plugs,
 - e. If required, multiple 4-plex receptacle sets are connected together by the manufacturer (provide a single electrical connection point for the Contractor).

Exception:

Where receptacle solution does not work, such as 240V heater requirement, the GADP can be a NEMA 1 gasketed 240/120 VAC single phase load center with a main breaker and appropriately sized branch circuit breakers for the battery charger and the heaters listed below under GENERATOR HEATERS. Available power to the panel is be 240/120 VAC, single phase.

2. For outdoor generators, the GADP shall be securely mounted within the enclosure in a location easily accessible by the operator and to a Contractor-provided power conduit.
3. The GADP shall be internally connected to the described loads by the generator manufacturer.
4. It is the intent that the Contractor need only provide a single power conduit and associated conductors to the manufacturer-provided GADP and terminate the conductors to a main circuit breaker, neutral, and ground. All connections for heater controls and devices shall be prewired and pretested by the manufacturer.

B. GENERATOR HEATERS

1. Coolant Heater

Engine mounted, thermostatically controlled immersion type engine coolant heater to ensure a minimum coolant temperature of 120 degrees F at ambient room temperature of 5 degrees F. Provide as shown in the table below.

Provide the following generator set heaters:

Device	Voltage Configuration	Wattage (W)
Coolant Heater	120/240, 1 ph	<2000

C. CIRCUIT BREAKERS

1. Provide an output main circuit breaker according to the plans and in accordance with Section 16410. This breaker shall be lockable in its open position. The breaker shall have an auxiliary contact that is open when the breaker is in the open position. This circuit shall be prewired by the generator manufacturer to dedicated terminals in the generator control panel. Wire between these devices in LFMC conduit.
2. Provide a generator field protection circuit breaker, or other means to protect the alternator.
3. Provide a load bank circuit breaker according to the plans and that meets the requirements listed in Section 16410.

D. CONVENIENCE RECEPTACLE

Provide one duplex, 120V receptacle (15A min) in the generator enclosure for maintenance purposes. This shall be independently powered by the generator, separate from the GADP of part 2.6A

E. DECALS, PLACARDS, AND SIGNS

1. The generator manufacturer shall provide all decals and signage as required by the regulatory and/or inspecting agency for the particular installation, including, but not limited to the following:
 - a. One hazardous material placard, diamond shape, 4 color (red, white, blue, yellow) with numbers 020 (diesel, kerosene, fuel oil) in accordance with NFPA 704.
 - b. A permanent sign at the fill point for the fuel tank. The sign shall include the filling procedure and tank calibration chart. The filling procedure shall require the person filling the tank to determine the gallons required to fill it to 90 percent of capacity before commencing the fill operation.
2. The Contractor shall provide the following in an easily viewable location on the fuel tank unless noted otherwise:
 - a. One 3" x 12" decal labeled "Diesel" (black/white).
 - b. At each entrance to the room, one 8" x 33" decal labeled "Danger Combustible Liquid" with white letters no less than 3 inches in height and 1/2 inch in stroke on a red background.
 - c. At each entrance to the room one 3" x 12" decal labeled "No Smoking" (red/white).

F. VIBRATION ISOLATORS

1. Provide vibration isolators between the unit and the sub-base fuel tank. The isolation mountings shall consist of malleable cast iron top and bottom housings incorporating steel spring or elastomeric construction and shall be provided with built-in leveling bolts, elastomeric pad and built-in resilient chocks to control oscillation and withstand lateral forces in all directions. Isolators shall be presized and installed in accordance with the recommendations of the generator set manufacturer.
2. Vibration isolation efficiency shall be 96 percent at 1,800 rpm. Provide Korfund or equal.

3. Calculations shall be provided with the vibration isolation submittal demonstrating that the specified efficiency can be met with the project specific system characteristics.
4. Vibration isolators may be waived with manufacturer's documentation that the entire generator package including mounted accessories is IBC certified without them.

G. SPRING ISOLATORS

Provide spring isolators for all generators 500 kW and larger.

H. ANCHORS

Anchors used to secure the generator to the base or other stable surface shall be designed and sized by the manufacturer. Anchors shall be cast-in-place 316 stainless steel anchor bolts or drilled-in 316 stainless steel anchors set with epoxy adhesive. Expansion type anchors shall not be acceptable. The Contractor shall provide and install these anchors.

2.7 SUBBASE TANK

A. GENERAL

Provide dual wall UL 142 listed sub base tank sized to meet 24 hours runtime at full load or 350 gallons, whichever is greater. The external tank profile shall be "flat" within ± 0.25 inches of vertical offset per 100 inches of horizontal length (± 0.14 degrees maximum).

The sub base tank shall have custom dimensions to reduce the height and accommodate the filling and venting components.

B. LEVEL SWITCH

Provide a liquid level float switches, Pneumercator LS600 or equal, assembly capable of the following:

1. High level alarm set at 90 percent tank capacity
2. Low level alarm set at 30 percent tank capacity

C. LEAK DETECTION SWITCH

Provide secondary containment leak detection. Provide Pneumercator LS600LD or equal.

D. DROP TUBE

Provide aluminum drop tube at the fuel fill, fuel return, and fuel supply ports. The drop tube with diffuser or suction strainer shall terminate a minimum of 6 inches from the bottom of the tank and shall be installed in a manner, which avoids excessive vibration.

E. FUEL FILL CONNECTION

Provide a 2-inch quick connect adapter and cap. Materials of construction shall be A36 carbon steel or aluminum meeting ASTM B221.

F. SPILL CONTAINER

Provide a 5-gallon spill container with a hinged, lockable cover and a manual drain valve into the primary tank. The spill container shall be of steel construction with a powder coated finish. The spill container shall be Morrison Bros. Fig. 516 or equal.

G. NORMAL VENT

Provide a 2-inch-diameter upward vent for normal atmospheric venting. The normal vent shall terminate outside, 12 feet above adjacent ground level. Vent piping shall be Schedule 40 Type S, Grade A steel pipe conforming to ASTM A53. The contractor shall provide all supports for the vent.

H. PRESSURE VACUUM VENT

A pressure/vacuum vent shall be installed at the top of the normal vent pipe, set at 1 oz per square inch. The body construction shall be Aluminum with stainless steel seat and poppet and the vacuum gasket shall be constructed of fuel resistant material. The pressure/vacuum vent shall be in accordance with NFPA 30. Provide Morrison Bros. Fig. 748 or equal.

I. EMERGENCY VENTS

Supply emergency vents for pressure relief only, Manufacturer shall size to prevent a pressure greater than 2.5 psi for the secondary containment tank and primary tank. The emergency vents shall terminate outside. Construction shall be aluminum with painted cast iron cover and Viton O-ring seat material; galvanized materials shall not be used. Mounting

connection shall be male NPT. Vents shall be UL listed and in accordance with NFPA 30. Provide Morrison Bros. Fig. 244 or equal.

2.8 EXHAUST SYSTEM

Sufficiently sized to ensure against loss of power due to excessive backpressure in accordance with engine manufacturer's recommendations. Include a drain plug and drip leg in low point of exhaust piping to protect engine. Terminate exhaust piping with a rain cap.

The exhaust systems shall be mounted inside the enclosure.

Provide a stainless steel flexible exhaust connector, with an exhaust temperature test fitting, flanged for service disconnection.

Provide a critical grade silencer. Silencer construction shall be steel with high temperature paint or aluminized finish.

2.9 ENCLOSURE

A. ACOUSTICAL ENCLOSURE

The Generator shall be provided with a skintight acoustical weather protective enclosure.

1. The enclosure shall reduce the sound pressure level of the generator set while operating at full rated load to an average of 76 dBA at any location 23 feet (7 meters) from the generator set in a free field environment.
2. The enclosure shall be constructed of minimum 12-gauge steel for framework and 14-gauge steel for panels. The enclosure shall have hinged access doors to maintain easy access for all operating and service functions. All hardware and hinges shall be stainless steel. All doors shall be lockable and include retainers to hold the door open during servicing. The roof shall be cambered to prevent the accumulation of water. The roof and walls shall be designed to withstand snow and wind loads per the IBC.
3. All sheet metal shall be primed for corrosion protection and finish painted with a color chosen by the Owner from the manufacturer's standard options.

4. The air intake and exhausts shall be sized to provide ample airflow for the generator set operation at rated load in ambient temperature of 100 degrees F.

2.10 GENERATOR RECEPTACLES

Contractor shall provide NEMA 3R mounting boxes for all new generator receptacles. Size mounting boxes such that the conductors maintain or exceed their minimum bending radius as required by the NEC.

Generator receptacles shall be provided with lockable end caps.

2.11 FINISH

The entire standby generator set assembly with accessories is to be factory painted, color chosen by Owner from manufacturer's standard colors. Generator set manufacturer shall provide appropriate epoxy/polyurethane coating system for high heat conditions.

2.12 ACCESS PLATFORM(S)

The generator manufacturer shall design and furnish any and all access platforms as required to meet current codes or to successfully access, operate, inspect, and/or maintain the equipment. Design shall be provided for review by the Engineer as part of the project submittal and in accordance with Section D. The Contractor shall install the equipment per the installation drawings, instructions, and recommendations.

Platform shall be suitable for installation outdoors, and all materials shall be hot-dip galvanized after fabrication. Stair access with railing shall be provided to all access platforms.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is 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. GENERAL

Install the complete generator set and accessories per the manufacturer's installation instructions.

1. Anchor the generator set to concrete housekeeping base or pad with high strength anchors and adequate penetration suitable for the Seismic Design Category as specified in the Plans.
2. Make all electrical connections between accessory items, which are not factory wired, prior to requesting the test engineer.

Maintain minimum workspace around unit and components per manufacturer's installation shop plans and NFPA 70 NEC.

Contractor shall locate generator control panel and the generator main circuit breaker per NEC clearances and provide accessibility to equipment. Neither shall be mounted more than 72 inches above the floor. Include all costs associated with relocating the standard control/service panel arrangement on generator set to maintain code requirements in the Bid Cost.

The generator set shall not be started up or tested in the field until all exhaust piping has been insulated as specified and shown on the Plans. All intake and exhaust louvers and fuel system components shall be fully functional.

B. LUBRICANT

Provide a complete fill of lubricating oil.

C. FUEL/FLUIDS

Provide a complete fill of fuel in diesel storage tank before testing.

Provide a complete fill of manufacturer approved antifreeze (ethylene-glycol) and water to protect the engine and heat exchanger cooling system to minus 25 degrees F.

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 Plans and Section 16060.

3.5 FIELD QUALITY CONTROL

A. GENERAL

Provide services of a factory authorized service representative to provide inspection results of field visit and field testing in writing.

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.

2. Provide third party breakers testing per Specification 16050, Section 3.

Check connections and mounting for proper torque.

Correct or replace malfunctioning units and retest.

Remove any burrs, filings, or other foreign materials from enclosure. Completely wipe down and vacuum enclosure.

3. 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.

D. FIELD TEST

Test the assembled generator set after installation at the job site is complete.

1. Advise the Engineer, the Integrator, the Contractor, the local Fire Prevention Inspector, and the Owner of the proposed time and date of the field test at least 2 weeks in advance so that the test may be witnessed if desired.
2. Under supervision of a factory authorized service representative, pretest all system functions, operations, and protective features. Provide all instruments and equipment required for tests. Adjust to ensure operation is according to specifications.
3. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations and these specifications under the environmental conditions present and expected.
4. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include, but not be limited to: all electric heaters, battery charger(s), etc.
5. Cold Start Test
 - a. The unit shall demonstrate the ability to start from a "cold" standby condition (i.e., normal standby mode with engine coolant temperature established by properly functioning water-jacket heater).
6. Calibration and PLC Signal Status Check
 - a. Calibrate all sensors and instruments.
 - b. Verify the scaling and connections of each signal to the PLC. Coordinate this work with the Integrator.
7. Generator Load Testing
8. Generator load testing shall be provided using a manufacturer-provided temporary load bank at 1.0 power factor. The generator shall be operated at 50 percent of full load rating for thirty minutes, followed seamlessly by thirty minutes at 80 percent of full load

rating, followed seamlessly by one hour at 100 percent full load rating.

9. After the first 15 minutes at full load, the following shall be recorded at 15-minute intervals (four recordings).
 - a. Voltage (phase to phase and phase to ground) and phase rotation
 - b. Amperage (each phase)
 - c. Frequency
 - d. Fuel pressure, oil pressure, and water temperature
 - e. Exhaust gas temperature at engine exhaust outlet
 - f. Ambient temperature

During the load test period, check for exhaust leaks, path of exhaust gases outside the building or enclosure, cooling air flow, movement during starting and stopping, vibration during 80 percent and 100 percent loading.

A certified copy of the test results shall be given to the Engineer and supplied with the O&M manuals.

10. Subbase Fuel Tank Test
11. The following test shall be observed by the local Fire Prevention Inspector:
 - a. Prior to any filling of combustible or flammable liquids the base tank shall be pressure tested per NFPA 30, Section 2.4.2. Include the test report in the O&M manuals.
 - b. The fuel fill container shall be tested for proper operation.
12. The Contractor shall demonstrate the backup power system is fully functional by simulating power outages. Provide 14 days written notice.
 - a. Coordinate phase rotation prior to transferring power.

- b. Power outages shall be simulated to the extent allowed by the process as determined by the Owner. Any process areas or loads not directly associated with the Contractor's scope of work, but connected to the generator being tested, will be turned on/off by the Owner.
- c. In the event that the installed generator assembly is unable to start and operate the specified loads, at a minimum:
 - i. Document the generator's output voltage current, and frequency during the demonstration including the point of failure.
 - ii. Provide written descriptions of the general conditions encountered during the demonstration and any field diagnostic actions performed.
 - iii. Document the changes, if any, between the test conditions and the table provided in section 1.5 Performance Requirements
 - iv. Provide recommendations to remedy the failed test.

13. Refill the generator tank after completion of field testing.

E. RETEST

Correct deficiencies identified by field tests and observations, and retest until specified requirements are fully met.

3.6 TRAINING

- A. The manufacturer of the generator set shall conduct specifically organized training sessions covering operation and maintenance of the unit for personnel employed by the Owner. The training sessions shall be conducted to educate and train the personnel in maintenance and operation of all components of the unit. Training shall include, but not be limited to, the following:
 - 1. Preventative maintenance procedures
 - 2. Trouble-shooting
 - 3. Calibration

4. Testing
 5. Replacement of components
 6. Automatic mode operation
 7. Manual mode operation
 8. Fuel and monitoring system
 9. Spare parts that have been provided
- B. At least one training session, at least 3 hours in duration, shall be conducted at the site after startup of the system. The manufacturer shall prepare and assemble specific instruction materials for each training session and shall supply such materials to the Owner at least 2 weeks prior to the time of the training.

3.7 FINAL ADJUSTMENTS

Adjust voltage and frequency output of generator set to nominal ratings and mark gauges with plastic pen for normal, operation references for Owner.

Adjust time response of control system to meet site performance requirements.

Check all remote connections again for proper tightness.

3.8 CLEANING

Upon completion of installation and startup, inspect engine generator set. Remove paint splatters, other spots, dirt, and debris. Perform touchup painting to cover scratches and marks to finish. Match original finish of generator set.

***** 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

1.2 RELATED WORKS SPECIFIED ELSEWHERE

<u>Sections</u>	<u>Item</u>
16050	Basic Electrical Materials and Methods

1.3 SUBMITTALS

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

Subject to compliance with requirements, manufacturers offering disconnect switches and circuit breakers that may be incorporated into the work include the following:

- A. General Electric Co.; Electrical Distribution and Control Division.

- B. Siemens Energy & Automation, Inc.
- C. Square D Co.
- D. Eaton, Cutler Hammer.

2.2 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. CIRCUIT BREAKERS, 400 A AND LARGER

Where indicated on the Plans, provide trip units with separate field-adjustable settings of instantaneous trip, short-time trip, short-time delay, long-time trip, and long-time delay.

F. MOLDED-CASE SWITCH

Where indicated, molded-case circuit breaker without trip units.

G. LUGS

Mechanical lugs and power-distribution connectors suitable for copper conductors of the number and size indicated.

H. SHUNT TRIP

Where indicated.

I. ACCESSORIES

As indicated.

NEMA AB 1, Type 4X stainless steel unless stated otherwise in the Plans.

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

Install the disconnect switches and circuit breakers level and plumb in locations as indicated, according to manufacturer's written instructions.

Install wiring between disconnect switches, circuit breakers, control, and indication devices.

Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and as instructed by manufacturer.

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.

Identify each disconnect switch and circuit breaker according to requirements specified in Section 16050.

3.3 FIELD QUALITY CONTROL

A. PRIOR TO ENERGIZATION

After installing disconnect switches and circuit breakers, perform visual and mechanical inspection of enclosure and devices.

Provide third party breaker testing per Specification 16050, Section 3.

Check connections and mounting for proper torque.

Remove any burrs, filings, or other foreign materials from enclosure. Completely wipe down and vacuum enclosure.

B. 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

TRANSFER SWITCHES

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section consists of furnishing and installing one automatic transfer switch.

1.2 RELATED WORKS SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
01800	Testing, Commissioning, and Training
Division 3	Concrete
09900	Painting
11000	Equipment General Provisions
Division 15	Mechanical
Division 16	Electrical

1.3 DEFINITIONS

A. 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.

B. 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.

C. 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 $\delta V \leq \pm 5$ 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.

D. 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.

E. 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.

F. 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.

G. NORMAL POSITION

A switch is in its “NORMAL” position when it is connected to the primary (utility) power source.

H. OPEN TRANSITION

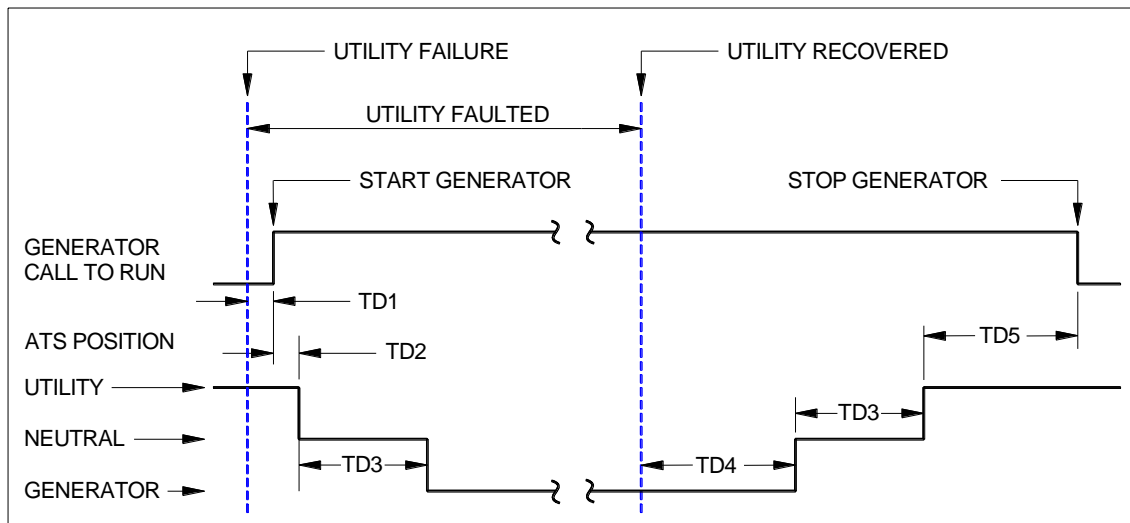
An “Open Transition” ATS provides a “break-before-make” transition under all transition conditions.

I. 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.

J. TIME DELAY DEFINITIONS

- TD1 “Call Delay” is the delay from the ATS sensing faulty utility power and the issue of a generator call to run command.
- TD2 “Off Utility Delay” is the delay from the ATS issuing a generator call to run command and the transfer of the ATS away from the “UTILITY” position.
- TD3 “Hold Neutral Delay” is the period of time that the ATS will hold the switch in its “neutral” (or “center” or “disconnected”) position when transferring from the “UTILITY” position to the “GENERATOR” position and from the “GENERATOR” back to the “UTILITY” position. In this neutral position, the load side of the ATS is disconnected from both utility and generator power. This delay allows the electronic equipment ample time to dissipate their residual power for proper reapplication of power following a shutdown. This delay only applies to 3-position delayed-transfer switches.
- TD4 “Hold Generator Delay” is the delay of the ATS to switch back to utility power after the utility has been sensed as healthy.
- TD5 “Cool-Down Delay” is the duration of generator runtime after the ATS has switched back to utility. This cool down period is intended to shut the generator off only after a relaxed cooling period.



3-POSITION SWITCH SIMPLIFIED TIMING DIAGRAM

K. UVTL

Utility Voltage Transition Level.

L. 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. Manufacturer's Product Data for trapped-key interlocks and accessories specified in this Section, and documentation of compatibility with hardware specified under other Sections.
- C. O&M Manual requirements are outlined elsewhere in the Contract Documents 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

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

Subject to compliance with requirements. All automatic transfer switches shall be compatible with the selected genset.

- A. General Electric Co.; Electrical Distribution & Control Div.
- B. Eaton, Cutler-Hammer.
- C. ASCO
- D. Kohler
- E. Cummins Power Generation/Onan

2.2 PROCUREMENT

The party responsible for the procurement of the automatic transfer switch shall be the single source of responsibility for submittal, products provided, warranty, startup and service purposes.

All automatic transfer switches shall be provided by the contractor that is supplying the generator set as defined in Specification 16230.

The generator and automatic transfer switches may be of different manufacturers.

2.3 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.

Delay settings:

Setting	Timing Function ⁽¹⁾	Initial Duration
TD1	Call Delay	1 second
TD2	Off Utility Delay	0 seconds
TD3	Hold Neutral Delay	30 seconds
TD4	Hold Generator Delay	30 minutes
TD5	Cool-Down Delay	5 minutes

(1) Reference “Time Delay Definitions.”

4. Power switching shall be provided for all phases.
5. Power sensing shall be provided for all phases.
6. Switch transfer control sensing shall be provided on all phases.
7. Switching mechanism shall be a discrete purpose device specifically designed for Automatic Transfer Switches.
8. Electrically operated by solenoid mechanisms and held by mechanical latches.

9. High current-breaking capacity with silver-surfaced contacts equipped with arc barriers and magnetic blow-out coils.
10. Contacts rated in accordance with UL 1008 for current carrying and switching capabilities.
11. Suitable for repetitive load transfer switching. Minimum 1,000 transfer cycles under full load conditions and minimum 2,000 cycles under no load conditions.
12. Interlocked to prevent supplying the load from more than one source at a time.
13. Adjustable close differential voltage monitoring relays provided on all three phases to sense voltage on the “NORMAL” and “STANDBY” sources.
14. 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.
 - iv. Generator call status. This status signal is one of two identical outputs. One can be directly connected to the generator to call a start operation. The second is electrically isolated from the generator connection and intended for connection to monitoring equipment.
15. Molded case breakers are not acceptable.
16. Intelligent display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no

light conditions. 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 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.
- 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 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 \geq 90 percent nominal system voltage
 - b. Invalid \leq 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 \geq 90 percent nominal system voltage
 - b. Invalid \leq 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 \geq 95 percent of system frequency
 - b. Invalid \geq 90 percent of system frequency

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

Install transfer switch per the manufacturer's installation instructions.

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. ADJUSTING AND PRETESTING

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.

B. 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.

1.2 RELATED WORK SPECIFIED ELSEWHERE

<u>Section</u>	<u>Items</u>
13451	Programmable Logic Controller (PLC) Programming
16050	Basic Electrical Materials and Methods
16120	Conductors and Cables
16410	Enclosed Switches, Fuses, and Circuit Breakers

1.3 DEFINITIONS

A. ANALOG AMMETER

A dial-type, d'Arsenal 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. FST (FIELD SERVICE TECHNICIAN)

A Field Service Technician (FST) is defined as a “hands-on” field representative qualified and authorized to perform technical start-up and trouble-shooting work on the manufacturer’s motor starters including drive programming and configuration.

D. FVNR BYPASS CONTACTOR

In RVSS starter power circuits, an FVNR rated BYPASS CONTACTOR is one whose current rating is sufficiently high to allow direct across-the-line motor starting in an FVNR mode (RVSS failure).

See RUN RATED BYPASS CONTACTOR in this section.

In VFD starter power circuits, the function of the FVNR BYPASS CONTACTOR is to provide across-the-line motor control in the event that the VFD fails. This CONTACTOR must have a current rating that is sufficiently high to allow direct across-the-line motor starting in an FVNR operating mode (VFD failure).

E. 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.

F. 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.

G. HIM (HUMAN INTERFACE MODULE)

HIM units are programmable human interfaces to RVSS and VFD drives and are used to configure the drive protection and control options. These devices are typically provided with programming/operating buttons and visual displays.

H. IGBT (Insulated Gate Bipolar Transistors)

IGBTs are embedded devices used to provide power switching in the DC-to-AC inverter section of VFD power modules.

I. 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.

J. POINT OF ANALYSIS

The Point of Analysis is a point indicated on the electrical one line diagram(s) where the contractor is responsible to comply with the Total Harmonic Current Distortion (THDC) limits of the IEEE-519, 2014 standard. By defining this point, the Engineer is providing all manufacturers a common point to calculate their THDC values.

The “available short circuit current” (I_{SC}) value required for IEEE-519 calculation shall be taken from the electrical one line diagram(s) of the Plans as the BOLTED FAULT CURRENT at the Point of Analysis.

The “average maximum demand current” (I_L) value required for IEEE-519 calculation shall be taken from the UTILITY LOAD DEMAND column of the LOAD SUMMARY table on the electrical one line diagram(s) of the Plans. Only loads “downstream” of the Point of Analysis shall be utilized in the calculation of I_L .

K. RAMP RATE, RVSS

The RVSS ramp rate is defined as the time, in seconds, for the RVSS to increase motor speed from zero to full speed or decrease motor speed from full speed to zero.

L. RUN-RATED BYPASS CONTACTOR

In RVSS starter power circuits, a run rated BYPASS CONTACTOR is one whose current rating is limited to the RVSS current rating. This type of bypass contactor cannot be used to directly start the motor across-the-line.

See FVNR BYPASS CONTACTOR in this section.

M. RVSS (REDUCED VOLTAGE, SOFT START)

The RVSS is the manufacturer's integrated power module package without additional starter components, and consists of embedded electronic power switching devices for acceleration and deceleration, associated "firing" control circuitry, and an embedded microprocessor for power circuit firing control and motor/module protection. It is one of the key components that make up a COMPLETE COMBINATION RVSS STARTER.

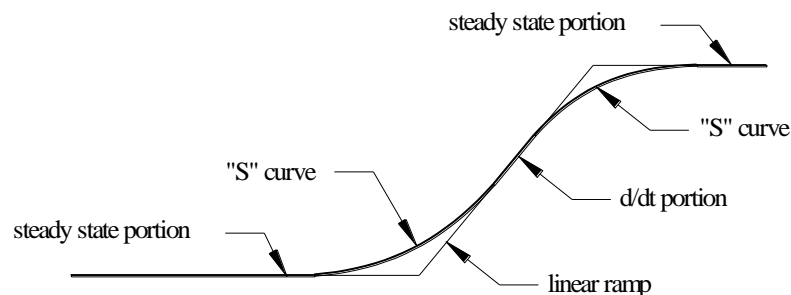
The RVSS power module may or may not include a RUN-RATED BYPASS CONTACTOR.

N. SCRS (SILICON CONTROLLED RECTIFIERS)

SCRs are GE's trade name for a thyristor (a four-layer unidirectional switching device). SCRs are triggered by the application of a gate current and are shut off at a zero-voltage crossover.

O. "S" CURVES

A modified linear-ramp curve with rounded edges between portions of the curve that are changing (d/dt portions) and portions of the curve that are not changing (steady state).



P. THD (TOTAL HARMONIC DISTORTION)

THD is defined as the ratio of the sum of the levels of all harmonic components to the level of the fundamental frequency.

Values are limited by the IEEE 519, 1992 standard developed to minimize power problems related to non-linear loads, such as VFDs.

1.4 SUBMITTALS

Submit a complete Bill of Materials (BOM) for each motor starter.

Submit drawings showing schematics for each motor starter. Schematics shall include all physical devices and connections of power and control circuits. Schematics shall include diagrams or descriptions clearly describing internal VFD logic where applicable. All devices on the schematics shall be tagged with their associated BOM number.

Submit drawings of door-mounted devices with associated BOM numbers.

Submit Manufacturer's product data for motor controllers and accessories specified in this Section.

Submit maintenance data for tripping devices to include in the operation and maintenance manual specified in Section 16050.

Submit compiled 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

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.

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.

1.7 EXTRA MATERIALS

Reference Specification Section 16050 for spare parts.

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. Square-D.

2.2 PRODUCT SHIPMENT AND 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 Not Internal to MCCs

Reference Plans for enclosure requirements.

Surface mounted, NEMA 250, Type 12, unless otherwise indicated 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

The following minimum requirements apply:

- a. Provide surge protective devices across each AC and DC relay coil.
- b. Provide LED “push-to-test” indicating lights.
- c. Provide combination electromechanical motor start counter and motor run time (elapsed time) meters Non-volatile battery backed LCD displays are acceptable.
- d. 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.

Exception:

- *Programmable starters that provide the Phase Monitor Relay functions as described above do not require an additional discrete phase monitor relay.*

e. 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.

f. 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.

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 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.

D. SPECIAL POWER CIRCUITS

Some motor starters require “special power circuits” as listed below. These circuits are not included in the G&O Motor Elementary Wiring Diagrams. If required, the manufacturer shall provide the power contactors and control circuits. Special Power Circuits include the following functions and are applicable to motor starter types as listed below:

Function	RVSS	FVNR
Isolation Contactor	X	
Bypass Contactor, Start-Rated (FVNR)	X	
Bypass Contactor, Run-Rated	X	
Power Factor Caps	X	X

These functions shall be provided as described on the Plans and within these Specifications.

E. WORK BY MANUFACTURER

1. All starters
 - a. The manufacturer shall provide motor controls as defined in these specifications and as shown on the Motor Starter Wiring Diagrams in the Plans.
 - b. The manufacturer shall provide complete combination motor starters as described in this section of this specification.
 - c. The manufacturer shall provide all physical (external) control relays and timers per Motor Starter Wiring Diagrams in the Plans. These devices shall not be integrated into programmable starter devices (VFDs, RVSSs, Smart Overload Relays, Extended I/O, etc.).

- d. The manufacturer shall provide additional internal controls and external relays/contactors for “special power circuits” as required for drive protection and manufacturer’s warranty.

2. Starters with Programmable Devices

Motor starters containing programmable devices (VFDs, RVSSs, Smart Overload Relays, Extended I/O modules, etc.) shall be configured as follows:

- a. The manufacturer shall provide internal fault logic for protection of motors and starter power devices. These are the manufacturer’s programmed conditions as required to warrant the system. A relay “FAULT” output will be programmed true on these fault conditions.
- b. The manufacturer shall provide HIM programming as follows:
 - i. HIM Display:
 - (1) The HIM will always display the “fault code” if faulted.
 - (2) If not faulted, then the HIM will display motor speed or motor amps (owner selection).
 - ii. HIM Key Pad:
 - (1) The system can be placed in the PROGRAMMING mode only through password entry. The password shall be provided to the owner.
 - (2) START, STOP, RESET, HAND, OFF, AUTO keys are inactive (locked out) unless in the programming mode.

3. Networked Starters.

For non-VFD motor starters, the manufacturer shall provide internal logic for control of “RUN” and “PUMP SET OK” functionality per the Motor Starter Wiring Diagrams in the Plans.

If different pin assignments are used by the manufacturer, then these shall match the external and internal logic connections as shown in the plans and shall be clearly documented during submittal. Extended I/O modules (EIOMs) shall be added as required to meet these conditions.

- a. The manufacturer shall configure and program the internal logic functions and HIM unit, as described in these specifications and on the Plans.
- b. The manufacturer shall provide all drive digital inputs to be readable by the PLC over the network.
- c. The manufacturer shall provide full support to the PLC programmer for the acquisition and transfer of networked I/O.

F. WORK BY INTEGRATOR OR FST

1. General

The manufacturer shall allow for field adjustments by a qualified FST and shall support the efforts of the FST during the panel shop during startup and commissioning as defined in this specification. Reference Section 3.5.

The manufacturer shall provide the FST directly or authorize the FST work to be performed by the Integrator. If authorized to be performed by the Integrator, then

- a. Such adjustments and settings shall not affect the manufacturer's warranty or transfer the manufacturer's liability to the Integrator, and
- b. Such work by the Integrator shall be financially compensated for by the manufacturer.

2. Settings Specific to the Application:

The FST shall provide drive module configuration settings as listed below. These changes shall not affect the manufacturer's warranty or reduce the manufacturer's liability.

- a. Current limit settings,

- b. Motor protection settings,
- c. Final settings for the fixed acceleration and deceleration ramp rates,
- d. Others with approval.

2.4 RVSS MOTOR STARTERS

Reference section COMBINATION MOTOR STARTERS, GENERAL

A. THD NOISE IMMUNITY AND COMPLIANCE WITH IEEE 519-1992

Reference Section 2.3B.

B. THE POWER CIRCUIT

1. Overcurrent Protective Device (OCPD).

Reference GENERAL DEVICES AND COMPONENTS,
Section 2.3C.

2. The RVSS.

- a. Provide a Run-Rated Bypass Contactor.

Exception:

- *Where specifically called out as an FVNR-Rated Bypass Contactor on the Plans.*
- b. Provide any additional power contactors and associated logic control, as required by the specific manufacturer, for power circuit isolation.
- c. Heat sink cooling fans shall be ball bearing type with internal impedance protection for the fan motor.
- d. All printed circuit boards shall be coated with a non-silicone base coating and shall be rated for wet applications.
- e. The circuit board and SCRs shall be noise immune per IEC 947-4-2, EMC requirements.

f. Electrical Specifications

- i. Voltage Ratings: as shown on the Plans.
- ii. Input voltage variations: ± 25 percent of nominal motor voltage, at a frequency of 58 to 62 Hz.
- iii. Operating Temperature: to 50 degrees C (122 degrees F) without derating.

50 to 70 degrees C (122 to 158 degrees F) derating 33 percent for every 10 degrees C over 50 degrees C to a maximum of 70 degrees C.
- iv. Permissible Altitude: 1,000 m at rated current
- v. Humidity: 5 to 95 percent relative humidity, non-condensing.
- vi. Overload Ratings Duration

<u>%FLA</u>	<u>@ 50°C (s)</u>	<u>@ 25°C (s)</u>
600	10	15
500	20	30
450	30	45
300	120	180
200	480	720
115	Continuous	Continuous

“Light duty” controllers are not acceptable.

vii. Power Devices

Power semiconductors shall be SCRs connected in inverse parallel configuration in each phase (six SCRs for 3-phase systems).

- (1) Peak Inverse Voltage (PIV) ratings shall be as follows:

200 to 480 V units: 1,400 V PIV
200 to 600 V units: 1,600 V PIV

- (2) Firing circuitry shall utilize optical isolated gate circuitry for hard firing of SCRs. Pulse

transformers and “picket fence” firing are not acceptable. The gate drive circuit shall be optically coupled for noise immunity and long life.

viii. Voltage Transient Suppression

- (1) Metal Oxide Varistors (MOVs) shall be supplied as standard across the power devices to protect them from line transients. Voltage transient suppression shall not cause the power devices to turn on. Built-in MOV protection shall prevent the MOVs from outgassing when rating is exceeded.
- (2) Resistor-capacitor snubber networks shall be supplied as standard to prevent the power devices from misfiring due to the dV/dT characteristics of the SCRs.

3. Motor Overload Protection (MOP).

The following overload protection shall be integrated into the RVSS or provided as a separate device within the combination starter.

a. Intelligent Overload Relay Protection

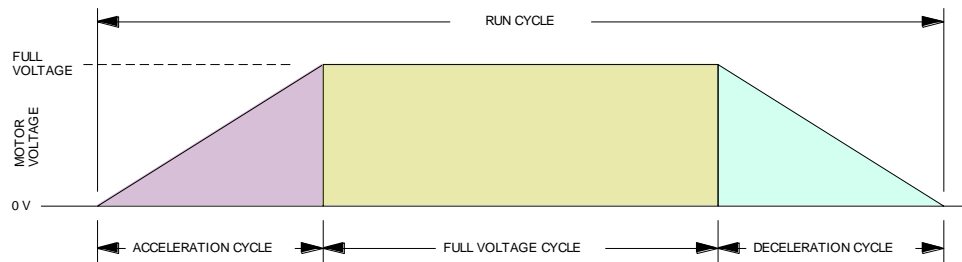
Where motor starters are shown on the Plans to be networked together or to a PLC, either directly or through network switches, such combination motor starters shall include the functionality of Intelligent Overload Relays complete with communication equipment and protocols compatible with the approved system control PLC. Functionality shall include ambient temperature compensation, visible trip indication, selectable trip Classes of 10, 15, 20, and 30, selectable manual/auto-manual reset, stall and jam protection with separate adjustable delays, phase imbalance, phase reversal, and phase loss, undervoltage, overvoltage, and underload sensing with conditional shutdown.

C. THE CONTROL CIRCUIT

Reference GENERAL DEVICES AND COMPONENTS, Section 2.3C.

D. OPERATING CYCLES

RVSS controllers shall be provided with three running cycles; (1) the “acceleration” cycle, (2) the “full voltage” cycle, and (3) the “deceleration” cycle. The “run” cycle shall consist of all three sequential running cycles as shown on the Figure below.



1. Acceleration Cycle

The acceleration cycle shall be operator-selectable from 0 to 30 seconds of speed/torque control from full stop to full slip speed (full voltage) from the drive’s Operator Interface Module.

Linear and non-linear acceleration curves shall be operator-selectable from the drive’s Operator Interface Module and shall include, as a minimum, the following control curves:

- a. Hydraulic pump acceleration curve
- b. Linear ramp curve
- c. Linear ramp with “S” curve at transitions (see definitions)
- d. Kick-start (break-away torque) feature

2. Full Voltage Cycle

A Form A contact shall be provided for drive status monitoring and an optional across-the-line contactor that is not integrated into the RVSS Drive.

3. Deceleration Cycle

The deceleration cycle shall be operator-selectable from 0 to 120 seconds of speed/torque control from full slip speed (full voltage) to full stop from the drive’s Operator Interface Module.

Operator selection of 0 seconds shall result in a “natural coasting” deceleration to full stop.

Linear and non-linear deceleration curves shall be operator-selectable from the drive’s Operator Interface Module and shall include, as a minimum, the following control curves:

- a. Hydraulic pump deceleration curve
 - b. Linear ramp curve
 - c. Linear ramp with “S” curve at transitions
4. Run Cycle

A Form A contact shall be provided that is continuously active over the acceleration, full voltage, and deceleration cycles.

E. FACTORY SETTINGS

Acceleration and deceleration values shall be preconfigured by the starter manufacturer for each RVSS starter as follows:

		Ramp Rates (0-100% speed), in sec.	
Tag Number	Description	Accel.	Decel.
[01 MTR 01]	MOTOR, WELL PUMP	5	5

F. RVSS I/O TERMINALS

The RVSS shall include, as a minimum, the following I/O connection terminals:

Signal	I/O Type	Function
Drive “START” Input	Input, 120 Vac	RVSS “Start” Command
Drive “RESET” Input	Input, 120 Vac	RVSS “Reset” Command
Drive Fault Output	Output, Form A or C	Programmable
Drive Running Output	Output, Form A or C	Programmable
Drive at Full-Speed Output	Output, Form A or C	Programmable

G. NETWORK COMMUNICATIONS

Where motor starters are shown on the Plans to be networked together or to a PLC, either directly or through network switches, such RVSS combination motor starters shall include communications equipment and protocols compatible with the approved system control PLC.

Provide the minimum command and status parameters as shown on the schematic(s) and I/O tables on the Plans.

Provide additional distributed I/O modules and associated power supplies, as required, to meet the data transfer networking requirements listed here and shown on the schematic(s) and I/O tables on the Plans.

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.
 - b. The assistance of the starter manufacturer's **Field Service Technician (FST)** as described below. Throughout this contract, the Field Service Technician shall be provided by the manufacturer.

Special Note:

Areas of field testing and commissioning where the work responsibilities are shown as "FST/INTEGRATOR" may be performed by either the manufacturer's FST or the Integrator (if so, authorized by the manufacturer and agreed upon by the Integrator). If the work is authorized to be performed by the Integrator, then such work shall not affect the manufacturer's warranty or transfer the manufacturer's liability to the Integrator.

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 (FST ASSISTANCE NOT REQUIRED)

1. Megger the motor leads per Specification 16120.
2. If the starter is powered from a separate feeder, then megger the feeder per Specification 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.

C. ENGAGING THE FST AT THE JOBSITE PRIOR TO ENERGIZATION

Engage an FST to be present when energizing or commissioning motor starters. Under the direction of the FST, the following minimum tests shall be performed, documented, and dated by the FST. These documents will be provided as a part of the MCC or Motor Starter Sections of the O&M Manual.

The FST shall:

1. Check connections and device mounting for proper torque.
2. Check alignment of plug-in devices with stationary parts.
3. Check operating mechanisms for binding, lubrication, etc.
4. Verify that all pilot lights are LED type. Replace if not.

5. Verify that analog meters are scaled roughly two times the motor's FLA.
6. Test the validity of the control, instrumentation, and communication circuits.
7. Test all breakers for proper physical movement and door interlocking. Repair or replace as required.
8. Set the motor protection values for the specific motors being controlled.
9. Verify the drive's initial minimum and maximum speed ranges per the table in Section 2.6F.
10. Set the acceleration and deceleration rates per the tables in Section 2.5 and Section 2.6, FACTORY SETTINGS, for RVSS and VFD units respectively.
11. The FST shall energize the starter.

D. SERVICES OF THE FST/INTEGRATOR AT THE JOBSITE AFTER ENERGIZATION

The FST/INTEGRATOR shall:

1. Verify motor rotation and direction. Coordinate this work with the pump/motor manufacturer. Wiring corrections shall be made by the Contractor.
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. Test starter cooling fan circuits.
8. Correct malfunctioning units on site where possible and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

E. ADJUSTMENTS AND STARTER PERFORMANCE VERIFICATION BY THE FST/INTEGRATOR

1. The FST/INTEGRATOR shall provide adjustments, calibrations, and final settings for RVSS units, VFD drives, and Motor Overcurrent Protective (MOP) devices as required to meet design intent and process requirements and make all necessary adjustments and calibrations as required to provide acceptable motor starting and operational performance. Motor nameplate data shall be provided to the FST by the Contractor.
2. The FST/INTEGRATOR shall provide the final OCPD breaker trip setting for the motor circuit being protected.
3. The FST/INTEGRATOR shall document all such adjustments and calibrations in a table similar to that shown below (as a minimum) and initial and date each final setting. This table shall be submitted to Engineering for approval and acceptance. All Status “As Left” conditions must be checked off as “OK” before completion. The final table shall be provided as a part of the MCC or Motor Starter Sections of the O&M Manual.

Parameter Adjusted		Value				
Ref. No.	Parameter Description	As Found	As Left	Status “As Left”	Date/Time	Test Performed By (Initials)

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. Cycle power to each starter while their motors are running. Provide a minimum of two cycle tests per motor/starter.

B. TRAINING

1. The FST shall provide basic starter operation training immediately following commissioning.

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 16940
CONTROL PANELS

PART 1 GENERAL

1.1 SCOPE

The work specified in this Section includes control panels and motor starter panels fabricated by a UL 508/508A, non-OEM package provider.

1.2 RELATED WORKS SPECIFIED ELSEWHERE

<u>Section</u>	<u>Item</u>
01300	Submittals
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

<u>Reference</u>	<u>Title</u>
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.

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. Nameplate text.

8. Heat calculations and relationship to enclosure fan.

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

1. If the submitted panel(s) are to be labelled and listed with an agency other than UL, submit proof of certification as a panel shop by that agency. For UL listed panels, the Contractor fabricating panels shall submit proof of certification as a UL 508A and/or UL 698A (if required) panel shop upon request.

1.7 QUALITY ASSURANCE

Make shop drawings available prior to placement of conduits in slabs to ensure placement is coordinated with panel access locations.

Test panels prior to shipment to project site.

The entire assembled panel shall be tested to be free from grounds and shorts.

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.

Panels supplied under this Section are provided by a single manufacturer.

Provide panels labeled by a recognized testing laboratory acceptable to the State of Washington Department of Labor and Industries meeting the requirements of Article 409 of the NEC.

Revise all drawings upon completion of the work to show "as shipped" condition of the panel.

1.8 STORAGE AND HANDLING

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.

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.

1.9 EXTRA MATERIALS

Reference Specification Section 16050 for spare parts.

PART 2 PRODUCTS, MATERIALS

2.1 CONTROL PANEL ENCLOSURES

A. ENCLOSURE BODIES

Control panel enclosures are factory listed and 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 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.

2.2 PANEL POWER DEVICES

A. FUSES

1. Power Circuit Fusing

Reference Specification 16410.

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 Specification 16410.

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 Specification 16410.

D. 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 Specification 16420, Motor Controllers.

E. CURRENT TRANSFORMERS

Current transformers are 1 percent accuracy at burden and lead length as installed. G.E., Midwest, Westinghouse or Hawkeye.

F. AMMETERS

Ammeters are ± 2 percent accuracy, 2-1/2-inch size GE, Simpson, Weston, or Crompton.

G. 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

1. Pilot lights shall be heavy duty, Class 9001, Type J, NEMA 4 (watertight) and NEMA 13 (oil-tight), metal collar, push-to-test, multi-segmented LED with red, green, amber, blue, clear, white, or yellow colored caps as shown on the Plans.
 - a. Allen-Bradley
 - b. Cutler-Hammer
 - c. General Electric
 - d. Siemens
 - e. Square D

B. PUSH BUTTONS

1. Push buttons shall be heavy duty, Class 9001, Type K, UL Types 4 and 13, NEMA 4 (watertight) and NEMA 13 (oil-tight), metal collar, 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.

- a. Allen-Bradley
- b. Cutler-Hammer
- c. General Electric
- d. Siemens
- e. Square D

C. SELECTOR SWITCHES

1. 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), metal collar, 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

D. RELAYS

Regardless of the technology of a relay's control (from simple to programmable), the relay's output technology shall be the electro-mechanical type. Electronic outputs (triacs, thyristors, transistors, etc.) shall not be allowed.

Exceptions:

- *Unless specifically shown otherwise on the Plans.*
- *Unless approved in writing by the Engineer.*

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 24V or 110-120V 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 10A at 250 VAC, 10A 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 indicators. Relays shall be IDEC, P&B/Tyco or equal.

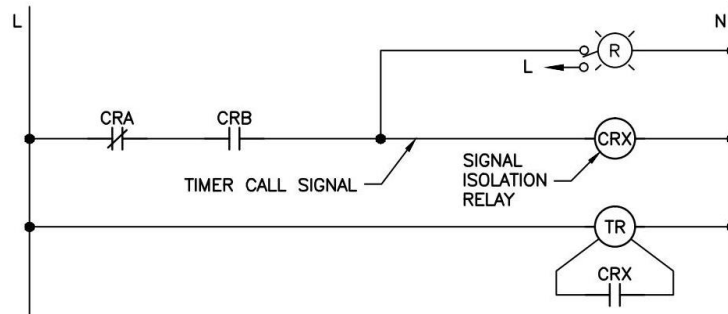
3. Time Delay Relays

Time delay relays shall be electronic, programmable, multifunction type with a minimum of two Form C (DPDT) contacts rated at 10 A into resistive loads. Timers shall have a selectable timing range from 0.05 seconds to 999 hours. The following features shall be provided on the front of the timer for easy and clear adjustability:

- a. Function selection (type of delay function);
- b. Time setting (3 digits);
- c. Timing range (seconds, minutes, hours);
- d. Table showing the selectable functions;
- e. LED indicator that indicates timing mode and time out condition.

On-delay timers (TDAE, Time Delay After Energization) shall be 8-pin octal socket style with 120 VAC or 24 VDC coils; Macromatic #TD-70222 and #TD-70228 respectively.

Off-delay timers (TDAD, Time Delay After De-energization) shall be 11-pin socket style with 120 VAC or 24 VDC coils, requiring an isolated trigger (see figure below); Macromatic #TD-71622 and #TD-71628, respectively.



4. 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.
Sockets shall be IDEC SJ2S-07L or exact equal.

5. 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.
Sockets shall be IDEC SJ2S-07L or exact equal.

2.4 PANEL ANCILLARY DEVICES

A. 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 setpoint range 32 to 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" x 5".

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.).

B. 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, 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.

C. PANEL WIRING PRODUCTS

1. Power Circuit Wiring; Reference Specification 16120.

2. Control Circuit Wiring; Reference Specification 16120.

2.5 PANEL ACCESSORIES

A. PANEL NAMEPLATES AND IDENTIFICATION

Identify each item on the control panel with rectangular nameplates.

Provide nameplates of rigid phenolic plastic laminate with engraved lettering or engraved metal plate with filled lettering. Use black background with white lettering.

Minimum letter height is 1/2 inch for instrument description and 1/4-inch height for instrument tag number.

Provide each panel with a 2-inch by 10-inch (minimum) nameplate with 1-inch-high lettering with panel identification.

Abbreviations are not permitted unless approved by the Owner or specifically shown on the nameplates, schedules, or plans.

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

Control panels are factory or shop fabricated units completely assembled, wired, and tested before shipment to the job site.

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.*

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).

Size panels for enclosed equipment and available space for mounting of panel or as shown on the Plans.

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.*

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

Welded construction. Completely enclosed, self-supporting, and gasketed dust-tight. Seams and corners welded and ground smooth. Furnish doors with keyed alike locking handles and three point catch. Provide each panel with lifting eyebolts. Furnish stainless steel base channels. Slotted bolt holes in base, 1-1/2 long for field adjustment.

C. COMPONENT INSTALLATION

Minimize welding to panel fronts and avoid distortion of panel metal.

Reinforce around areas of the enclosure weakened by openings or mounting of heavy equipment/components.

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.

Provide minimum 1-5/8-inches spacing between horizontal rows of externally mounted components; 1-1/2 inches minimum between vertical columns of components.

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.

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.

Components mounted in the interior shall be fastened to an interior subpanel using machine screws plus adhesive to insure vibration-free attachment.

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.

D. PANEL WIRING METHODS

Provide panel wiring sizes and colors per Specification 16120.

Field wiring terminations to control panel terminal strips shall be connected as shown on the Plans.

Provide raceways for panel wiring. Size raceways per the requirements of NEC. Provide panel wireways between each row of components, and adjacent to each terminal strip. 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

Provide wire bending space per NEMA ICS 6.

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.

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.

Connect electrical equipment grounds to the chassis grounding bus.

Provide necessary power supplies for control equipment.

E. WIRE TERMINATION METHODS

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.

Provide fused terminals as shown on the Plans or defined herein.
Reference Section 2.2 for materials

Provide terminal strips for the termination of panel wiring not directly connected to panel mounted devices.

Terminals shall facilitate wire sizes as follows:

1. 120 VAC applications: Wire size 12 AWG and smaller.
2. Other: Wire size 14 AWG and smaller.

Tag each I/O terminal to indicate tag number of the connected device or wire.

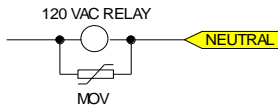
Provide 20 percent excess terminals (minimum) for future expansion.

Provide a minimum of 1.5 inches between terminal strips and wireways or between terminal strips.

F. RELAY COIL SURGE SUPPRESSION

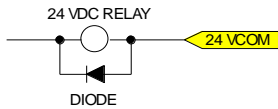
1. 120 VAC Coil Surge Suppression

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 1A, 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. Relay and Process Controller Test
 - a. Demonstrate the complete operation of the relay logic, backup logic, process controllers, and etc.
3. 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.
4. 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.

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

F PREVAILING WAGES

PREVAILING WAGE RATES

The following wage rates are in effect for this project.

**State of Washington
Department of Labor and Industries
Washington State Prevailing Wage Rates For Public Works Contracts**

Thurston County Rates For All Trades

**Effective: March 19, 2024 including any correction notices issued
by Labor and Industries prior to bid.**

Wage Rates and the Benefit Code Key may be found at:
<https://secure.lni.wa.gov/wagelookup/>


Supplemental to State Wage Rates may be found at:
<http://www.wsdot.wa.gov/Design/ProjectDev/WageRates/default.htm>

A copy is also available for viewing at the City of Lacey Public Works Engineering office located at 420 College St SE, Lacey, WA 98503. If requested, a hard copy will be mailed to you.

APPENDIX A


COL RAM FORMS

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PROJECT:		SUBMITTAL No.		 CITY OF LACEY
LACEY CONTRACT NO. PW____-20____		Date sent to City:		
Request for Approval of Material, Product or Shop Drawing				
Contractor:		Subcontractor:		
No. of Pages	Item: Material, Product or Shop Drawing		Specification Reference	
<input type="checkbox"/> This item is as specified		OR <input type="checkbox"/> This item is a substitution/or equal Material/Product Substitution Request shall be submitted		
<input type="checkbox"/> Supplier/Subcontractor certifies material/product conforms to contract.				
Review Priority: <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 Requested Due Date:				
Notes to Engineer:				

City of Lacey Engineer:		Date Approved by City:	
<input type="checkbox"/> Rejected	New Submittal Required.		
<input type="checkbox"/> Revise and Resubmit	See Engineer's comments.		
<input type="checkbox"/> Conditionally Approved	See items included in Engineer's comments.		
<input type="checkbox"/> Conditionally Approved	No exceptions noted.		
Review of the materials, products or plans do not relieve the contractor from compliance with requirements of the contract documents and does not necessarily constitute acceptance for materials, products or plans to be incorporated in the work. This review is for general conformance of the project's conceptual design and general compliance with the project's plans and specifications.			
Date City Transmitted to Contractor:		Date Contractor Transmitted to Subcontractor/Supplier:	

Date Received by City of Lacey:	Reviewed by: (Name/Company)
<u>Engineer's Comments:</u> 1.	

PROJECT: <i>A</i>		SUBMITTAL No. <i>C</i>	 CITY OF LACEY
LACEY CONTRACT No. PW___-20___ <i>B</i>			
Request for Approval of Material, Product or Shop Drawing			
Contractor: <i>D</i>		Subcontractor: <i>E</i>	
No. of Pages	Item: Material, Product or Shop Drawing	Specification Reference	
<i>F</i>	<i>G</i>	<i>H</i>	
<input type="checkbox"/> This item is as specified <i>I1</i> OR <input type="checkbox"/> This item is a substitution/or equal Material/Product Substitution Request shall be submitted <i>I2</i>			
<input type="checkbox"/> Supplier/Subcontractor certifies material/product conforms to contract.			
Review Priority: <input type="checkbox"/> 1 <i>K</i> <input type="checkbox"/> 2 <input type="checkbox"/> 3 Requested Due Date: <i>L</i>			
Notes to Engineer: <i>M</i>			

Section 1

City of Lacey Engineer: <i>R</i>		Date City Transmitted to Contractor: <i>S</i>	
<input type="checkbox"/> Rejected	New Submittal Required.		
<input type="checkbox"/> Revise and Resubmit	See Engineer's comments.		
<input type="checkbox"/> Conditionally Approved	See items included in Engineer's comments.		
<input type="checkbox"/> Conditionally Approved	No exceptions noted.		
Review of the materials, products or plans do not relieve the contractor from compliance with requirements of the contract documents and does not necessarily constitute acceptance for materials, products or plans to be incorporated in the work. This review is for general conformance of the project's conceptual design and general compliance with the project's plans and specifications.			
Date Received by Contractor: <i>T</i>		Date Returned to Subcontractor/Supplier: <i>U</i>	

Section 3

Date Received by City of Lacey:	<i>N</i>	Reviewed by: (Name/Company)	<i>@</i>
------------------------------------	----------	--------------------------------	----------

Engineer's Comments:

1. *P*

Section 2

Section 1

The **Project Manager** shall fill in items **A** and **B**. The “Request for Approval of Material, Products or Shop Drawing” form shall be included in the specifications.

A Project Manager enters in the project title that matches the plans and specifications.

B Project Manager enters in PW project number that matches the plans and specifications.

The **Contractor** shall fill out the “Request for Approval of Material, Product or Shop Drawing” form for all materials or products that will be installed and Shop Drawing that will be used in the project. The form and the submittal shall be sent in the same e-mail. Submittals that exceed 10 MB shall either be provided on a CD, a flash drive or an internet link.

The products and materials that are specific to the project shall be circled or highlighted. If a submittal includes products or materials that are not project specific then these items shall be crossed out. Project Submittals that exceed 10 pages shall be submitted in Adobe Acrobat format and include a table of contents. Submittals that are not submitted in this format may be rejected outright and the contractor will be required to resubmit in the correct format.

The contractor shall enter in items **C, D, E, F, G, H, I, J, K, L**, and **M**.

C Contractor enters in the submittal number. The first “Request for Approval of Material, Product or Shop Drawing” submittal number shall be 1.0, the second shall be 2.0, the third shall be 3.0, etc.

When a “Request for Approval of Material, Product or Shop Drawing” requires resubmitting, the next submittal shall be the first part of the submittal number and then 0.1. Example: If submittal 9.0 requires resubmitting, then the resubmittal shall be 9.1. If a second resubmittal is required, then the next resubmittal shall be 9.2.

D Contractor shall fill in their name.

E Contractor shall fill in the subcontractor that is requesting approval. If only the General Contractor is requesting approval, then NA (not applicable) shall be entered.

F The number of pages for each specific material, product or shop drawing shall be entered.

G The specific material, product or shop drawing shall be entered. Material or product will be the trade name of the product or the name it is most easily recognized by. Materials or products that are similar (i.e. pipe fittings) can be bundled into one submittal.

H The specification that pertains to the specific material, product or shop drawing shall be entered. This information is critical in comparing the material, product or shop drawing to the specifications. You may also list Plan Sheet number or Special Provision page in this area.

I The Contractor shall check if the items submitted are either specified (I1) or that the submitted item is a substitution or equal (I2). If the product is a substitute or equal, then a Material/Product Substitution Request shall be submitted.

J The Contractor shall check that supplier and/or subcontractor certifies the bid item.

K The Contractor shall check if the submittal for approval is a high (1), average (2) or low (3) priority. The City of Lacey will review priority submittals as quickly as possible. Note: The majority of the submittals shall be checked as priority 2 or 3. Priority 1 submittals shall be critical or long lead items.

L A due date can be entered by the contractor. The City of Lacey will endeavor to review and return the request for approval by the requested due date.

M Any additional notes that the Contractor finds would assist the City of Lacey in reviewing the submittal can be entered in here.

Section 2

The **City of Lacey Engineer** shall fill in items **N**, **O** and **P**.

N Enter the date that the City of Lacey received the “Request for Approval of Material, Product or Shop Drawing” from the Contractor.

O Enter the name and company of the person that reviewed the submittal.

P Any comments regarding changes needed, resubmittals requirements, conditional approval, etc. shall be entered.

Section 3

The **City of Lacey Engineer** shall fill in items **Q**, **R**, and **S**.

Q Either “Rejected: New Submittal Required.”, “Review and Resubmit: See Engineer’s comments.”, “Conditionally Approved: See items included in Engineer’s comments.”, or “Conditionally Approved: No exceptions noted” shall be checked”.

R Enter the name of the Engineer sending the submittal back to the Contractor. The Engineering sending the form back may not necessarily be the Engineer completing the review.

S Enter the date that the City of Lacey transmits the “Request for Approval of Material, Product or Shop Drawing” to the Contractor.

The **Contractor** shall enter in items **T** and **U** for their own records. If there is a discrepancy between the **S** “Date City Transmitted to Contractor” and **T**, the Contractor shall notify the City of Lacey within 3 working days.

T Contractor enters the date that they received the completed “Request for Approval of Material or Shop Drawing”.

U Contractor enters the date that that they return the completed “Request for Approval of Material or Shop Drawing” to the Subcontractor/Supplier.

GEOTECHNICAL REPORT PROPOSED S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS Parkside Drive SE and 57th Way SE Lacey, Washington

PROJECT NO. 22-448
February 2023

Prepared for:



*Geotechnical & Earthquake
Engineering Consultants*

February 8, 2023
PanGEO File No. 22-448

Mr. Keith Stewart, P.E.
Gray & Osborne, Inc.
1130 Rainier Avenue South, Suite 300
Seattle, Washington, 98144

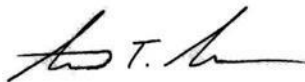
Subject: Geotechnical Report
S10 Generator, Well Pump, and Site Improvements
Parkside Drive SE and 57th Way SE, Lacey, WA
G&O IPN #22625

Dear Mr. Stewart,

PanGEO has completed a geotechnical study for the proposed Source 10 (S10) generator, well pump, and site improvements project for the City of Lacey, Washington. Based on the results of our study, it is our opinion that the project is feasible as planned. Site excavations are anticipated to encounter about 3 to 3½ feet of loose to medium dense silty sand (existing fill) overlying medium dense to dense recessional outwash sand deposits. In our opinion, the generator can be founded on a structural slab supported by a one-foot-thick lift of crushed surfacing base course (CSBC) placed upon an adequately compacted subgrade.

We appreciate the opportunity to assist you with this project. Please call if you have any questions.

Sincerely,



Steven T. Swenson, L.G.
Senior Geologist

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ATTACHMENTS

- Figure 1 Vicinity Map
Figure 2 Site and Exploration Plan

APPENDICES

Appendix A Summary Test Pit Logs

- Figure A-1 Terms and Symbols for Boring and Test Pit Logs
Figure A-2 Test Pit TP-1
Figure A-3 Test Pit TP-2
Figure A-4 Test Pit TP-3

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Appendix B Well No. 10 Water Well Report (1 page)

Appendix C Laboratory Test Results

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Appendix D Analytical Laboratory Test Results

Cation Exchange Capacity and Organic Matter Testing Results (4 pages)

GEOTECHNICAL REPORT
PROPOSED S10 GENERATOR, WELL PUMP, AND SITE IMPROVEMENTS
PARKSIDE DRIVE SOUTHEAST AND 57TH WAY SOUTHEAST
LACEY, WASHINGTON

1.0 GENERAL

PanGEO completed a geotechnical engineering study for the proposed Source 10 (S10) generator, well pump, and site improvements project for the City of Lacey, Washington. The objective of our study was to evaluate subsurface conditions at the site, and based on the conditions encountered, provide geotechnical engineering recommendations for the proposed improvements. Our work was performed in accordance with our proposal dated September 6, 2022. Our service scope included reviewing readily available geologic and geotechnical data, a site reconnaissance, excavating three (3) test pits at the site, and developing the conclusions and recommendations presented in this report.

2.0 SITE AND PROJECT DESCRIPTION

The subject site is the existing City of Lacey's water source 10 well facility located at the northwest corner Parkside Drive Southeast and 57th Way Southeast in Lacey, Washington. The site location is approximately as shown in the attached Figure 1, Vicinity Map. Existing site conditions are shown in Plate 1 on the following page.

The rectangular shaped site is bordered to the north by existing residences, to the east by Parkside Drive Southeast, to the west by an existing shopping center, and to the south by the entrance to the shopping center. The site is vegetated with short grass and has a gravel driveway at the entrance on the south end of the site. Topography at the site is essentially flat.

We understand the project will include constructing a 4-foot-wide by 15-foot-long concrete pad to support a new generator and fuel tank. The location of the generator pad has not been finalized, but potential locations are indicated on the attached Figure 2. In addition, relatively shallow stormwater piping improvements are planned. The utility pipes are anticipated to be about 4 to 5 feet deep.



Plate 1 – Facing North from near entrance gate at south end of site.

The conclusions and recommendations outlined in this report are based on our understanding of the proposed project, which is in turn based on the project information provided. If the above project description is substantially different from the proposed improvements or if the project scope changes, PanGEO should be consulted to review the recommendations contained in this report and make modifications, if needed.

3.0 SUBSURFACE EXPLORATIONS

3.1 TEST PITS

Three test pits (TP-1 through TP-3) were excavated for the project on December 6, 2022. The test pits were excavated by the City of Lacey Public Works Department using a Deere rubber-tired backhoe. The approximate test pit locations were measured from existing site features and are indicated on the attached Figure 2. The test pits were

excavated to a maximum depth of about 9.3 feet below the ground surface. After each test pit was logged, the excavation was backfilled with the excavated soils and the surface was tamped and re-graded smooth.

A geologist from PanGEO was present during the field exploration to observe the test pit excavations, obtain representative soil samples, and describe and document the subsurface conditions encountered in the test pits. The system used to classify the soils is summarized on Figure A-1, Terms and Symbols for Boring and Test Pit Logs.

Summary test pit logs presented in Appendix A, Figures A-2 to A-4, provide descriptions of the materials encountered, depths to soil contacts, and depths of seepage or caving observed in the test pit sidewalls. The relative in-situ density of cohesionless soils, or the relative consistency of fine-grained soils, was estimated from the excavating action of the backhoe, probing the sidewalls with a ½-inch diameter steel rod, and the stability of the test pit sidewalls.

3.2 WELL NO. 10 WATER WELL LOG

We reviewed a copy of the well report for the City of Lacey's Well No. 10, which is located at the subject site (See Figure 2). Well No. 10 was drilled to about 216 feet below the ground surface in 1981. Discussion of the subsurface conditions reported on the water well report is included in Section 4.0 of this report. A copy of the water well report is provided in Appendix B.

3.3 LABORATORY TESTING

The following laboratory tests were performed on select soil samples collected from the test pits:

- Moisture Content (ASTM D 2216)
- Grain Size Distribution (ASTM D 6913)

The test results are noted on the test pit logs in Appendix A, where appropriate, and the grain size distribution test results are included in Appendix C.

Laboratory tests were also performed to determine the Cation Exchange Capacity (CEC) and percent organic matter of select soil samples. The CEC tests were performed using USEPA Method 9081 and the organic matter tests were performed using the Walkley-Black method. The results are presented in Section 4.4 of this report, and the raw laboratory test data is included in Appendix D.

4.0 SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

In preparing this report, we reviewed the *Geologic Map of the East Olympia 7.5-Minute Quadrangle, Thurston County, Washington* (Walsh and Logan, 2005). Based on our review, the site is mapped as Vashon recessional outwash sand and silt (Map Unit Qgos). This unit is described as sand and silt with occasional interbedded gravel deposited by stagnant meltwater from the receding glacier. Walsh indicates this soil unit typically ranges from about 4 to 20 feet thick.

4.2 SOIL CONDITIONS

The subsurface conditions at our test pit locations were generally consistent with the mapped geology and encountered soils that we interpret as recessional outwash. Detailed test pit logs are provided in Appendix A of this report.

The following is a summary of the subsurface conditions encountered at our test pit locations:

Topsoil and Sod – The topsoil and sod layer at each of our test pit locations was typically about 6-inches thick.

Existing Fill – Underlying the topsoil and sod layer, loose to medium dense silty sand with occasional organics was encountered. We interpret this soil unit as existing fill based on its disturbed appearance and the presence of organic debris. This soil unit was encountered to about 3 to 3½ feet below grade at our test pit locations.

Vashon Recessional Outwash Sand and Silt: Underlying the existing fill, medium dense to dense silty to relatively clean sand was encountered. In general, a decrease in fines with depth was noted. An approximately 6-inch-thick layer of gap graded fine gravel was encountered in TP-2 at about 8 feet below grade. We interpret this soil unit to be recessional outwash deposit, which is consistent with the geologic mapping of the project area. This soil unit was encountered to the maximum depth explored at all our test pit locations.

4.3 GROUNDWATER

Groundwater seepage was not encountered within the exploration depth of our test pits at the time of exploration in December 2022.

The Well No. 10 water well report indicates that the static groundwater level was at about 17 feet below the ground surface (approximate elevation 178 feet) at the time of drilling in May 1981. Subsequent groundwater level readings by the City between 1993 and 2020 indicate static groundwater has been measured as shallow as about 15 feet below grade.

The design team and earthwork contractor should be aware that groundwater levels and seepage rates are not static. There will likely be fluctuations in the groundwater level depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, the water level is higher and seepage rates are greater in the wetter, winter months (typically October through May).

4.4 LABORATORY TEST RESULTS

Select representative samples of the Vashon recessional outwash soils were submitted for laboratory testing to characterize the native recessional outwash soils. The test results are summarized in Table 1, on the following page.

Table 1 – Laboratory Test Results (Native Recessional Outwash)

Sample Location, Depth (feet)	Cation Exchange Capacity (meq/100g)	Organic Content	% Moisture	% Fines Passing U.S. #200 Sieve (by weight)
TP-1, 6'	4.0	0.52%	9%	1.2%
TP-2, 7.5'	3.8	0.93%	9%	3.1%
TP-3, 6'	13.0	0.60%	23%	35.3%

5.0 GEOTECHNICAL RECOMMENDATIONS

5.1 GENERATOR CONCRETE PAD SUPPORT

Based on the results of our test pits, loose to medium dense silty sand (existing fill) is anticipated at the generator pad subgrade elevation. We recommend the generator pad be supported on a minimum of 12 inches of granular structural fill such as Crushed Surfacing Base Course (CSBC, WSDOT 9-03.9(3)) or a project engineer approved equivalent. Granular structural fill should be compacted to a firm and unyielding condition and to at least 95% of its maximum dry density as determined using ASTM D1557 (Modified Proctor).

Prior to placing the granular structural fill, the bottom of the overexcavation should be compacted to a firm and unyielding condition. If deleterious materials such as organics are present at the base of the overexcavation, the deleterious material should be removed. Any soft/loose or pumping subgrade soil detected during compaction should be removed and replaced with CSBC. PanGEO or the project engineer should verify the adequacy of the compacted subbase prior to placing the CSBC.

For a subgrade prepared as discussed above, an allowable soil bearing pressure of 2,000 pounds per square foot (psf) may be used. For allowable stress design, the recommended

bearing pressure may be increased by one-third for transient loading, such as wind or seismic forces.

5.2 UNDERGROUND UTILITIES

We understand that stormwater piping improvements that are about 4 to 5 feet deep are planned. Recommendations pertaining to trench excavation and support, pipe support and bedding, and utility trench backfill are provided in the following sections.

5.2.1 Trench Excavation and Support

Based on our field exploration, trench excavations are generally anticipated to encounter loose to medium dense silty sand with trace gravel (existing fill) overlying medium dense to dense silty to relatively clean sand with trace gravel (recessional outwash).

The excavation method and equipment should be determined by the contractor. Based on the subsurface conditions encountered at our test pit locations, it is our opinion that conventional excavators should be capable of excavating utility trenches.

Utility trenches greater than 4 feet deep should be properly sloped. Temporary slope recommendations can be found in Section 6.2 of this report. Alternatively, conventional trench shoring systems such as trench boxes are considered feasible for this project. For shoring design purposes, the contractor may utilize an equivalent fluid weight of 35 pcf to represent the lateral earth pressures on the shoring. This pressure should be increased for backslopes above the shoring or to account for soil stockpiles and/or equipment traffic surcharges within a horizontal distance equal to the depth of the excavation. All excavations should be conducted in accordance with all applicable federal, state, and other local safety requirements. It is the contractor's responsibility to design and maintain the required temporary excavation stability to achieve a safe working condition.

5.2.2 Pipe Support and Bedding

Based on our subsurface explorations, the recessional outwash deposits anticipated at the bottom of utility trenches should generally provide adequate support for utility pipes. If soft or unstable soil that cannot be adequately compacted or unsuitable organic material

is encountered at the trench bottom, it may be necessary to overexcavate the material and backfill with pipe bedding or CSBC compacted to a dense condition.

Utility installation should be conducted in accordance with the 2023 WSDOT *Standard Specifications* or other applicable specifications for placement and compaction of pipe bedding and backfill. General recommendations relative to pipe bedding are presented below.

- Pipe bedding material, placement, compaction, and shaping should be in accordance with the project specifications and the pipe manufacturer's recommendations. At a minimum, the pipe bedding should meet the gradational requirements for Gravel Backfill for Pipe Zone Bedding, Section 9-03.12(3) of the 2023 WSDOT *Standard Specifications*;
- Pipe bedding should be placed on relatively undisturbed native soils, or compacted fill. If the native subgrades are disturbed, the disturbed material should be removed and replaced with compacted bedding material;
- Pipe bedding should provide a firm, uniform cradle for the pipe. We recommend a minimum 4-inch thickness of bedding material beneath the pipe and a minimum 12-inch thickness of bedding material above the crown of the pipe be provided;
- Prior to the installation of the pipe, the pipe bedding should be shaped to fit the lower part of the pipe exterior with reasonable closeness to provide continuous support along the pipe;
- Pipe bedding material and/or backfill around the pipe should be placed in layers and tamped to obtain complete contact with the pipe. In areas where a trench box is used, the bedding material should be placed before the trench box is advanced.

5.2.3 Material Reuse and Utility Trench Backfill

The soils encountered in the upper 4 to 5 feet of our test pits have a relatively high fines content and are considered moisture sensitive. These soils are particularly susceptible to

excessive drying during periods of hot and dry weather or, conversely, they can quickly become too wet for adequate compaction during wet weather. Moisture conditioning measures such as aeration, sprinkling, or mixing may be needed to obtain a near-optimum moisture content. If it is planned to use the site soils as backfill, the excavated soil should be stockpiled and protected with plastic sheeting to prevent it from becoming saturated by precipitation or runoff.

The onsite soils may be utilized for trench backfill provided they can be compacted to the project specifications. Boulders and cobbles larger than about 6 inches should be removed from onsite material to be used as trench backfill. If the onsite soils cannot be adequately compacted, trench backfill should consist of imported granular material meeting the requirements for Bank Run Gravel for Trench Backfill (WSDOT 9-03.19) or Gravel Borrow as specified in Section 9-03.14(1) of the 2023 WSDOT *Standard Specifications*, or an approved equivalent. The trench backfill should be placed in 8-inch thick loose lifts and compacted using mechanical equipment to at least 95 percent maximum dry density, per ASTM D1557.

During placement of the initial lifts, the trench backfill should not be bulldozed into the trench or dropped directly on the pipe. Furthermore, heavy vibratory equipment should not be permitted to operate directly over the pipe until a minimum of 2 feet of backfill has been placed over the pipe.

6.0 EARTHWORK CONSIDERATIONS

6.1 STRIPPING

Based on the thickness of the topsoil and sod encountered at our test pit locations, we anticipate a stripping depth of about 6 inches will be needed. The actual stripping depth should be based on field observation at the time of construction.

In no case should the stripped or grubbed materials be used as structural fill or mixed with material to be used as structural fill. The stripped materials may be “wasted” on site in non-structural areas such as landscaping areas, or they should be exported.

Following the stripping operation and excavations necessary to achieve construction subgrade elevations, the ground surface where structural fill, foundations, slabs, or pavements are to be placed should be observed by a qualified individual experienced in earthwork construction.

Proofrolling may be necessary to identify soft or unstable areas. The needs for proof rolling should be determined at the time of construction. Loose or soft areas, if re-compacted and still yielding, should be overexcavated and replaced with granular structural fill. The optional use of a geotextile fabric placed directly on the overexcavated surface may also help to bridge unstable areas.

6.2 TEMPORARY EXCAVATIONS

All temporary excavations should be performed in accordance with Part N of WAC (Washington Administrative Code) 296-155. The contractor is responsible for maintaining safe excavation slopes and/or shoring. Based on the soil conditions encountered in our test pits, it is our opinion that temporary excavations in existing fill and recessional outwash deposits may be sloped as steep as 1½H:1V (Horizontal:Vertical) but should be reevaluated in the field based on the actual soil conditions.

6.3 CONSTRUCTION DEWATERING

Based on the subsurface conditions encountered at our test pit locations and our understanding of the project, we do not anticipate groundwater will result in significant construction related issues. If perched groundwater is encountered, we anticipate that the rate of groundwater flow will be small, and that a conventional dewatering system consisting of trenches, sumps and pumps will be adequate to dewater the temporary excavation.

6.4 STRUCTURAL FILL AND COMPACTION

Structural fill should consist of clean, free-draining granular soils that are relatively free from organic matter or other deleterious materials. Such materials should be less than 4

inches in maximum dimension, with less than 7 percent fines (portion passing the U. S. Standard No. 200 sieve), as specified for Gravel Borrow in Section 9-03.14(1) of the 2021 WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction*. The fine-grained portion of structural fill soils should be non-plastic.

All structural fill should be moisture conditioned to within about 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and compacted to at least 95 percent maximum dry density, determined using ASTM D 1557 (Modified Proctor). The procedure to achieve proper density of a compacted fill depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain soil properties. In areas where the size of the excavation restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough layers to achieve the required relative compaction.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with high fines contents are particularly susceptible to becoming too wet, and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried as necessary, or moisture conditioned by mixing with drier materials, or other methods.

7.0 LIMITATIONS

We have prepared this report for Gray & Osborne, Inc. and the project design team. Recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

Variations in soil conditions may exist between the locations of the explorations and the actual conditions underlying the site. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations. Additionally, we should also be

notified to review the applicability of our recommendations if there are any changes in the project scope.

The scope of our work does not include services related to construction safety precautions. Our recommendations are not intended to direct the contractors' methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design. Additionally, the scope of our work specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances.

This report has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk. Any party other than the client who wishes to use this report shall notify PanGEO of such intended use and for permission to copy this report. Based on the intended use of the report, PanGEO may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release PanGEO from any liability resulting from the use this report.

We appreciate the opportunity to be of service.

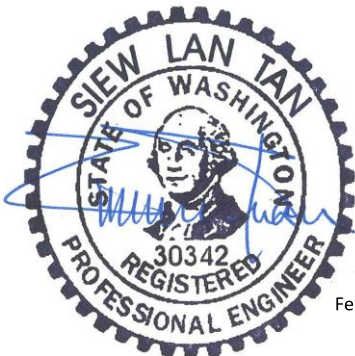
Sincerely,



Mary V. Green, L.E.G., C.E.G.
Project Engineering Geologist

A handwritten signature in black ink, appearing to read "S.T. Swenson".

Steven T. Swenson, L.G.
Senior Geologist

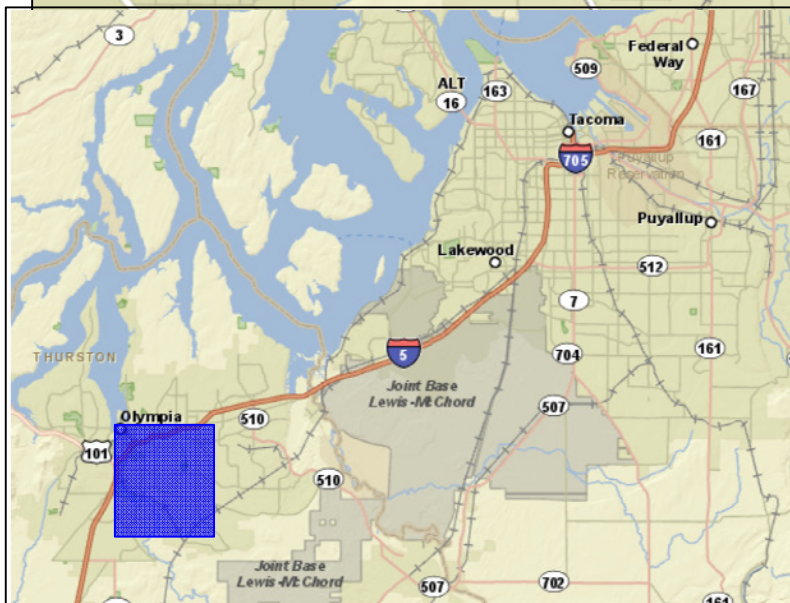
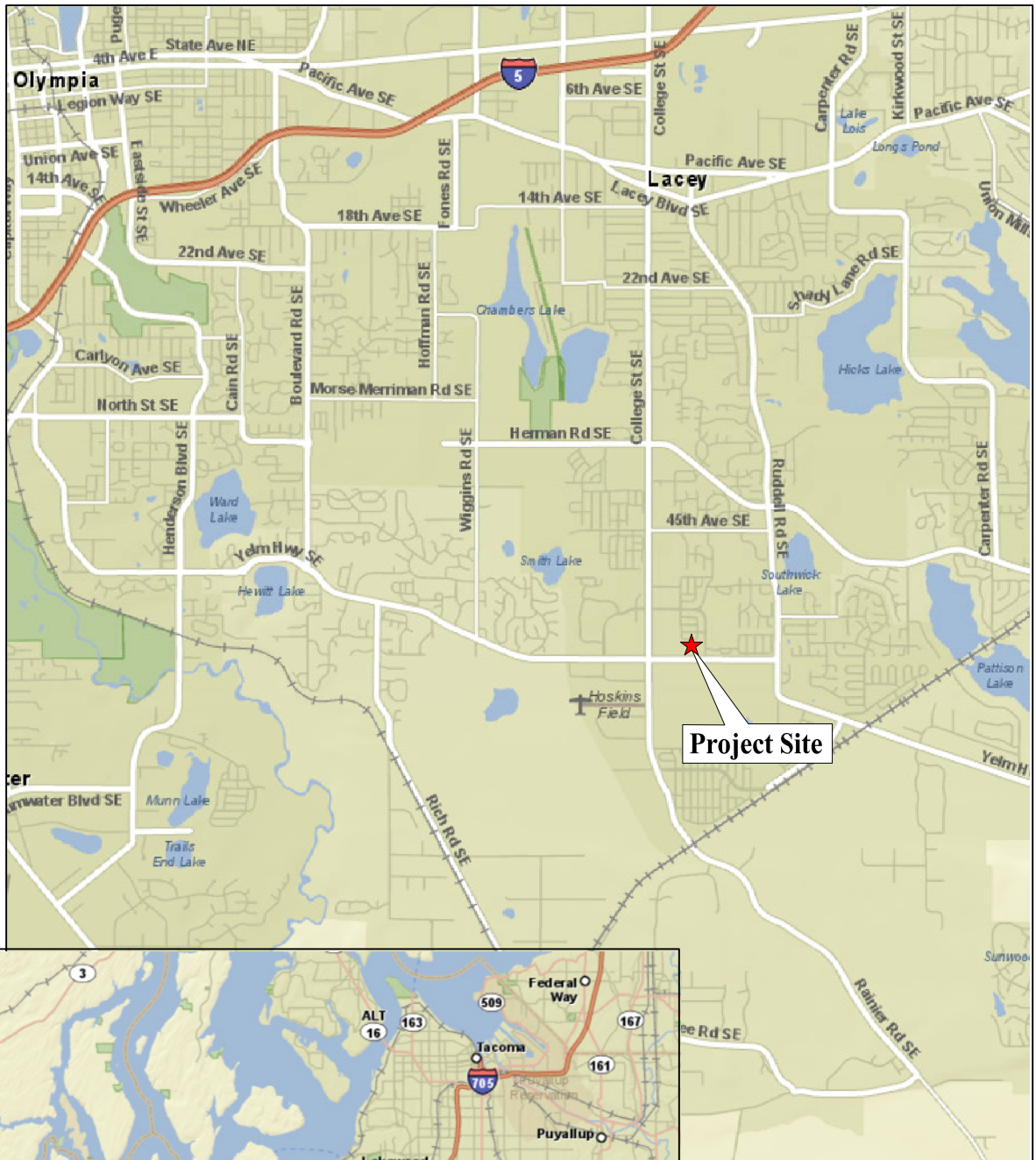


February 8, 2023

Siew L. Tan, P.E.
Principal Geotechnical Engineer

8.0 LIST OF REFERENCES

- Walsh, T.J., and Logan, R.L., 2005, *Geologic Map of the East Olympia 7.5-Minute Quadrangle, Thurston County, Washington*, Washington Division of Geology and Earth Resources, Geologic Map GM-56, Scale 1:24,000
- Washington State Department of Transportation (WSDOT), 2023, *Standard Specifications for Road, Bridge and Municipal Construction, M 41-10*.



Base Map: WSDOT GeoPortal



Approx. Scale:
Not to Scale

PanGEO
INCORPORATED

**Proposed S10 Generator,
Well Pump, and Site Improvements
Parkside Drive SE and 57th Way SE
Lacey, Washington**

VICINITY MAP

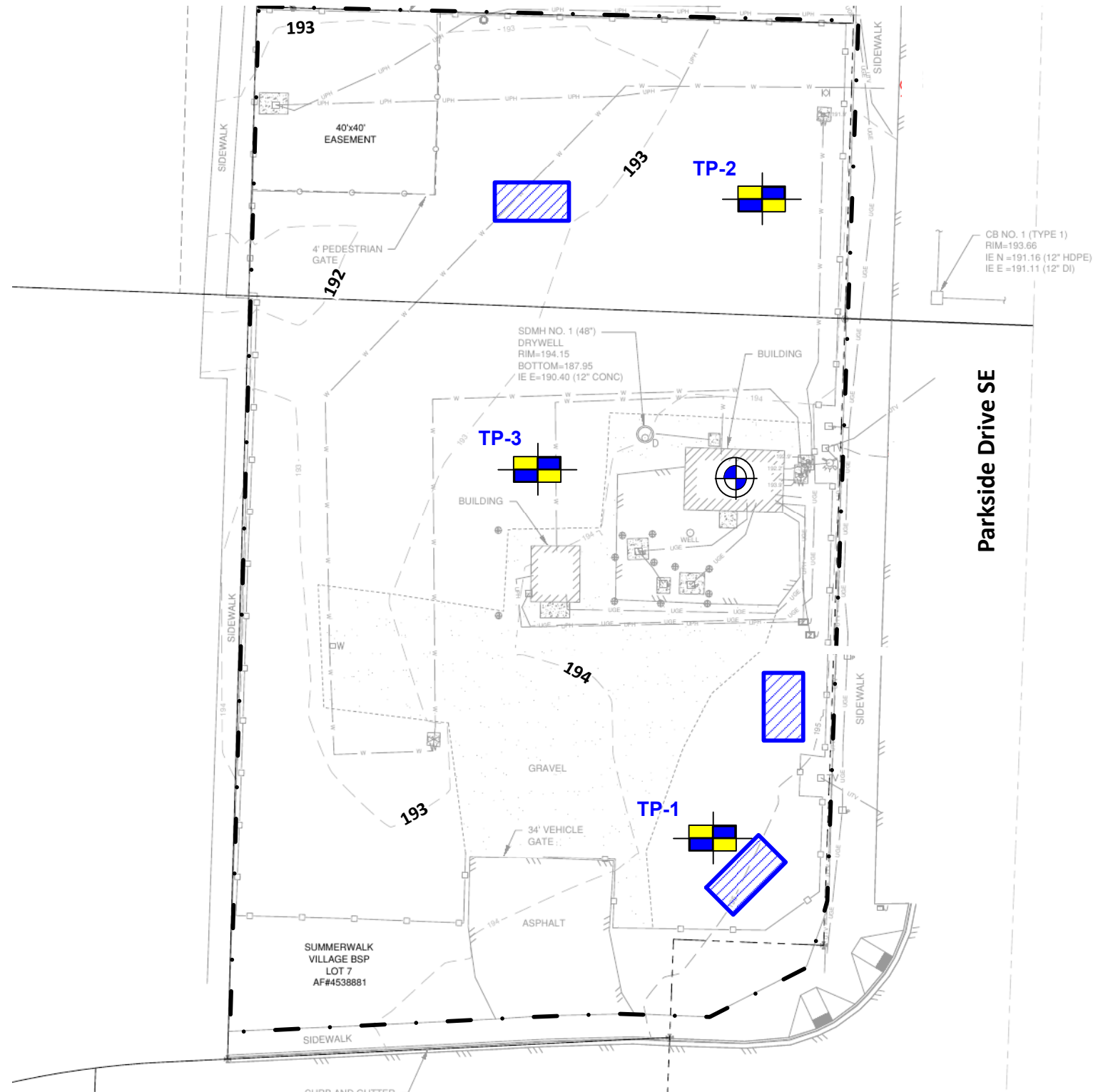
Project No.

22-448

Figure No.

1

22-448 Fig 2 Site & Exploration Plan.dwg 2/6/23 MVG



LEGEND:



Subject Site



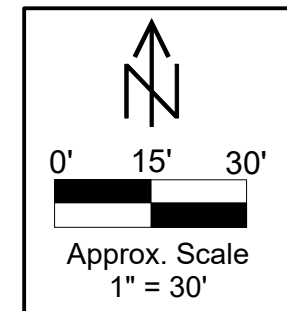
Approximate Proposed Generator Locations



City of Lacey Water Source Well No. 10



Approximate Test Pit Locations
PanGEO, Inc., December 2022



PanGEO
INCORPORATED

Proposed S10 Generator,
Well Pump, and Site Improvements
Parkside Drive SE and 57th Way SE
Lacey, Washington

SITE AND EXPLORATION PLAN

Project No. 22-448

Figure No. 2

Base map modified from existing site plan based on City of Lacey survey provided to Gray & Osborne in October 2022

APPENDIX A

SUMMARY TEST PIT LOGS

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)		GW: Well-graded GRAVEL
	GRAVEL (>12% fines)		GP: Poorly-graded GRAVEL
			GM: Silty GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)		GC: Clayey GRAVEL
	SAND (>12% fines)		SW: Well-graded SAND
			SP: Poorly-graded SAND
Silt and Clay 50% or more passing #200 sieve			SM: Silty SAND
			SC: Clayey SAND
	Liquid Limit < 50		ML: SILT
			CL: Lean CLAY
			OL: Organic SILT or CLAY
	Liquid Limit > 50		MH: Elastic SILT
			CH: Fat CLAY
Highly Organic Soils			OH: Organic SILT or CLAY
			PT: PEAT

- Notes:**
- Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.
 - The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

Layered: Units of material distinguished by color and/or composition from material units above and below	Fissured: Breaks along defined planes
Laminated: Layers of soil typically 0.05 to 1mm thick, max. 1 cm	Slickensided: Fracture planes that are polished or glossy
Lens: Layer of soil that pinches out laterally	Blocky: Angular soil lumps that resist breakdown
Interlayered: Alternating layers of differing soil material	Disrupted: Soil that is broken and mixed
Pocket: Erratic, discontinuous deposit of limited extent	Scattered: Less than one per foot
Homogeneous: Soil with uniform color and composition throughout	Numerous: More than one per foot
	BCN: Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

ATT	Atterberg Limit Test
Comp	Compaction Tests
Con	Consolidation
DD	Dry Density
DS	Direct Shear
%F	Fines Content
GS	Grain Size
Perm	Permeability
PP	Pocket Penetrometer
R	R-value
SG	Specific Gravity
TV	Torvane
TXC	Triaxial Compression
UCC	Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals

	2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
	3.25-inch OD Split Spoon (300-lb hammer, 30" drop)
	Non-standard penetration test (see boring log for details)
	Thin wall (Shelby) tube
	Grab
	Rock core
	Vane Shear

MONITORING WELL


	Groundwater Level at time of drilling (ATD)
	Static Groundwater Level
	Cement / Concrete Seal
	Bentonite grout / seal
	Silica sand backfill
	Slotted tip
	Slough
	Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water


Test Pit Logs

Project No: 22-448
 Project Name: S10 Generator & Well Pump, Lacey
 Project Location: Parkside Drive SE and 57th Way SE, Lacey, WA
 Date Excavated, Logged By: 12/06/2022, M. Green

Test Pit No. TP-1	
Location: See Figure 2	
Approximate ground surface elevation: 194.5 feet (NAVD88)	
Depth (ft)	Material Description
0 – 0.3	2 inches sod over 2 inches loose, light brown, silty SAND, trace gravel, fine-grained sand, numerous rootlets, moist. [Topsoil and Sod]
0.3 – 3.5	Medium dense, dark brown, silty SAND, trace gravel, fine-grained sand, occasional rootlets, moist. [Existing Fill]
3.5 – 6	Medium dense, light brown, poorly graded SAND with SILT, trace gravel, fine-grained sand, moist. [Vashon Recessional Outwash Sand and Silt – Qgos]
6 – 6.5	Medium dense to dense, gray, poorly graded SAND (SP), trace gravel, fine to medium-grained sand, moist. <ul style="list-style-type: none"> • Sample at 6': 9% moisture, 1.2% fines (SP)
 <p>Test pit at 6.5 feet deep.</p>	
TP-1 was terminated approximately 6.5 feet below grade. No groundwater was observed at the time of excavation.	


Test Pit Logs

Project No: 22-448
 Project Name: S10 Generator & Well Pump, Lacey
 Project Location: Parkside Drive SE and 57th Way SE, Lacey, WA
 Date Excavated, Logged By: 12/06/2022, M. Green

Test Pit No. TP-2	
Location: See Figure 2	
Approximate ground surface elevation: 193 feet (NAVD88)	
Depth (ft)	Material Description
0 – 0.5	2 inches sod over 4 inches loose, dark brown, silty SAND, trace gravel, fine-grained sand, numerous rootlets, moist. [Topsoil]
0.5 – 3	Loose to medium dense, dark brown, silty SAND, trace gravel, fine-grained sand, moist. [Existing Fill] <ul style="list-style-type: none"> Encountered empty 2-inch diameter PVC pipe at about 3-feet deep
3 – 6	Medium dense, light brown, poorly graded SAND with SILT, trace gravel, fine-grained sand, moist. [Vashon Recessional Outwash Sand and Silt – Qgos] <ul style="list-style-type: none"> Slight caving observed around 5 feet.
6 – 9.3	Medium dense to dense, gray, poorly graded SAND, trace gravel, fine to medium-grained sand, moist. <ul style="list-style-type: none"> Approximately 6-inch layer of gap graded fine gravel at about 8-feet deep Sample at 7.5': 9% moisture, 3.1% fines (SP)
<p>Test pit at 9.3 feet deep.</p> <p>TP-2 was terminated approximately 9.3 feet below grade. No groundwater was observed at the time of excavation. Caving was observed at about 5-feet deep to the bottom of the excavation.</p>	
	

Test Pit Logs

Project No: 22-448
 Project Name: S10 Generator & Well Pump, Lacey
 Project Location: Parkside Drive SE and 57th Way SE, Lacey, WA
 Date Excavated, Logged By: 12/06/2022, M. Green

Test Pit No. TP-3	
Location: See Figure 2	
Approximate ground surface elevation: 193 feet (NAVD88)	
Depth (ft)	Material Description
0 – 0.5	2 inches sod over 4 inches loose, light brown, silty SAND, trace gravel, fine-grained sand, numerous rootlets, moist. [Topsoil]
0.5 – 3.5	Medium dense, dark brown, silty SAND, trace gravel, fine-grained sand, occasional rootlets, moist. [Existing Fill]
3.5 – 7	Medium dense, light brown, silty SAND, trace gravel, fine-grained sand, frequent layers of poorly graded SAND with SILT with frequent pockets of light brown silty SAND (SM), moist. [Vashon Recessional Outwash Sand and Silt – Qgos] <ul style="list-style-type: none"> Sample at 6': 23% moisture, 35.3% fines (SM)
 <p>Test pit at 7 feet deep.</p> <p>TP-3 was terminated approximately 7 feet below grade. No groundwater was observed at the time of excavation.</p>	

APPENDIX B

WELL No. 10 WATER WELL REPORT

WATER WELL REPORT

STATE OF WASHINGTON

Application No.

Permit No.

62-25778

(1) OWNER: Name City of Lacey Address P.O. Drawer "B" Lacey, WA
(2) LOCATION OF WELL: County Thurston SE 1/4 SW 1/4 Sec 33 T 18 N. R. 1 W.M.
Bearing and distance from section or subdivision corner 480' N 1700' E 1/4 SW 1/4 Sec 33

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well No. 10
(if more than one).....
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 16 inches.
Drilled 216 ft. Depth of completed well ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 16 " Diam. from 0 ft. to 178 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒

Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐ Johnson

Manufacturer's Name Johnson
Type Telescoping Stainless Steel
Diam. 16 Slot size 80 from 178 ft. to 208 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal concrete grout
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: HP

(8) WATER LEVELS: Land-surface elevation 195 ft.
above mean sea level.....
Static level 17 ft. below top of well Date 7/23/81
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? Hart-Crowder
Yield: 1400 gal./min. with 48 ft. drawdown after 6.6 hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level

Transmissivity estimated to be 48,600 gpd/ft.

Date of test 7/23/81
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☒ No ☐

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Sand	6	10
Dirty Sand & Gravel	10	53
Blue Clay	53	72
Sand and Gravel with Cobbles	72	77
Silty Gravelly Sand	77	84
Sandy Gravel	89	91
Sandy Gravel with Silty Layers	91	124
Silty Sand and Gravel	124	140
Cemented Gravel	140	169
Dirty Sand and Gravel	169	180
Brown Sand and Gravel	180	211
Blue Clay	211	216

RECEIVED

NOV - 5 1981

DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 5-13 1981. Completed 6/16 1981

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Story and Dodge Drilling
(Person, firm, or corporation) (Type or print)

Address Graham, Washington

[Signed] Edgar J. Story
(Well Driller)

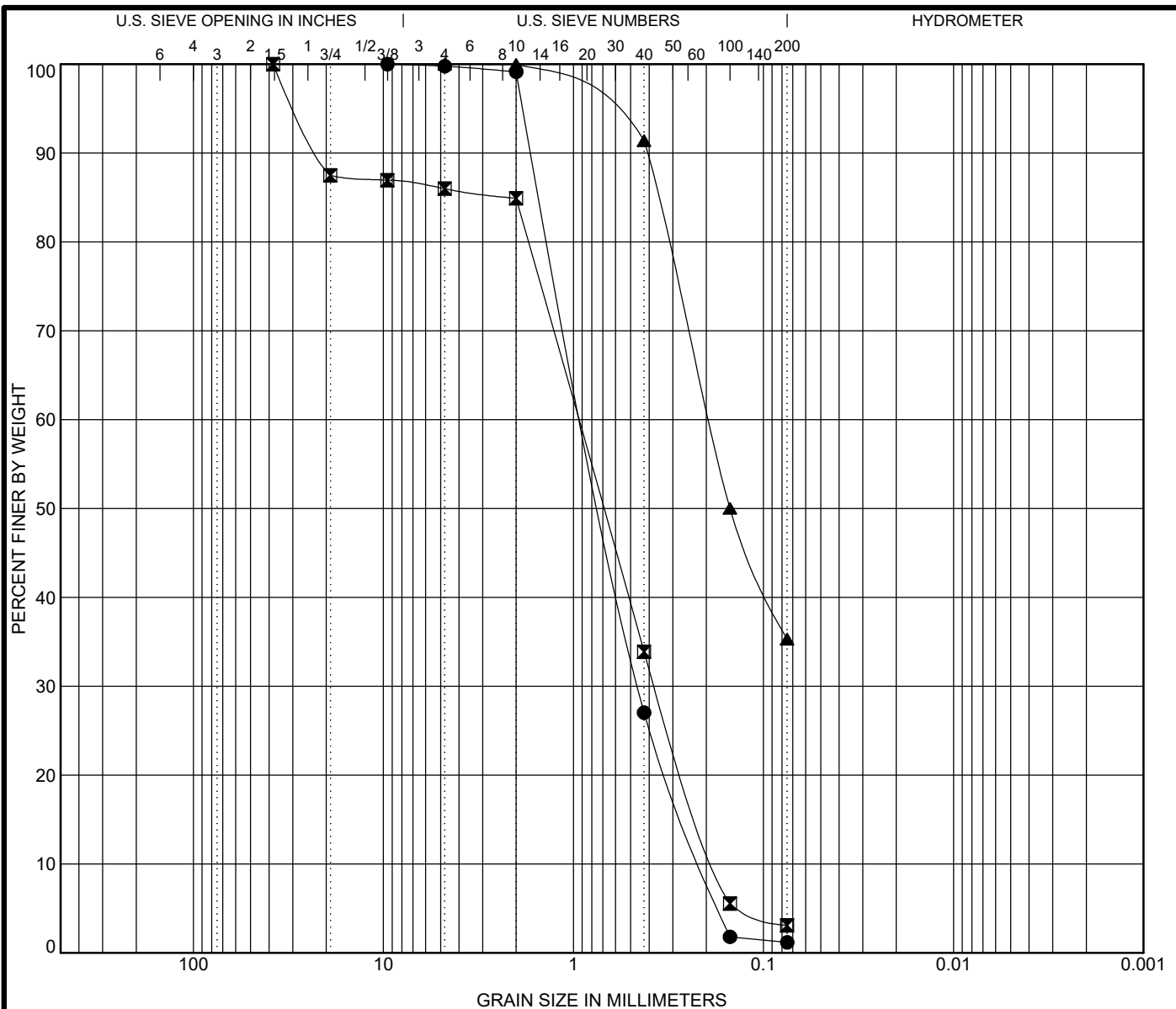
License No. 0492 Date 11/3/81

OK 11/12-17-81

(USE ADDITIONAL SHEETS IF NECESSARY)

APPENDIX C

LABORATORY TEST RESULTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification			LL	PL	PI	Cc	Cu
●	TP-1	@ 6.0 ft.	POORLY GRADED SAND(SP)			NP	NP	NP	1.13	4.10
☒	TP-2	@ 7.5 ft.	POORLY GRADED SAND(SP)			NP	NP	NP	0.82	5.32
▲	TP-3	@ 6.0 ft.	SILTY SAND(SM)			NP	NP	NP		

Specimen Identification		D100	D90	D60	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-1	6.0	9.525	1.644	0.863	0.21	0.2	98.6	1.2
☒	TP-2	7.5	38.1	21.892	0.939	0.177	14.0	82.9	3.1
▲	TP-3	6.0	4.75	0.41	0.193		0.0	64.7	35.3

PanGEO
INCORPORATED
Phone: 206.262.0370

GRAIN SIZE DISTRIBUTION

Project: S10 Generator & Well Pump, Lacey
Job Number: 22-448
Location: Parkside Drive SE & 57th Way SE, Lacey, WA

**Figure
C-1**

APPENDIX D

ANALYTICAL LABORATORY TEST RESULTS

Report Date: December 13, 2022

Report No: 93760

Client: PanGEO Inc.

Sampler: Mary Green

Project: PanGEO Inc.

Field:

P.N.: S10 Generator & Pump Well

Sampled: 12/6/2022



SOIL ANALYSIS REPORT

Lab #	Depth Inches		Field ID	Sample ID	OM	CEC
	Start	End			%	Meq/ 100g
5092	72	78	TP-1	S3	0.52	4.0
5093	90	96	TP-2	S3	0.93	3.8
5094	72	78	TP-3	S3	0.60	13.0

Main Office: 119 E Main St., Othello, WA 99344

Oregon Office: 1300 Sixth St., Suite J, Umatilla, OR 97882

Pasco Office: 1320 E Spokane St., Pasco, WA 99301

☎ (509) 488-0112 ✉ info@kuotestinglabs.com

Report Date: December 13, 2022

Report No: 93760

Client: PanGEO Inc.

Sampler: Mary Green

Project: PanGEO Inc.

Field: TP-1 S3

P.N.: S10 Generator & Pump Well

Sampled: 12/6/2022



SOIL ANALYSIS REPORT

Lab #	Depth Inches		Field ID	Sample ID	OM %	CEC Meq/ 100g
	Start	End				
5092	72	78	TP-1 S3		0.52	4.0

Main Office: 119 E Main St., Othello, WA 99344

Oregon Office: 1300 Sixth St., Suite J, Umatilla, OR 97882

Pasco Office: 1320 E Spokane St., Pasco, WA 99301

☎ (509) 488-0112 ✉ info@kuotestinglabs.com

Report Date: December 13, 2022

Report No: 93760

Client: PanGEO Inc.

Sampler: Mary Green

Project: PanGEO Inc.

Field: TP-2 S3

P.N.: S10 Generator & Pump Well

Sampled: 12/6/2022



SOIL ANALYSIS REPORT

Lab #	Depth Inches		Field ID	Sample ID	OM %	CEC Meq/ 100g
	Start	End				
5093	90	96	TP-2 S3		0.93	3.8

Main Office: 119 E Main St., Othello, WA 99344

Oregon Office: 1300 Sixth St., Suite J, Umatilla, OR 97882

Pasco Office: 1320 E Spokane St., Pasco, WA 99301

☎ (509) 488-0112 ✉ info@kuotestinglabs.com

Report Date: December 13, 2022

Report No: 93760

Client: PanGEO Inc.

Sampler: Mary Green

Project: PanGEO Inc.

Field: TP-3 S3

P.N.: S10 Generator & Pump Well

Sampled: 12/6/2022



SOIL ANALYSIS REPORT

Lab #	Depth Inches		Field ID	Sample ID	OM	CEC
	Start	End			%	Meq/ 100g
5094	72	78	TP-3 S3		0.60	13.0

Main Office: 119 E Main St., Othello, WA 99344

Oregon Office: 1300 Sixth St., Suite J, Umatilla, OR 97882

Pasco Office: 1320 E Spokane St., Pasco, WA 99301

☎ (509) 488-0112 ✉ info@kuotestinglabs.com

APPENDIX B

GEOTECHNICAL REPORT